46001-18

Model DR/700
PORTABLE COLORIMETER
Instrument Manual

Printed in the U.S.A.

08-12-93-1ED
Rev. 7; 11/96

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 DR/700 Colorimeter has been tested and is certified as indicated to the following instrumentation standards:

Product Safety:
120 Vac Battery Eliminator with N-American Style Plug, approved by UL & CSA
230 Vac Battery Eliminator with Continental European Style Plug, approved by VDE & CE Marked

Immunity:
EN 50081-1 (European Generic Immunity Standard)
per 89/336/EEC EMC: Supporting test records by manufacturer & Dash, Straus & Goodhue (now Intertek Testing Services), certified compliance by manufacturer.

Required Standard/s include:
IEC 801-2 Electro-Static Discharge
IEC 801-3 Radiated RF Electro-Magnetic Fields
IEC 801-4 Electrical Fast Transients/Burst
ENV 50141 Conducted RF Fields
EN 61000-4-5 (IEC 1000-4-5) Surge
EN 61000-4-11 (IEC 1000-4-11) Power Quality

Emissions:
Emissions **per 89/336/EEC EMC:** Supporting test records by TUV Product Services (formerly Amador), certified compliance by manufacturer.

EN 55011 (CISPR 11) Emissions, Class B Limits

CANADIAN RADIO INTERFERENCE- REGULATION, 1374, Class A: Supporting test records by TUV Product Services (formerly Amador), certified compliance by manufacturer.

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 by Dash, Straus & Goodhue (now Intertek Testing Services), certified compliance by manufacturer.

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. Disconnect the DR/700 Colorimeter from it’s power source to verify that it is or is not the source of the interference.
2. If the DR/700 Colorimeter is connected into the same outlet as the device with which it is interfering, try another outlet.
3. Move the DR/700 Colorimeter away from the device receiving the interference.
4. Reposition the receiving antenna for the device receiving the interference.
5. Try combinations of the above.

NOTE: *Changes or modifications to this product not expressly described by the manufacturer could result in the product not complying with the above listed standards.*

CONTENTS

CONTENTS (continued)

ILLUSTRATIONS

TABLES

SAFETY PRECAUTIONS

Before attempting to unpack, set up or operate this instrument, it is important to read this entire manual. Pay particular attention to all warnings, cautions and notes. Failure to do so could result in serious injury to the operator or damage to the equipment.

Use of Hazard Information

If multiple hazards exist, the signal word corresponding to the greatest hazard shall be used

DANGER
Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury

WARNING
Indicates a potentially hazardous situation that 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.

SHALL
This word is understood to be mandatory

SHOULD
This word is understood to be advisory

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*

Operating Modes (based on clear water)	Percent Transimittance: 0.0 to 200.0 %T Absorbance: -0.300 to 2.000 Abs Relative % T: 0.0 to 9999 %T Relative Abs : +4.00 to -3.60 Abs; useful operating range limited to 2.3 Abs units Concentration (as programmed)
Detector	Silicon Photocel
Operating Temperature Range	0 to 50 °C
Storage Temperature Range	-40 to 60 °C
Operating Humidity Range	0% to 95% relative, noncondensing
Linearity (@550 nm)	≤ ±0.004 Abs @ 0.3 Abs ≤ ±0.01 Abs @ 1.0 Abs ≤ ±0.05 Abs @ 2.0 Abs
Repeatability (@550 nm)	≤ ±0.004 Abs @ 0 Abs ≤ ±0.01 Abs @ 1.0 Abs ≤ ±0.05 Abs @ 2.0 Abs
Light Source	Tungsten lamp; lamp life typically greater than 100,000 tests
Weight	Net: 1 lb. (454 g) Shipping: 10 lbs (4.54 kg)
Power Source	Four AA size alkaline batteries. Good for up to 500 tests (1000 lamp activations). Optional battery eliminator available
Sample Cells. 10-mL and 25-mL	Round borosilicate glass vials, 25 mm OD, 60 mm and 90 mm high, 1.2 mm average wall thickness, with teflon-lined screw caps, marking band and fill lines.

Specifications subject to change without notice
*Operating specifications applicable at 25 °C unless otherwise noted

OPERATION

Because of the inherent dangers in handling chemical samples, standards and reagents, Hach Company strongly recommends the user of this product review the Material Safety Data Sheets and become familiar with safe handling procedures and proper usage prior to handling any chemical.

SECTION 1 GENERAL DESCRIPTION

1.1 Colorimeter

The Hach Model DR/700 Colorimeter *shown in Figure 1* is a portable, digital, filter photometer that uses plug-in filter modules with preprogrammed calibrations for various measurements. Modes of operation include concentration, absorbance and percent transmittance. Ten different filter modules covering wavelengths ranging from 420 to 810 nanometers and containing more than 75 factory-entered calibrations are available currently. In addition to the factory preprogrammed methods, each filter module will accept one user-entered calibration into nonvolatile memory.

