59579-88

POCKET COLORIMETER™ II
ANALYSIS SYSTEMS
INSTRUCTION MANUAL

Aluminum
Manganese—High Range
Nitrate
Dissolved Oxygen

te/dk 09/06 3ed

Important Note

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

Aluminum	Cat. No. 59530-25
Manganese	Cat. No. 59530-15
Nitrate	Cat. No. 59530-02
Dissolved Oxygen	Cat. No. 59530-03

The Pocket Colorimeter II instruments listed above are not interchangeable.

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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), 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*

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* 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.

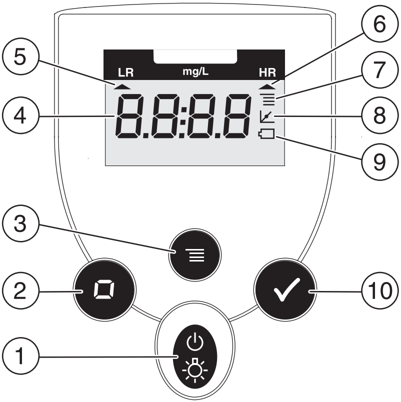
PERIGO

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

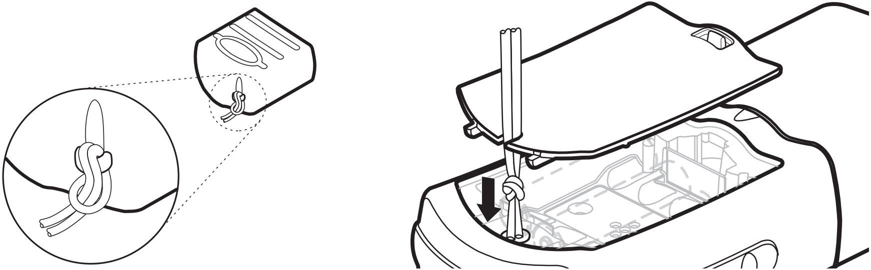
Instrument Cap Cord

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—15.

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



Aluminum (0.02 to 0.80 mg/L Al)

For water and wastewater **Method 8012**

Aluminon Method*

Measuring Hints

- If samples cannot be analyzed immediately, see Sampling and Storage on page 1—22
- Rinse glassware with 1:1 Hydrochloric Acid and deionized water before use to avoid errors due to contaminants absorbed in the glass.
- The sample temperature must be between 20–25 °C (68–77 °F) for accurate results.
- Total aluminum determination requires a prior digestion, especially of particulate matter is present. See Sampling and Storage on page 1—22 .

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.*

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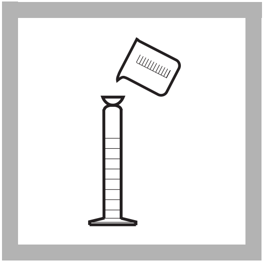
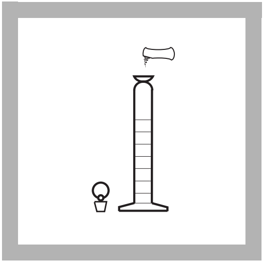
* Adapted from *Standard Methods for the Examination of Water and Wastewater.*

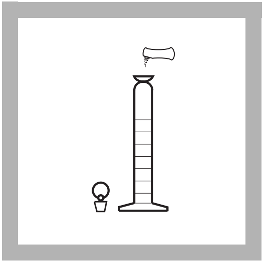


1. Fill a 50-mL graduated mixing cylinder to the 50-mL mark with sample.

Note: *For proof of accuracy, use a 0.4 mg/L aluminum standard solution in place of the sample. See page 36 for preparation instructions.*



2. Add the contents of one Ascorbic Acid Powder Pillow. Stopper. Invert several times to dissolve powder.



3. Add the contents of one AluVer® 3 Aluminum Reagent Powder Pillow. Stopper. Invert repeatedly for one minute to dissolve.

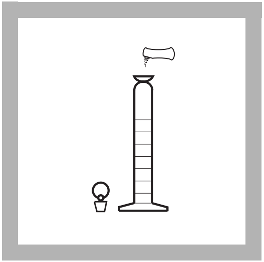
Note: *A red-orange color will develop if aluminum is present.*

Note: *Inconsistent results will be obtained if any powder is undissolved.*

4. Fill a clean 10-mL sample cell with at least 10 mL of mixture (the prepared sample). Cap the cell.

5. Pour an additional volume of mixture into a clean 50-mL beaker, so that exactly 25 mL remains in the graduated mixing cylinder.

Note: *If too much mixture is poured out, fill the graduated mixing cylinder up to the 25-mL mark with the mixture in the beaker.*

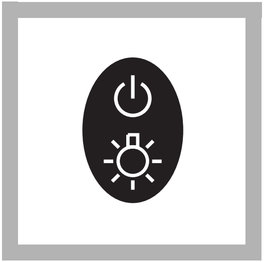


6. Add the contents of one Bleaching 3 Reagent Powder Pillow to the 25 mL remaining in the graduated mixing cylinder. Stopper. Vigorously shake for 30 seconds.

Note: *This solution should turn a light to medium orange upon bleaching. It will not become colorless.*

7. Pour at least 10 mL of the remaining 25 mL of mixture in the cylinder into a second clean 10-mL sample cell (the blank).

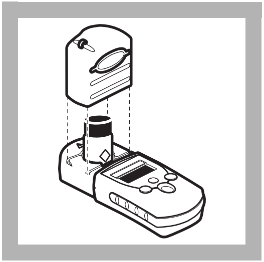
8. Wait 15 minutes.



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

The arrow should indicate mg/L Al.

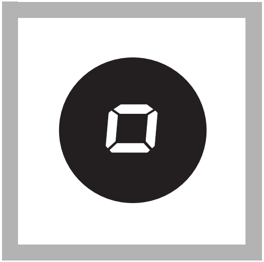
Note: *See page 2—4 for information on selecting the correct range channel.*



10. Remove the meter cap. Within 5 minutes after the 15-minute reaction period, place the blank in the cell holder with the diamond mark facing the keypad.