All operating controls are contained in the eight-key keypad. The liquid crystal display has two fields that include an upper 4-digit display with 0.4-inch high digits, a lower 5-digit display with 0.2-inch high digits and annunciators for lamp on, low battery, a zero prompt, standard 1 and standard 2 prompts and units of measure (µg/L, mg/L, g/L, %, %T, Abs and blank).

FIGURE 1 MODEL DR/700 PORTABLE COLORIMETER

The colorimeter operates on four AA size alkaline batteries, good for approximately 500 tests. An optional battery eleminator is available for laboratory use. Rechargeable batteries can be used but they must be removed from the instrument for charging. To conserve battery life, the colorimeter will only turn on the lamp for 8 seconds to read the sample when the **READ** or **ZERO** keys are pressed. The low battery indicator flashes when the battery voltage drops to 4.2 volts. At 4.0 volts, the colorimeter turns off automatically. Automatic shut-off also occurs when the colorimeter is on and no keys are pressed for 28 minutes.

1.2 Sample Cells

Sample cells for the DR/700 Colorimeter are round, 1-inch (25 mm) diameter borosilicate glass cells with screw caps. Because not all reagents are available in 10-mL sample size dosages, two sets of cells are provided: one set for 10-mL samples and the other set for 25-mL samples. If the colorimeter is to be used in bright sunlight, the 10-mL cells should be used to enable the cell compartment to be closed. Test results are equally accurate regardless of the sample size used. Accuracy and repeatability are enhanced by using optically matched sample cells. *Refer to paragraph 2.3.3, Matching Sample cells.* Each individual test procedure specifies the appropriate sample cell size. In most tests, the samples are prepared and measured in the sample cells. Some of the samples, however, because of the way the reagents are packaged, are prepared in another vessel and then transferred to the appropriate cell for measurement. Chemical Oxygen Demand determinations are made in COD (16 mm) reagent vials. An adapter is supplied with the 420 and 610-nm filter modules to hold the vials in the DR/700 Colorimeter.

Hach Company's line of AccuVac Ampul reagents can be used in the DR/700 Colorimeter with the aid of the adapter provided in the accessories. Reagents are contained in sealed, evacuated vials and are mixed with the water sample by partially immersing ampuls and breaking off the tip to allow sample to be drawn in. This is the prepared sample and can

be measured in the AccuVac vial itself. The DR/700 AccuVac Vial Adapter facilitates removal of the vials from the cell compartment and its use is illustrated in the test procedures using the AccuVac vials.

1.3 Filter Modules

One filter module is supplied with each DR/700 Colorimeter. Filter modules are inserted into the opening in the bottom rear of the colorimeter enclosure and contain the appropriate optical filters, nonvolatile memory devices and other dedicated electronics to configure the instrument for that group of tests. The following table lists the modules currently available, their wavelength and the calibration parameters provided by each. One user-calibration can be added to each filter module.

Table 1 Parameters by Module Number

Module No.	Wavelength	Parameter
42.01	420 nm	Benzotriazole & Tolyltriazole
(46242-00)		Chemical Oxygen Demand, LR
		Copper (Porphyrin)
		Molybdenum, Molybdate, HR
		Nickel (Heptoxime)
		Nitrogen, Ammonia (Nessler)
		Palladium
		Phosphorus, Reactive (Molybdovanadate)
		Silica, HR
45.01	450 nm	Chloride
(46245-00)		Color, True and Apparent
		Hydrazine
		Phenols
		Sodium Chromate
48.01	480 nm	Lead (Fast Column Extraction)
(46248-00)		
50.01	500 nm	Iron, Ferrous
(46250-00)		Iron, Total (FerroVer)
		Nitrate Nitrogen, HR
		Nitrate Nitrogen, LR
		Nitrite, LR
		Nitrite, Test ‘N Tube
		PAA, LMW-20, Acumer 1000
		PAA, LMW-45, Acumer 1100
		Volatile Acids
52.01	525 nm	Aluminum (Aluminon)
(46252-00)		Aluminum (ECR)
		Bromine
		Chlorine, Free

Module No.	Wavelength	Parameter
52.01	525 nm	Chlorine, Total
(continued)		Hardness, Calcium
		Hardness, Magnesium
		Iodine
		Manganese, HR
		Oxygen, Dissolved, HR
		Phosphorus, Reactive (Amino Acid)
55.01	550 nm	Chromium, Hexavalent
(46255-00)		Chromium, Total
		Copper (Bicinchoninate)
		DEHA
		Iron, Total (FerroZine)
		Manganese, LR
		Nickel (PAN)
57.01	575 nm	Fluoride
(46257-00)		Iron, Total (TPTZ)
		Nickel, Autocatalytic
		Nitrite, HR
		Quaternary Ammonium Compounds
		Silver
61.01	610 nm	Boron
(46261-00)		Chemical Oxygen Demand, HR & HR +
		Cobalt
		Cyanide
		Formaldehyde
		Molybdenum, LR
		Monochloramine
		Free Ammonia

Module No.	Wavelength	Parameter
61.01 (continued)		Ammonia Nitrogen, HR, Test ‘ N Tube
		Ammonia Nitrogen, LR, Test ‘ N Tube
		Ammonia Nitrogen (Salicylate)
		Total Inorganic Nitrogen, Test ‘ N Tube
		Total Persulfate Nitrogen, Test ‘ N Tube
		Oxygen, Dissolved, LR
		Ozone, LR
		Ozone, MR
		Ozone, HR
		Sulfide
		Surfactants, Anionic
		Zinc
69.01	690 nm	Oxygen, Dissolved, SHR
(46269-00)		Tannin and Lignin
81.01	810 nm	Phosphonates
(46281-00)		Phosphorus, Reactive (PhosVer 3)
		Residue, Nonfilterable
		Silica, LR

SECTION 2. OPERATION

2.1 Description of Operating Controls

Figure 2 shows the DR/700 Colorimeter controls and indicators. Their functional descriptions are given in *Table 2*.

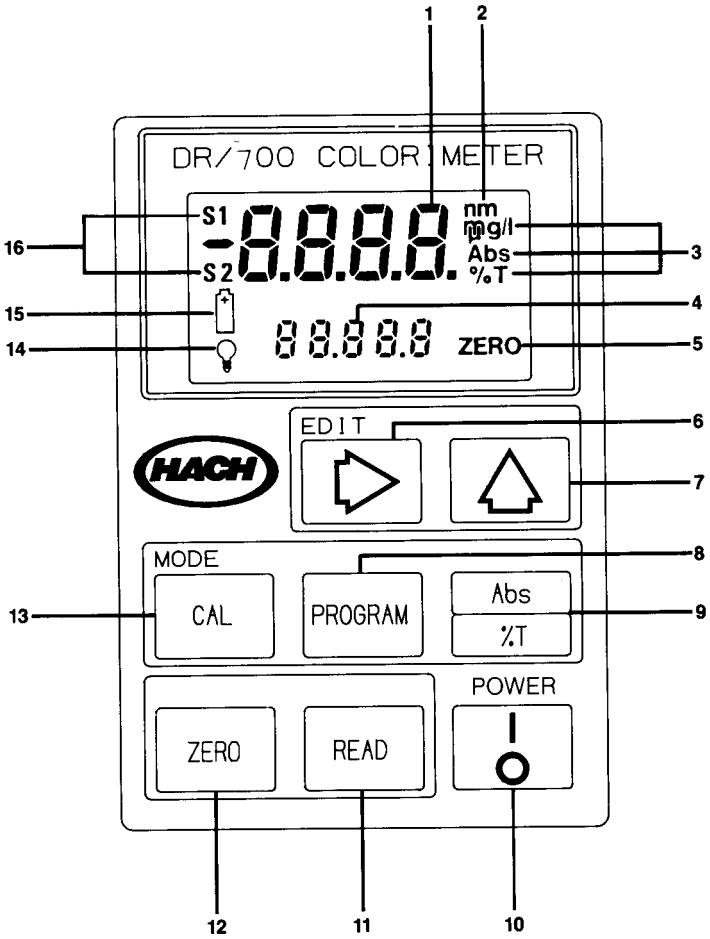


FIGURE 2 **OPERATING CONTROLS AND INDICATORS**

Table 2. Operating Controls and Indicators

Item	Name	Description
1.	Upper Field Display	Four-digit display provides wavelength display for ≈2 seconds when first turned on; then changes to reading format giving decimal position. After **READ** or **ZERO** key is pressed, a fixed delay count-down (timed lamp stabilization period) begins and decreases to zero followed by display of measurement.
2.	nm Indicator	Wavelength unit
3.	Unit of Measure Indicators	Unit of measure (%, µg/L, mg/L, g/L, Abs or %T)
4.	Lower Field Display	Five-digit display shows filter module number for ≈2 seconds when colorimeter is first turned on; then shows test method program number.
5.	Zero Indicator	Zero annunciator flashes to prompt for zeroing function.
6.		The **RIGHT ARROW** key is used in editing displayed values to move the flashing digit one space to the right. Also used during calibration to begin editing.
7.		The **UP ARROW** key is used to scroll through methods menu in selecting preprogrammed method. Also used to edit displayed values during user-stored method programming procedure.
8.	PROGRAM	The **PROGRAM** key switches between factory-entered methods and the user-entered method. If in Abs or %T mode, returns meter to concentration mode.