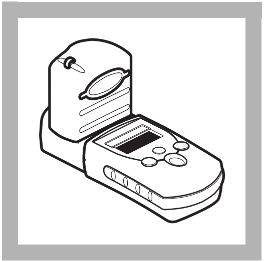
Cover the cell with the instrument cap.

Note: *Wipe excess liquid and finger prints off sample cells.*



11. Press **ZERO/SCROLL**. The display will show "- - - -" then "0.00".

Remove the blank from the cell holder.



12. Remove the meter cap.

Place the prepared sample into the cell holder with the diamond mark facing the keypad.

Cover the cell with the instrument cap.

Note: *Wipe excess liquid and finger prints off sample cells.*

13. Press **READ/ENTER**. The instrument will show “- - - -” followed by the results in mg/L aluminum.

Sampling and Storage

Collect sample in clean plastic or glass bottles. For storage, adjust the pH to 2 or less with nitric acid (about 1.5 mL per liter). Preserved samples can be stored up to six months at room temperature. Adjust the pH to between 3.5 and 4.5 with 5.0 N

Sodium Hydroxide before analysis. Correct the test result for volume additions using the following equation:

$$\frac{\text{final sample volume (mL)} \times \text{test result (mg/L)}}{\text{initial sample volume (mL)}} = \text{correct sample concentration (mg/L)}$$

See Section 1 of the Hach Water Analysis Handbook for further information concerning total aluminum digestions.

Accuracy Check

Standard Additions Method

a. Snap the neck off an Aluminum Standard Solution Voluette™ Ampule, 50 mg/L Al.

b. Use a TenSette® pipet to add 0.1 mL, 0.2 mL, and 0.3 mL of standard, respectively, to three 50-mL samples. Mix each thoroughly.

c. Analyze each sample as directed in the procedure. The aluminum concentration should increase 0.1 mg/L for each 0.1 mL of standard added.

Standard Solution Method

Prepare a 0.4 mg/L aluminum standard solution following step 1 through step 3 in Preparing the Aluminum Calibration Standard Solution. Analyze this solution following the procedure gives a result close to 0.40 mg/L.

Preparing the Aluminum Calibration Standard Solution

1. Snap the neck off an Aluminum Standard Solution Voluette™ Ampule, 50 mg/L as Al.
2. Use a TenSette® pipet to add 0.4 mL of aluminum standard from the Voluette ampule into a 50-mL graduated cylinder to prepare a 0.4 mg/L standard. Alternatively, the following formula may be used to determine the preparation of a different concentration standard using the same initial 50 mg/L standard and final 50 mL sample volume:

   volume of initial standard used (mL) = final sample concentration (mg/L)

3. Using deionized water, dilute the 0.4 mL (or other volume of standard calculated in step 2) of aluminum standard to the 50 mL mark. Mix thoroughly. This is the aluminum standard working solution (for best results, prepare this solution daily).

Note: *More accurate results may be achieved using volumetric glassware to prepare standards. Using class A pipets, transfer five times the volume of initial 50 mg/L Al standard calculated in step 2 to a 250-mL volumetric flask. Dilute to the mark and mix thoroughly.*

4. Use the aluminum reagents to produce color in the prepared standard solution following step 1 through step 8 of the procedure beginning on page 1—18.

Method Performance

Typical Precision (95% Confidence Interval):

0.40 ± 0.02 mg/L Al

Estimated Detection Limit:

EDL = 0.01 mg/L Al

Spec√™ Secondary Standards for Instrument Verification

Note: *Due to improvements in the optical system of the Pocket Colorimeter™ II, the tolerance ranges and values on the Certificate of Analysis of previously purchased Spec√ standards may no longer be valid. Obtain a new set of standards, or use the Pocket Colorimeter II to assign new values to existing standards.*

Spec√ Secondary Standards are available to quickly check the repeatability of the Pocket Colorimeter™ II instrument. After initial measurements for the Spec√ standards are collected, the standards can be re-checked as often as desired to ensure the instrument is working consistently.

The standards do not ensure reagent quality nor do they ensure the accuracy of the test results. Analysis of real standard solutions using the kit reagents is required to verify the accuracy of the entire Pocket Colorimeter system. The Spec√ Standards should *NEVER* be used to calibrate the instrument. The certificate of analysis lists the expected value and tolerance for each Spec√ Standard.

Note: *Before proceeding, make sure the instrument is in the low range (LR). See Switching Ranges on page 2—4.*

Using the Spec√ Standards

1. Place the colorless Spec√ blank into the cell holder with the alignment mark facing the keypad. Tightly cover the cell with the instrument cap.
2. Press **ZERO**. The display will show “0.00”.
3. Place the STD 1 cell into the cell holder. Tightly cover the cell with the instrument cap.

4. Press **READ/ENTER**. Record the concentration measurement.
5. Repeat steps 3– 4 with cells labeled STD 2 and STD 3.
6. Compare these measurements with previous measurements to verify the instrument is performing consistently. (If these are the first measurements, record them for comparison with later measurements.)

Note: *If the instrument is user-calibrated, initial standard measurements of the Spec√ Standards will need to be performed again for the user calibration.*

Interferences

The following do not interfere up to the indicated concentrations.

Interfering Substance	Concentration at Which Substance Interferes
Alkalinity	1000 mg/L as $CaCO_3$
Acidity	300 mg/L as $CaCO_3$
Iron	20 mg/L
Phosphate	50 mg/L

Interferences from higher alkalinity concentrations can be eliminated by the following pretreatment:

1. Add one drop of m-Nitrophenol Indicator Solution to the sample in step 1 of the procedure. A yellow color indicates excessive alkalinity.
2. If the sample is yellow, add one drop of Sulfuric Acid Standard Solution, 5.25 N. Stopper the cylinder. Invert to mix. If the yellow color persists, repeat until the sample changes to colorless. Continue with the test.

Polyphosphate interferes at all levels, causing negative errors. Before running the test polyphosphate must not be present.

Acidity interferes at greater than 300 mg/L as $CaCO_3$. Samples with acidity in greater concentrations must be treated as follows:

1. Add one drop of m-Nitrophenol Indicator Solution to the sample in step 1.
2. Add one drop of Sodium Hydroxide Standard Solution, 5.0 N. Stopper the cylinder. Invert to mix. Repeat as often as necessary until the color changes from colorless to yellow.
3. Add one drop of Sulfuric Acid Standard Solution, 5.25 N, to change the solution from yellow back to colorless. Continue with the test.

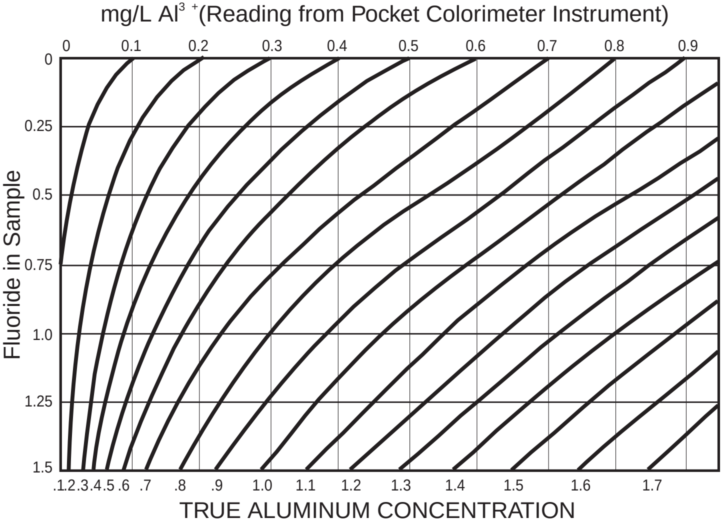
Calcium does not interfere.

Fluoride interferes at all levels by complexing with aluminum. The actual aluminum concentration can be determined using the *Figure 1* on page *1—30* when the fluoride concentration is known. To use the fluoride interference graph:

1. Select the vertical grid line along the top of the graph that represents the aluminum reading obtained in step 13 of the procedure.
2. Locate the point of the line intersecting with the horizontal grid line that indicates how much fluoride is present in the sample.
3. Extrapolate the true aluminum concentration by following the curved lines on either side of the intersect point down to the true aluminum concentration.

For example, if the aluminum test result was 0.7 mg/L Al and the fluoride present in the sample was 1 mg/L F^-, the point where the 0.7 grid line intersects with the 1 mg/L F^- grid line falls between the 1.2 and 1.3 mg/L Al curves. In this case the true aluminum content would be 1.27 mg/L.

Figure 1 Fluoride Interference Graph



Summary of Method

Aluminon indicator combines with aluminum in the sample to form a red-orange color. The intensity of color is proportional to the aluminum concentration. Ascorbic acid is added to remove iron interference. AluVer 3 Aluminum Reagent, packaged in powder form, shows exceptional stability and is applicable for fresh water samples.

Replacement Parts

Required Reagents

Description	Unit	Cat.No.
Aluminum Reagent Set	100 Tests	22420-00
Includes: (1) AluVer® 3 Aluminum Reagent Powder Pillows, 100/pkg (1) Ascorbic Acid Powder Pillows, 100/pkg (1) Bleaching 3 Reagent Powder Pillows, 100/pkg		

Required Apparatus

Description	Unit	Cat.No.
Beaker, polypropylene, 50 mL	each	1080-41
Cylinder, graduated mixing, 50 mL	each	1896-41

Optional Reagents

Aluminum Standard Solution, 100 mg/L	100 mL	14174-42
Aluminum Standard Solution, 50 mg/L, 10 mL Voluette™ Ampules	16/pkg	14792-10
Hydrochloric Acid Solution, 6 N (1:1)	500 mL	884-49
m-Nitrophenol Indicator Solution, 10 g/L	100 mL	2476-32
Nitric Acid, ACS	500 mL	152-49
Nitric Acid Solution, 1:1	500 mL	2540-49
Sodium Hydroxide Standard Solution, 5.0 N	100 mL	2450-32
Sodium Hydroxide Standard Solution, 5.0 N	59 mL	2450-26
Spec√ Aluminum Secondary Standards	each	27072-00
Sulfuric Acid Standard Solution, 5.25 N	100 mL	2449-32
Water, deionized	4 liters	272-56

Optional Apparatus

Description	Unit	Cat.No.
pH Indicator Paper, 1 to 11 pH	5 rolls/pkg	391-33
sension™1 Basic Portable pH Meter, with electrode	each	51700-10
Pipet Filler, safety bulb	each	14651-00
Pipet, serological, 2 mL	each	532-36
Pipet, TenSette®, 0.1 to 1.0 mL	each	19700-01
Pipet Tips, for 19700-01 TenSette® Pipet	50/pkg	21856-96
Pipet, volumetric, Class A, 0.50 mL	each	14515-34
Pipet, volumetric, Class A, 1.00 mL	each	14515-35
Pipet, volumetric, Class A, 2.00 mL	each	14515-36
Pipet, volumetric, Class A, 3.00 mL	each	14515-03
Pipet, volumetric, Class A, 4.00 mL	each	14515-04
Thermometer, -10 to 110 °C	each	1877-01
Timer, 3-channel	each	23480-00

Replacement Parts

Batteries, alkaline	4/pkg	46743-00
Instrument Cap/light shield	each	59548-00
Instruction Manual	each	59579-88
Sample Cells, 10 mL, with caps	6/pkg	24276-06

Oxygen, Dissolved, HR (0.2 to 10.0 mg/L O_2)

Method 8166

For water and wastewater

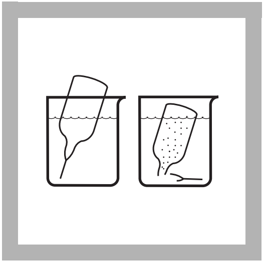
HRDO Method

Measuring Hints

- Samples must be analyzed immediately and cannot be preserved for later analysis. See Sampling and Storage on page 1—40.
- Avoid sample manipulation that could either expose the sample to contamination from atmospheric oxygen or cause oxygen to be lost from the sample. See Sampling and Storage on page 1—40.
- The optional AccuVac® Snapper Kit can facilitate testing by providing controlled ampule filling.