Item	Name	Description
9.	Abs / %T	The **ABS/%T** key switches between absorbance and transmittance measurement modes and also to Abs and %T from concentration.
10.	I O	The **I/O** key is the power switch for the instrument. Also used to test display elements by holding the key down during turn-on.
11.	READ	Once the colorimeter is zeroed, each press of the **READ** key turns on the lamp, enabling measurement of solution in the sample cell. When the **READ** key is held down, continuous reading mode occurs. The display is updated every 2.4 seconds.
12.	ZERO	The **ZERO** key will automatically zero the instrument in Program, Abs and %T modes.
13.	CAL	The **CAL** key is used for user-programmed calibration. Starts and stops calibration procedure.
14.	Lamp Indicator	Lights when the colorimeter lamp is on and flashes to indicate low light level.
15.	Low Battery Indicator	Flashes when battery voltage drops to 4.2 V as an indication new batteries are needed. At 4.0 V, the instrument shuts off.
16.	S1 & S2 Indicators	Prompting indicators for user-entered calibration sequence. Flashing indicator is asking for measurement of S1 or S2 standard to establish calibration curve. Steady indicator identifies standard value in display. Both S1 and S2 flashing indicates out of user-entered calibration range.

2.2 Operating the DR/700 Colorimeter

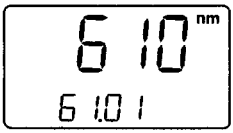
Illustrated parameter-specific procedures for performing measurements with the DR/700 Colorimeter are provided as part of the filter module unit. In the following paragraphs of this section, the various operational functions are discussed to further clarify its use.

NOTE

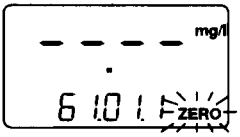
Typical indoor lighting permits the DR/700 to operate with the cell compartment cover open. In bright sunlight, it may be necessary to close the cell compartment cover. Transfer 10 mL of the blank solution to a 10-mL cell. If the 10-mL cell is used for the blank, another 10-mL cell must be used for the sample.

2.2.1 Initial Turn-On Sequence

When the colorimeter is turned on with the **I/O** key, the meter display gives the filter wavelength and filter module number with software version number (610) for approximately 2 seconds. For example:

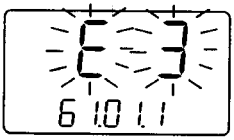


The colorimeter will display a concentration format (decimal point position and unit of measure) of a preprogrammed test. The lower display shows the program number with its current version number.



NOTE

If no filter module is installed, the error message E3 will flash.



NOTE

The colorimeter will turn itself off to conserve battery life if no keys are pressed for 28 minutes.

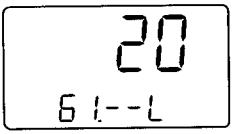
2.2.2 Lamp Intensity Adjustment

Before performing any colorimetric tests with a new filter module installed, a lamp intensity adjustment should be performed. With the proper sequence of keystrokes, the lamp voltage can be adjusted to give the optimum meter response. This adjustment

should be performed with the instrument on a firm surface and with a sample cell containing clear water in the cell compartment.

The lamp voltage setting for each filter module is stored in that module so that the colorimeter lamp intensity will always be correct for any given filter module. If a filter module is used with another colorimeter the adjustment must be repeated in that colorimeter. Perform the lamp intensity adjustment as follows:

1. With the colorimeter off, press and hold the **READ** key down while turning on the colorimeter. Continue holding the **READ** key down until "– –L" appears in the lower display as shown:



At this point, release the **READ** key. The display will count down from 20 to 0, the lamp will light and then the lamp voltage will automatically adjust to the optimum setting. The upper display field will show the lamp voltage (within the range of 2.000 to 3.300 V) as the instrument adjusts for optimum intensity. When the lamp annunciator goes out, the adjustment is complete.

2. Press the **PROGRAM** key or turn the colorimeter off momentarily to return to normal operation. The lamp voltage is now established and stored in this module.

2.2.3 Using Preprogrammed Calibrations

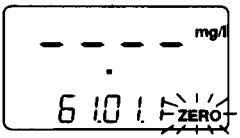
Each filter module is preprogrammed with factory-entered calibrations. *Refer to Table 1* for a list of test methods available.

NOTE

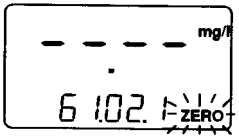
A lamp intensity adjustment should be performed after installing the filter module. *See Section 2.2.2.*

2.2.3.1 Selecting a Method

At power up or after pressing the **PROGRAM** key, the colorimeter display shows one of the preprogrammed methods contained in the installed filter module. The upper display field will show the decimal point position and the units of measure used in that calibration, with hyphens in all digit positions. The lower display field shows the program number. For example:



The operator can select a different method by pressing the **UP ARROW** key.

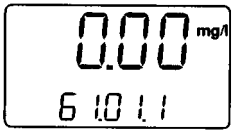


With each press of the **UP ARROW** key, the colorimeter steps to the next preprogrammed method with the appropriate method number, decimal point position and unit of measure displayed. At the end of the cycle, the colorimeter will return to the first method in the menu.