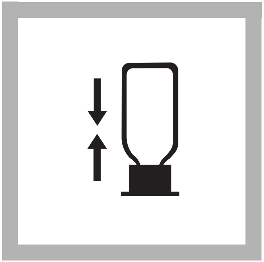
Note: *The Pocket Colorimeter™ II is designed to measure solutions contained in sample cells.* ***DO NOT*** *dip the meter in the sample or pour the sample directly into the cell holder.*

1. Fill a blue ampule cap with sample. Fill a 10-mL sample cell with sample (blank). Cap.



2. Fill a high range dissolved oxygen AccuVac® Ampul with sample (the prepared sample).

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



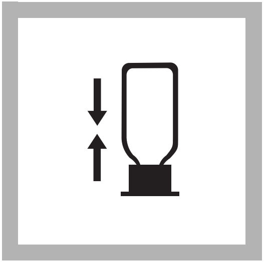
3. Without turning the ampule upright, immediately place the ampule cap securely over the tip of the ampule. Shake for approx. 30 sec.

Note: *A small amount of undissolved HRDO reagent does not influence test results.*

Note: *The cap prevents contamination with atmospheric oxygen.*

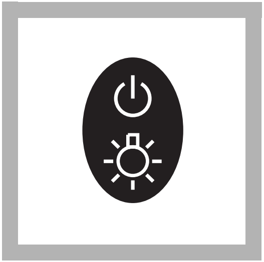
4. Wait 2 minutes.

Note: *The two-minute reaction period enables oxygen, which was degassed during aspiration, to redissolve and react.*



5. At the end of the 2-minute period, shake the ampule for 30 seconds.

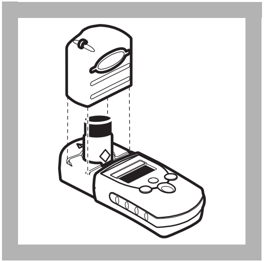
Note: *Wipe excess liquid and fingerprints off the sample cell.*



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

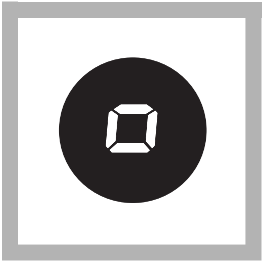
The arrow should indicate the mg/L O_2 channel.

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



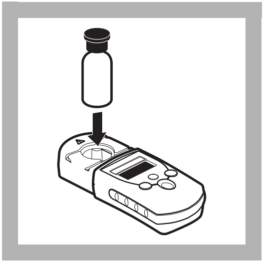
7. Remove the meter cap. Place the blank in the cell holder with the diamond mark facing the keypad.

Cover the cell with the instrument cap.



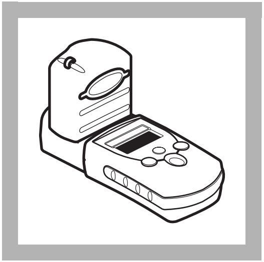
8. Press **ZERO/SCROLL**. The display will show "- - - -" then "0.0".

Remove the blank from the cell holder.



9. Wipe the AccuVac Ampul dry and insert it into the cell holder.

Wait approximately 30 seconds for any air bubbles to dissipate from the light path.



10. Cover the ampule with the instrument cap.

11. Press **READ/ENTER**. The instrument will show “- - - -” followed by the results in mg/L dissolved oxygen.

Sampling and Storage

The primary consideration in sampling with the high range dissolved oxygen AccuVac Ampul is preventing the sample from being contaminated with atmospheric oxygen. This is accomplished by capping the ampule with the ampule cap after filling the ampule and before reading the concentration. If the ampule is securely capped, the cap should protect the sample from contamination for several hours. The absorbance will decrease approximately 3% during the first hour and will not change significantly afterwards.

Sampling and sample handling are important in obtaining meaningful results. The dissolved oxygen content of water changes with depth, turbulence, temperature, sludge deposits, light, microbial action, mixing, travel time, and other factors. A single dissolved oxygen test rarely reflects the accurate over-all condition of a body of water. Several samples taken at different times, locations, and depths are recommended for most reliable results. A dissolved oxygen sampler for AccuVac Ampuls is available for taking samples of different depths, see Optional Apparatus on page 1—45.

Samples should be tested immediately after collection, although only a small error results if the reacted sample is measured several hours after color development.

Accuracy Check

Standard solutions for dissolved oxygen are difficult and time-consuming to prepare. Lack of attention to detail can result in errors that can occur during standards preparation. The manufacturer prepares the calibration curve under rigorous analytical laboratory conditions and recommends using the factory calibration.

A user calibration or user-prepared dissolved oxygen standard may be required by a regulatory official or agency. Two options are available on the Pocket Colorimeter II to meet this requirement. A dissolved oxygen 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 or colorimeter or by using another alternate method such as titration or dissolved oxygen meter. The concentration of the dissolved oxygen standard must be between 4.0 and 9.0 mg/L dissolved oxygen.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% CI):

7.4 ± 0.2 mg/L O_2

Estimated Detection Limit:

EDL = 0.2 mg/L O_2

Spec√™ Secondary Standards for Instrument Verification

Note: *Due to improvements in the optical system of the Pocket Colorimeter™ II, the tolerance ranges and values on the Certificate of Analysis of previously purchased Spec√ standards may no longer be valid. Obtain a new set of standards, or use the Pocket Colorimeter II to assign new values to existing standards.*

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The standards do not ensure reagent quality nor do they ensure the accuracy of the test results. Analysis of real standard solutions using the kit reagents is required to verify the accuracy of the entire Pocket Colorimeter system. The Spec√ Standards should *NEVER* be used to calibrate the instrument. The Certificate of Analysis lists the expected value and tolerance for each Spec√ Standard.

Note: *Before proceeding, make sure the instrument is in the mg/L O_2 range. See Switching Ranges on page 2—4.*

Using the Spec√ Standards

1. Place the colorless Spec√ blank into the cell holder with the alignment mark facing the keypad. Tightly cover the cell with the instrument cap.
2. Press **ZERO**. The display will show “0.0”.
3. Place the STD 1 cell into the cell holder. Tightly cover the cell with the instrument cap.
4. Press **READ/ENTER**. Record the concentration measurement.
5. Repeat steps 3– 4 with cells labeled STD 2 and STD 3.
6. Compare these measurements with previous measurements to verify the instrument is performing consistently. (If these are the first measurements, record them for comparison with later measurements.)