2.2.3.2 Zeroing a Preprogrammed Method

The colorimeter must be zeroed with a reference solution before unknown solutions can be measured. At the appropriate time the colorimeter will prompt for the zeroing procedure with a flashing ZERO indicator. Zero the meter as follows:

1. Select the desired preprogrammed method.
2. Place a sample cell containing the blank solution into the sample compartment.
3. Press the **ZERO** key. After approximately 8 seconds in which time the display will count down from 20 to 0 and the lamp indicator will be displayed, the colorimeter will display zero concentration and the Zero indicator will be turned off as follows:

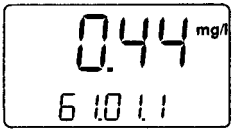


NOTE

A flashing display after the zeroing procedure warns the operator that an operational parameter has not been met. *Refer to Error Indications and Codes in Section 4.*

2.2.3.3 Reading the Concentration

After zeroing has been accomplished, each press of the **READ** key will cause the colorimeter to cycle through the lamp stabilization period and then read the concentration of the solution in the cell compartment, such as:



A period of approximately eight seconds (with 20 to 0 countdown) will elapse between pressing the **READ** key and the appearance of the reading. For continuous readings, holding the **READ** key

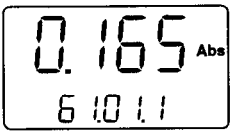
will update the display approximately every two seconds as long as the key is held.

NOTE

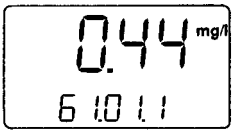
A flashing display after the read sequence warns the operator of an operational parameter that has not been met. *Refer to Error Indications and Codes in Section 4.*

2.2.3.4 Reading Absorbance and Percent Transmittance

Absorbance (Abs) and percent transmittance (%T) equivalent values for the measured concentration of the solution in the sample cell compartment can be determined by pressing the **ABS/%T** key. The first press of the key provides the absorbance reading and the next press results in the percent transmittance reading.



Concentration can be recalled by pressing the **PROGRAM** key.

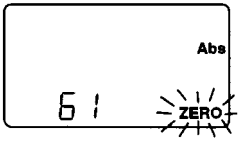


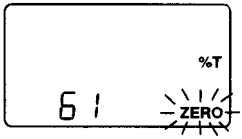
These values are relative to the zero setting in the particular calibration being used; they must be considered relative absorbance and relative percent transmittance.

2.2.3.5 Absorbance and Transmittance Measurement

Values (based on clear water) in Abs and %T can be determined if the colorimeter is zeroed in the absorbance or percent transmittance mode with a zero reference solution in the sample cell compartment. Proceed as follows:

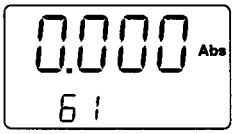
1. Press the **ABS/%T** key once for absorbance or twice for percent transmittance. Verify that the desired mode is displayed and that the ZERO indicator is flashing as follows:

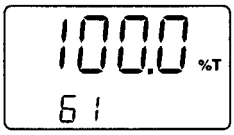




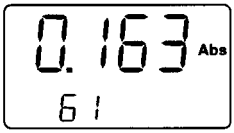
2. Place the zero solution blank into the sample compartment.

3. Press the **ZERO** key and wait for the display to count down to zero. The absorbance or %T will be displayed as follows with the ZERO no longer shown.





4. Place the unknown sample into the sample compartment and press the **READ** key. After the 20 to 0 countdown is complete, the meter will display the absolute absorbance or percent transmittance. For example:



The **ABS/%T** key can be used to toggle between absorbance and percent transmittance mode readings.

NOTE

A flashing display after the zero or read sequence warns the operator that an operational parameter has not been met. *Refer to Error Indications and Codes in Section 4.*

5. Press the **PROGRAM** key to return to the concentration mode.

NOTE

If the colorimeter is zeroed while in the Abs or %T mode and then returned to a stored method, the colorimeter must be zeroed again before taking the concentration measurement reading.

2.2.3.6 Rezeroing a Preprogrammed Method

The colorimeter can be rezeroed by placing a sample cell containing a zero reference solution in the sample cell compartment and pressing the **ZERO** key. If measurements were being made in relative absorbance or percent transmittance, the colorimeter must first be returned to the concentration mode. After the lamp stabilization period (20 to 0 countdown), the colorimeter

will measure the relative absorbance and display the new zero concentration.

2.2.4 Using User-Programmed Methods

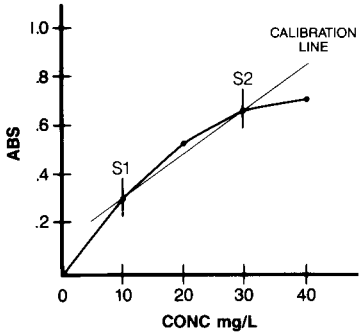
Each filter module has the capacity to permanently store one user-programmed calibration which is defined by two calibration points established with two standard solutions of known concentration value. Both standards, designated S1 and S2, must have the same decimal position and unit of measure. One, but not both, can be zero concentration, but neither S1 or S2 solution is required to have zero concentration. Once the calibration points have been entered, the method can be recalled any time *as described in paragraph 2.2.4.3*, Measurement of Samples. The calibration will remain in memory until changed by the user *as described in paragraph 2.2.4.2*, Calibration Using A Relative Absorbance With One Standard or *as described in paragraph 2.2.4.1*, Calibration Using Two Prepared Standards. The user programmed method will always end with .000.

NOTE

While only one user-programmed method can be stored in each filter module, the method can be replaced by writing over the calibration in memory with a new calibration. The replaced method can be reinstalled later using one known standard and the known absorbance difference between Standards 1 and 2 *as described in paragraph 2.2.4.2.*

Prior to entering a calibration, the operator should prepare a calibration curve on an absorbance vs. concentration graph using standards (solutions of known concentrations) which cover the entire working range. *See Figure 3.* The number of standards needed will vary, depending on the linearity of the calibration and its expected usage. The minimum number will be two and, generally speaking, the more standards used, the more precise the curve and the better you will be able to select the optimum two calibration points (S1 and S2) on the curve to perform the colorimeter calibration. The DR/700 Colorimeter is limited to linear calibrations being stored in instrument memory, so selection of the calibration points on the curve

should be based on where the plot is straightest.* In the following example, five standards are used to establish the curve and from that curve standards of 10 mg/L and 30 mg/L were selected for S1 and S2 standards, respectively.



	Conc	Abs
1.	0 mg/L	0.000
2.	10 mg/L	0.318
3.	20 mg/L	0.542
4.	30 mg/L	0.663
5.	40 mg/L	0.709

FIGURE 3 **SAMPLE CALIBRATION CURVE**

The following procedures describe how to enter and use the user-programmed method.

WARNING

To familiarize yourself with handling precautions, dangers and emergeny procedures, always review the Material Safety Data Sheets prior to handling containers, reservoirs, and delivery systems that contain chemical reagents and standards. Protective eye wear always is recommended when contact with chemicals is possible.

ADVERTENCIA

Para familiarizarse con las precauciones de manipulación, los peligros y los procedimientos de emergencia, siempre estudie las Hojas de Datos de Seguridad de los Materiales antes de manipular recipients, depósitos y sistemas de entrega que contengan reactivos y patrones químicos. Siempre se recomienda el uso de protectors oculars cuando sea possible el contacto con productos químicos.

AVISO

Para familiarizar-se com as precauções de manipulação, riscos e precedimentos de emergência, examine sempre o Folheto de Dados de Segurança antes de manipular os recipients, tanques e sistemas de distribuição que contenham reagents químicos e outros elementos padronizados. Se recomenda sempre o uso de protetores para olhos, quando possa acontecer contato com os produtos químicos.

*Note: Hach DR/2010 and DR/4000 Spectrophotometers are designed to accept multiple calibration points and provide direct readouts from nonlinear calibrations.

ATTENTION

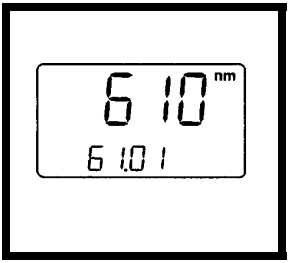
Pour se familiariser avec les precautions à prendre lors de la manipulation, les dangers et les procedures d'urgence, toujours lire les Fiches de Données de Sécurite avant de manipuler les recipients, les reservoirs et les systèmes de distribution contenant les réactifs chimiques et les solutions etalons. Il est toujours recommandé de porter des lunettes de protection lorsu'un contact avec les produits chimiques est possible.

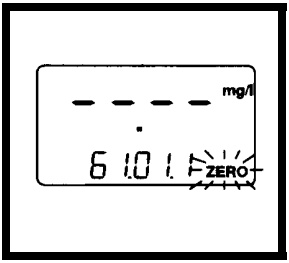
WARNHINWEIS

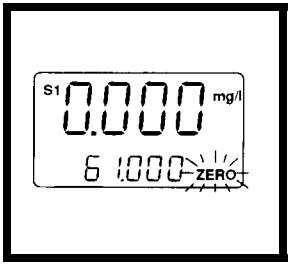
Es wird dringend empfohlen, die Sicherheitsdatenblätter vor der Handhabung von Behältern, Tanks und Zufuhrsystemen, die chemische Reagenzien und Standardsubstanzen enthalten, aufmerksam durchzulesen, damit Sie sich mit den beim Umgang mit diesen Chemikalien notwendigen Vorsichtmaßnahmen, Risiken und Notfallschutzmaßnahmen vertraut machen. Es wird empfohlen, in allen Situationen, in denen mit einem Kontakt von Chemikalien zu rechnen ist, eine Schutzbrille zu tragen.