Note: *If the instrument is user-calibrated, initial standard measurements of the Spec√ Standards will need to be performed again for the user calibration.*

Standard Calibration Adjust Method

To perform a standard calibration adjust, see Standard Calibration Adjust on page 2—13.

Interferences

The following do not interfere at a level of 10 mg/L: Cr^{3+}, Mn^{2+}, Fe^{2+}, Ni^{2+}, Cu^{2+} and NO_2^-. These ions normally occur in concentrations of less than 10 mg/L in the environment.

Magnesium is commonly present in seawater and causes a negative interference. If the sample contains more than 50% seawater, the oxygen concentration obtained by this method will be 25% less than the true oxygen concentration. If the sample contains less than 50% seawater, the interference will be less than 5%.

Summary of Method

The High Range Dissolved Oxygen AccuVac Ampul contains reagent vacuum sealed in a 14-mL ampule. When the AccuVac Ampul is opened in a sample containing dissolved oxygen, it forms a yellow color which turns purple. The purple color development is proportional to the concentration of dissolved oxygen.

Replacement Parts

Required Reagents

Description	Unit	Cat.No.
High Range Dissolved Oxygen Reagent AccuVac® Ampuls, with 2 reusable ampule caps	25/pkg	25150-25

Required Apparatus

Beaker, 50 mL	each	500-41H
Caps, ampule, blue	25/pkg	1731-25

Optional Reagents

Spec√ Secondary Standards, Dissolved Oxygen	each	27078-00

Optional Apparatus

AccuVac® Snapper Kit	each	24052-00
Caps for 10-mL sample cells	12/pkg	24018-12
Dissolved Oxygen Sampler for AccuVac® Ampuls	each	24051-00

Replacement Parts

Description	Unit	Cat.No.
Batteries, alkaline, AAA	4/pkg	46743-00
Instrument Cap/light shield	each	59548-00
Instrument Manual	each	59579-88
Sample Cells, 10-mL with screw caps	6/pkg	24276-06

Manganese, HR (0.2 to 20.0 mg/L Mn)

Method 8034

For water and wastewater

Periodate Oxidation Method*, USEPA approved for reporting (digestion required)**

Measuring Hints

- Determine a reagent blank for each new lot of reagent.

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.*

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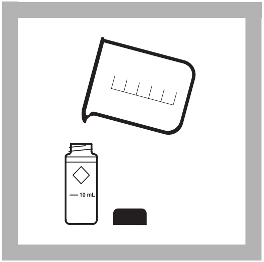
* Adapted from *Standard Methods for the Examination of Water and Wastewater.*

** *Federal Register*, 44 (116) 34193 (June 14, 1979).

Manganese, HR, continued



1. Fill a 10-mL sample cell to the 10-mL line with sample.

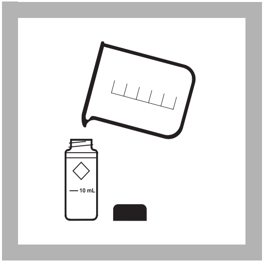
2. Add the contents of one buffer powder pillow, citrate type, to the sample cell (the prepared sample). Cap the cell and shake gently to mix.

3. Add the contents of one sodium periodate powder pillow to the sample cell. Cap the cell and shake gently to mix.

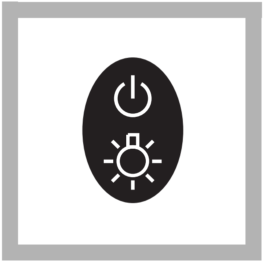
Note: *A violet color will form if manganese is present.*

4. Wait 2 minutes

Note: *Continue with step 5 while the timer is running.*



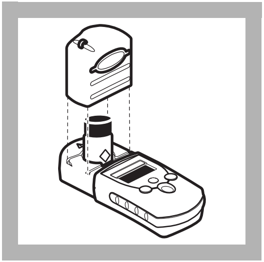
5. Fill a 10-mL cell to the 10-mL line with sample (the blank). Cap the cell.



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

The arrow should indicate mg/L Mn.

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

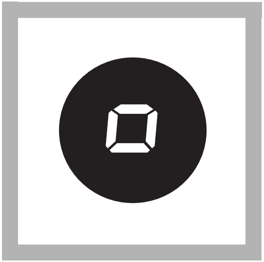


7. Remove the meter cap. Place the blank in the cell holder with the diamond mark facing the keypad.

Cover the cell with the instrument cap.

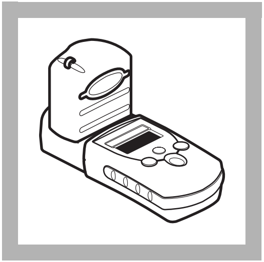
Note: *Wipe excess liquid and finger prints off sample cells.*

Note:



8. Press **ZERO/SCROLL**. The display will show "- - - -" then "0.0".

Remove the blank from the cell holder.



9. Remove the meter cap.

After the 2-minute wait, place the prepared sample into the cell holder with the diamond mark facing the keypad.

Cover the cell with the instrument cap.

Note: *Wipe excess liquid and finger prints off sample cells.*

10. Press **READ/ENTER**. The instrument will show “- - - -” followed by the results in mg/L manganese

Table 1

To convert reading from	To	Multiply by
mg/L Mn	mg/L MnO_4^-	2.16
mg/L Mn	mg/L $KMnO_4$	2.88

Note: *To convert results to other units, use the conversion table (Table 1).*

Sampling and Storage

Collect samples in acid-washed plastic bottles. Manganese may be lost by absorption to glass container walls. Adjust the pH to 2 or less with nitric acid (about 2 mL per liter). Preserved samples may be stored up to six months at room temperature. Adjust the pH to between 4 and 5 with 5.0 N sodium hydroxide before analysis. Do not exceed pH 5, as the manganese may be lost as a precipitate. Correct the test results for volume additions.

Accuracy Check

Standard Additions Method

1. Snap the neck off a manganese standard solution Voluette™ ampule, 25 mg/L Mn.
2. Use the Tensette® pipet to add 0.2, 0.4, and 0.6 mL of standard to three 10-mL water samples. Mix thoroughly.
3. Analyze each sample as described above. The manganese concentration should increase approximately 0.5, 1.0, and 1.4 mg/L for the 0.2, 0.4, and 0.6 mL added, respectively.

Standard Solution Method

Prepare a 10.0 mg/L manganese standard solution by pipetting 10.0 mL of manganese standard solution, 1000 mg/L Mn, into a 1000-mL volumetric flask. Dilute to the mark with deionized water. Prepare daily. Perform the procedure as described with the prepared standard.

Multi-parameter standards that simulate typical high range metals concentrations found in water are available to confirm test results. See Optional Reagents on page 1—55.

Method Performance

Typical Precision (95% CI):

10.0 ± 0.2 mg/L Mn

Estimated Detection Limit:

EDL = 0.2 mg/L Mn

Standard Calibration Adjust

To perform a standard calibration adjustment using the 10.0 mg/L manganese standard, or using an alternative concentration, see Standard Calibration Adjust on page 2—13

Interferences

The following may interfere when present in concentrations exceeding those listed below:

Interfering Substance	Concentration
Calcium	700 mg/L
Chloride	70,000 mg/L
Iron	5 mg/L
Magnesium	100,000 mg/L

Highly buffered samples or extreme sample pH may exceed the buffering capacity of the reagents and require sample pretreatment.

Summary of Method

Manganese in the sample is oxidized to the purple permanganate state by sodium periodate, after buffering the sample with citrate. The purple color is directly proportional to the manganese concentration. If only dissolved manganese is to be determined, filter the sample before acid addition.

Required Reagents

Description	Unit	Cat. No.
Manganese Reagent Set, Periodate Oxidation Method, 10 mL sample	each	24300-00
Includes:		
(1) Citrate Buffer Powder Pillow, 100/pkg		
(1) Sodium Periodate Powder Pillow, 100/pkg		

Required Apparatus

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

Optional Reagents

Hydrochloric Acid Solution, 1:1, 6.0 N	500 mL	884-49
Manganese Standard Solution, 1000 mg/L Mn	100 mL	12791-42
Manganese Standard Solution, Voluette® Ampule, 250 mg/L Mn, 10 mL	16/pkg	14258-10
Nitric Acid, ACS	500 mL	152-49
Nitric Acid Solution, 1:1	500 mL	2540-49
Sodium Hydroxide Solution, 5 N	100 mL MDB	2450-32
Water, deionized	4 L	272-56

Optional Apparatus

Description	Unit	Cat. No.
Dropper, plastic, 0.5- and 1.0-mL marks	20/pkg	21247-20
Flask, Erlenmeyer, 250-mL	each	505-46
Flask, volumetric, 1000-mL, Class A	each	14574-53
pH Indicator Paper, 1 to 11 pH	5 rolls/pkg	391-33
Pipet, serological, 1-mL	each	9190-02
Pipet, serological, 5-mL	each	532-37
Pipet, TenSette® 0.1- to 1.0-mL	each	19700-01
Pipet Tips, for 19700-01 TenSette® Pipet	50/pkg	21856-96
Pipet, volumetric, 10.0 mL, Class A	each	14515-38
Pipet Filler, Safety Bulb	each	14651-00

Replacement Parts

Batteries, alkaline	4/pkg	46743-00
Instrument cap/light shield	each	59548-00
Instruction manual	each	59579-88

Nitrate, HR (0.4 to 30.0 mg/L NO_3^-–N)

Method 8039

For water, wastewater, and seawater*

Cadmium Reduction Method

Measuring Hints

- For more accurate results, determine a reagent blank value for each new lot of reagent. Follow the procedure using deionized water in place of the sample. Subtract the reagent blank value from the final results or perform a reagent blank adjust.
- A deposit of unoxidized metal will remain after the NitraVer® 5 dissolves. The deposit will not affect results.
- This method is technique-sensitive. Shaking time and technique influence color development. For most accurate results, make successive tests on a 10-mg/L Nitrate Nitrogen Standard solution. Adjust shaking time and technique to obtain the correct result.

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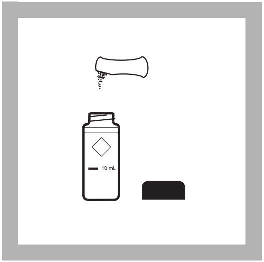
* For seawater, a manual calibration is required; see Interferences on page 1—71 .

- Wipe the outside of sample cells before each insertion into the instrument cell holder. Use a damp towel followed by a dry one to remove fingerprints or other marks.
- Rinse the sample cell immediately after use to remove all cadmium particles. Prepared samples will contain cadmium and must be disposed of according to Federal, State, and local hazardous waste regulations.

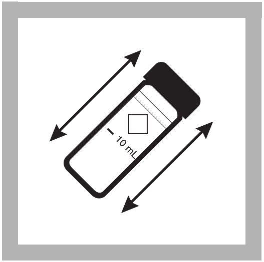
Note: *The Pocket Colorimeter™ II is designed to measure solutions contained in sample cells.* **DO NOT** *dip the meter in the sample or pour the sample directly into the cell holder.*

Using Powder Pillows

1. Fill a 10-mL sample cell to the 10-mL line with sample.



2. Add the contents of one NitraVer® Reagent Powder Pillow (the prepared sample). Cap the cell.



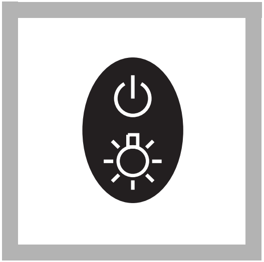
3. Shake the sample cell vigorously for one minute.

Note: *Inverting time and technique influence color development. For best results perform a user-entered calibration*

4. Let the cell sit undisturbed for 5 minutes.

Note: *An amber color will develop if nitrate-nitrogen is present.*

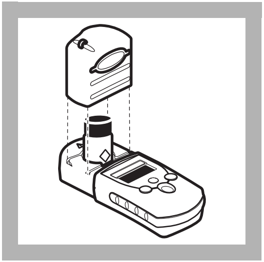
5. Fill a second 10-mL cell to the 10-mL line with untreated sample (the blank). Cap the cell.