2.2.4.1 Calibration Using Two Prepared Standards

PROCEDURE



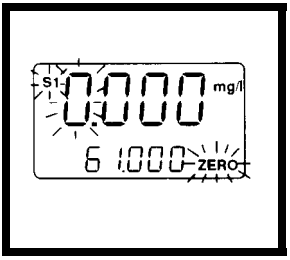


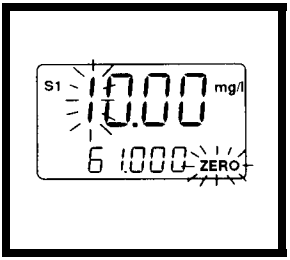


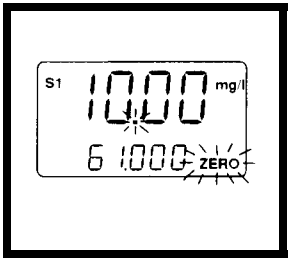
1. If the colorimeter is on, proceed to Step 3. If the colorimeter is off, press **I/O**. The upper display will show the wavelength and the lower display will show the filter module and the software version number. Verify that the appropriate filter module is installed.

2. After about 2 seconds, the display will show a concentration format, a program number and the ZERO prompt.

3. Press the **PROGRAM** key to obtain a program number ending in .000 (i.e., 61.000). The ZERO annunciator will be flashing.





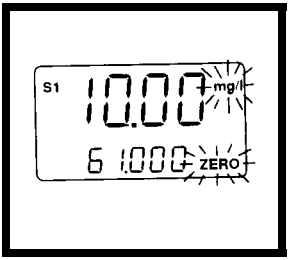


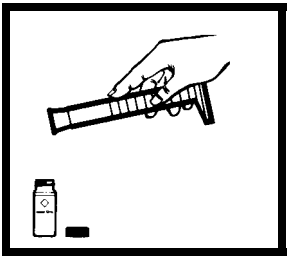
4. Press the **CAL** key. The S1 annunciator and the first digit on the left will start flashing.

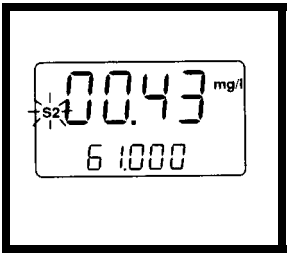
Note: *If the displayed concentration is correct (digits, decimal position and units of measurement), proceed to Step 8.*

5. Use the **UP ARROW** key to edit the first digit. When correct, press the **RIGHT ARROW** key to select the next digit. Repeat this procedure until the four digits reflect the concentration value of the first standard. Use zeros to fill positions where 1 through 9 are not appropriate. If there are any errors, proceed with the next step. Errors can be corrected later.

6. Press the **RIGHT ARROW** key. The decimal point will begin flashing. Press the **UP ARROW** key until the decimal is positioned properly.







7. Press the **RIGHT ARROW** key. A units indicator will start flashing. Press the **UP ARROW** key until the correct unit is selected. If none of the units of measure in the units menu is appropriate, a blank unit can be selected.

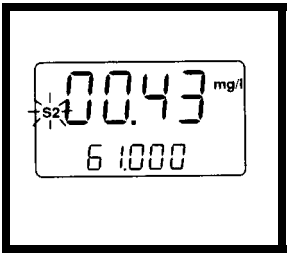
Note: *If any errors have been made to this point of the calibration, correct them by pressing the* **RIGHT ARROW** *key and repeating Steps 5 through 7.*

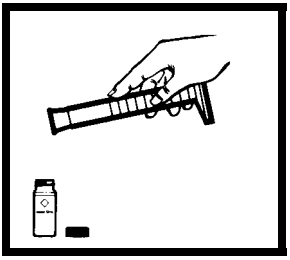
8. Prepare Standard 1 and fill a sample cell to the mark. Cap the cell.

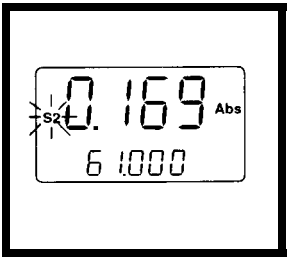
Note: *In bright sunlight, it may be necessary to close the cell compartment cover. If using a 25-mL sample cell, transfer sample to a 10-mL sample cell.*

9. Place the sample cell containing Standard 1 into the colorimeter. Press the **ZERO** key. The display will count down and then show another four-digit concentration value. The S2 annunciator will begin flashing.