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

The arrow should indicate Channel 1.

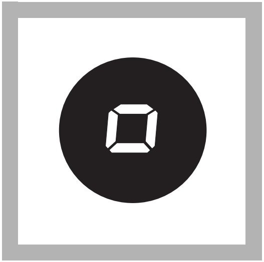
Note: *See page 2—4 for information on selecting the correct range channel.*



7. Remove the meter cap. Place the blank in the cell holder with the diamond mark facing the keypad.

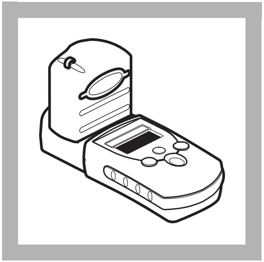
Cover the cell with the instrument cap.

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



8. Press **ZERO/SCROLL**. The display will show "- - - -" then "0.0".

Remove the blank from the cell holder.



9. Remove the meter cap. Place the prepared sample into the cell holder with the diamond mark facing the keypad.

Cover the cell with the meter cap.

Note: *Wipe excess liquid and finger prints off sample cells.*

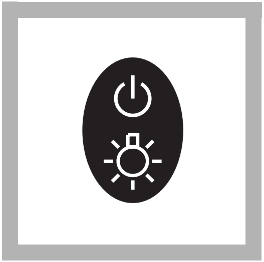
10. Press **READ/ENTER**. The instrument will show "- - - -" followed by the results in mg/L nitrate as nitrogen.

Subtract the reagent blank from the reading to obtain the mg/L nitrate value.

Note: *Rinse the sample cell immediately after use to remove metal particles.*

Note: *To convert results to mg/L nitrate (NO_3^-), multiply by 4.4.*

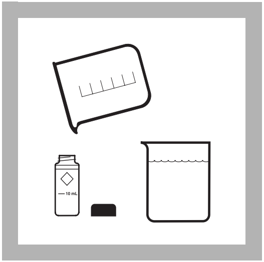
Using AccuVac® Ampuls



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

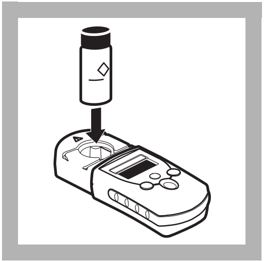
The arrow in the display should indicate Channel 2.

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



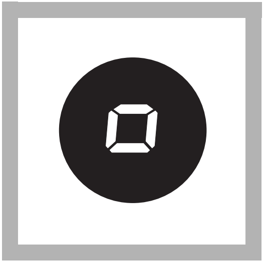
2. Fill a 10-mL sample cell to the 10-mL line with sample (the blank). Cap. Collect at least 40 mL of sample in a 50-mL beaker.

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



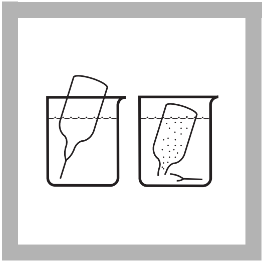
3. Remove the instrument cap. Place the blank in the cell holder, with the diamond mark facing the keypad. Cover the cell with the instrument cap.

Note: *Wipe liquid and finger prints off of sample cells.*



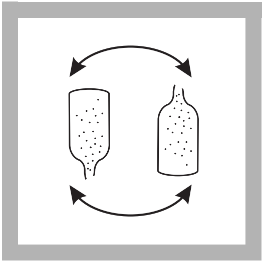
4. Press **ZERO/SCROLL**. The display will show “- - - -” then “0.0”.

Remove the blank.



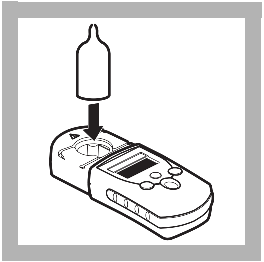
5. Fill a NitraVer® 5 Reagent AccuVac Ampule with sample.

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



6. Repeatedly invert the ampule for one minute. Wipe off any liquid or fingerprints.

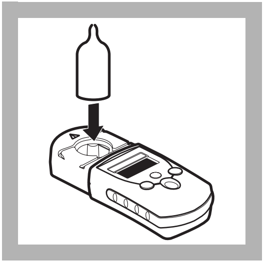
Note: *Accuracy is not affected by undissolved powder.*



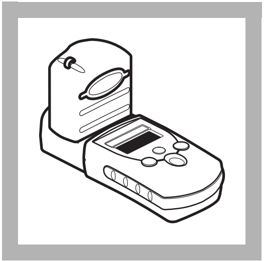
7. Let the ampule sit undisturbed for 5 minutes.

Note: *An amber color will develop if nitrate-nitrogen is present.*

Note: *Wipe liquid off the AccuVac Ampul.*



8. Insert the ampule into the cell holder.



9. Cover the ampule with the instrument cap.

10. Press **READ/ENTER**. The instrument will show "- - - -" followed by the results in mg/L nitrate as nitrogen.

Subtract the reagent blank from the reading to obtain the mg/L nitrate value.

Note: *To convert results to mg/L nitrate (*NO_3^-*), multiply by 4.4.*

Sampling and Storage

Collect samples in clean plastic or glass bottles. Store at 4 °C (39 °F) or lower if the samples will be analyzed within 48 hours. Before analysis, warm the sample to room temperature, then neutralize the sample with 5.0 N Sodium Hydroxide Standard Solution. Correct the test results for volume addition.

For longer storage periods (up to 14 days), adjust the sample pH to 2 or less with ACS Sulfuric Acid (about 2 mL per liter of sample). Sample refrigeration is still required. Do not use mercury compounds as preservatives.

Accuracy Check

Standard Additions Method—PermaChem® Powder Pillows

a. Snap the neck off a High Range Nitrate-Nitrogen Standard Voluette® Ampule, 500 mg/L NO_3^-–N.

b. Use a TenSette® Pipet to ad 0.1, 0.2, and 0.3 mL of standard to three 10-mL aliquots of the sample to be analyzed. Mix thoroughly.

c. Analyze each aliquot as described above. The nitrate-nitrogen concentration should increase 5.0 mg/L for each 0.1 mL of standard added.

Standard Additions Method—AccuVac® Ampules

a. Fill three 50-mL graduated mixing cylinders with 50-mL of sample.

b. Use a TenSette® Pipet to add 0.2, 0.4, and 0.6 mL of a 1000-mg/L Nitrate-Nitrogen Standard Solution to each cylinder. Stopper and invert to mix.

c. Analyze each sample as described using the AccuVac method. The nitrate-nitrogen concentrations should increase 4.0 mg/L for each 0.2 mL of standard added.

Standard Solution Method

Use a 10.0-mg/L Nitrate-Nitrogen Standard Solution in place of the sample. Perform the procedure. Multi-parameter standards that simulate typical wastewater concentrations without dilution are available to confirm test results. See Optional Reagents on page 1—72.

Method Performance

Typical Precision (95% Confidence Interval):

10.0 ± 0.8 mg/L NO_3^-–N (AccuVacs)

10.0 ± 3.0 mg/L NO_3^-–N (Powder Pillows)

Estimated Detection Limit:

EDL = 0.4 mg/L NO_3^-–N

Standard Calibration Adjust

To perform a standard calibration adjustment using the 10.0 mg/L nitrate-nitrogen standard, or using an alternative concentration, see Standard Calibration Adjust on page 2–13

Spec√™ Secondary Standards for Instrument Verification

Note: *Due to improvements in the optical system of the Pocket Colorimeter™ II, the tolerance ranges and values on the Certificate of Analysis of previously purchased Spec √standards may no longer be valid. Obtain a new set of standards, or use the Pocket Colorimeter II to assign new values to existing standards.*

Spec√ Secondary Standards are available to quickly check the repeatability of the Pocket Colorimeter II instrument. After initial measurements for the Spec√ standards are collected, the standards can be re-checked as often as desired to ensure the instrument is working consistently.

The standards do not ensure reagent quality nor do they ensure the accuracy of the test results. Analysis of real standard solutions using the kit reagents is required to verify the accuracy of the entire Pocket Colorimeter system. The Spec√ Standards should *NEVER* be used to calibrate the instrument. The certificate of analysis lists the expected value and tolerance for each Spec√ Standard.

Note: *Before proceeding, make sure the instrument is in the correct range. See Switching Ranges on page 2—4.*

Using the Spec√ Standards

1. Place the colorless Spec√ blank into the cell holder with the alignment mark facing the keypad. Tightly cover the cell with the instrument cap.
2. Press **ZERO**. The display will show “0.0”.
3. Place the STD 1 cell into the cell holder. Tightly cover the cell with the instrument cap.

4. Press **READ/ENTER**. Record the concentration measurement.
5. Repeat steps 3– 4 with cells labeled STD 2 and STD 3.
6. Compare these measurements with previous measurements to verify the instrument is performing consistently. (If these are the first measurements, record them for comparison with later measurements.)

Note: *If the instrument is user-calibrated, initial standard measurements of the Spec √ Standards will need to be performed again for the user calibration.*

Interferences

This method measures the nitrate and nitrite present in the sample. Nitrite is normally not present in significant amounts in surface waters.

Strong oxidizing and reducing substances will interfere. Ferric iron causes high results and must be absent. Chloride concentrations above 100 mg/L will cause low results. The test may be used at high chloride levels (seawater), but a calibration must be performed using a 10-mg/L Nitrate-Nitrogen Standard with the same chloride concentration as samples.

Highly buffered samples or extreme sample pH may exceed the buffering capacity of the reagents and require sample pretreatment.

Summary of Method

Cadmium reduces nitrate in the sample to nitrite. The nitrite ion reacts at the sample pH with sulfanilic acid to form an intermediate diazonium salt. This salt couples to gentisic acid to form an amber-colored product. See the Hach *Water Analysis Handbook* for more information.

Replacement Parts

Required Reagents

Description	Unit	Cat. No.
NitraVer® 5 Nitrate Reagent Powder Pillows, 10 mL	100/pkg	21061-69
OR		
NitraVer® 5 Nitrate Reagent AccuVac® Ampules	25/pkg	25110-25

Optional Reagents

Description	Unit	Cat. No.
Nitrate-Nitrogen Standard Solution, 10 mg/L NO_3^-–N	500 mL	307-49
Nitrate-Nitrogen Standard Solution Voluette® Ampules, 500 mg/L NO_3^-–N, 10 mL	16/pkg	14260-10
Sodium Hydroxide Standard Solution, 5.0 N	50 mL SCDB	2450-26

Optional Reagents, continued

Description	Unit	Cat. No.
Standards, mixed parameter, ammonia–nitrate, phosphate, COD, sulfate, TOC	500 mL	28331-49
Sulfuric Acid, ACS	500 mL	979-49
Water, deionized	4 L	272-56

Optional Apparatus

Droppers, plastic, 0.5- and 1.0-mL marks	20/pkg	21247-20
pH Indicator Paper, 1 to 11 pH	5 rolls/pkg	391-33
Pipet, serological, 2-mL	each	532-36
Pipet, TenSette®, 0.1- to 1.0-mL	each	19700-01
Pipet Tips, for 19700-01 TenSette® Pipet	50/pkg	21856-96
Pipet, volumetric, Class A, 1.0-mL	each	14515-35
Pipet Filler, safety bulb	each	14651-00
Sample Cells, 10-mL with screw caps	6/pkg	24276-06

Replacement Parts

Batteries, alkaline, AAA	4/pkg	46743-00
Instrument Cap/light shield	each	59548-00
Instruction Manual	each	59579-88

Section 2
Instrument Manual

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

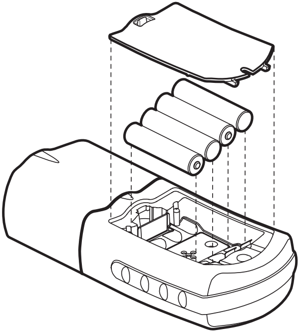
Figure 1 on page 2—7 provides an exploded view of battery installation.

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—13.*

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.

Certification, continued

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.