Note: *If the displayed concentration of S2 is correct, proceed to Step 11.*





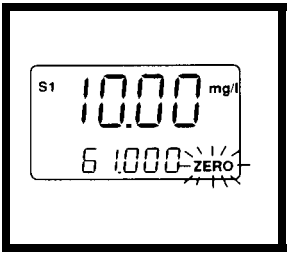


10. Press the **RIGHT ARROW** key. The left digit will begin flashing. Use the arrow keys to edit the display to show the concentration value of Standard 2. Changes cannot be made to the decimal position or unit of measure for Standard 2 (S2). Decimal position or unit of measure must be the same for both S1 and S2.

11. Prepare Standard 2 and fill a sample cell to the mark. Cap the cell. Use the same size of sample cell as used for Standard 1.

12. Place the sample cell containing Standard 2 into the colorimeter. Press **READ**. The display will count down, then show the relative absorbance of Standard 2.

Note: *It is good practice to record the concentration of Standards 1 and 2 and the absorbance of Standard 2 for future use. That data is used in the calibration procedure described in section 2.2.4.2.*



13. Press the **CAL** key. The calibration is automatically completed and stored in the module memory. The upper display field will show the value of Standard 1 with the proper decimal position and unit of measure. The ZERO indicator will be flashing. Unknown samples can now be measured *as described in section 2.2.4.3,* Measurement of Samples.

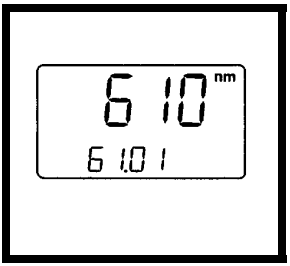
Note: *The concentration value of Standard 2 entered here establishes the upper limit of the calibration range. The colorimeter displays measurements beyond this value, but an overrange condition will exist and the accuracy may be questionable.*

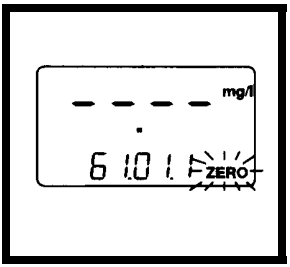
2.2.4.2 Calibration Using a Relative Absorbance With One Standard

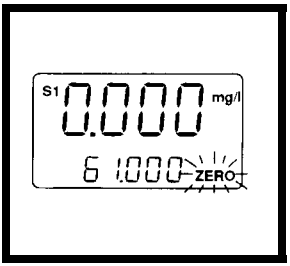
It is important to verify calibration linearity by measuring and plotting the absorbance of standards spanning the intended range of measurement. *Refer to 2.2.4, Using User-Programmed Methods.*

This procedure is primarily used to restore a previously used calibration for which calibration data is already known. If one of the standards (S1 or S2) had a zero concentration value (often the case), the calibration can be re-entered without preparing a standard. If more than one user-entered method is routinely needed, a second filter module is recommended to allow permanent storage.

PROCEDURE



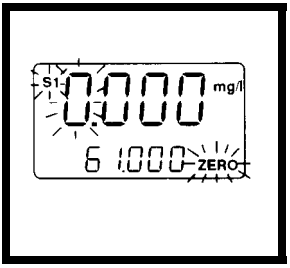


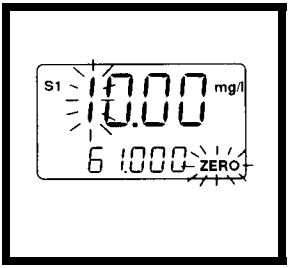


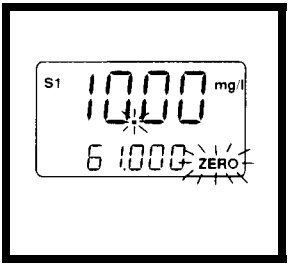
1. If the colorimeter is on and in a pre-programmed method, proceed to Step 3. If the colorimeter is off press **I/O**. The upper display will show the wavelength and the lower display will show the module installed and software version number. Verify the appropriate filter module is installed.

2. After about 2 seconds, the display will show a concentration format, a program number and the ZERO prompt.

3. If necessary, press the **PROGRAM** key to obtain a digit program number ending in .000. The first two digits identify the filter module installed. The ZERO annunciator will be flashing.





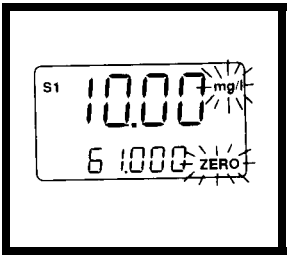


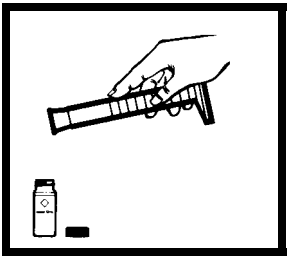
4. Press **CAL**. The S1 annunciator and the first digit on the left will start flashing.

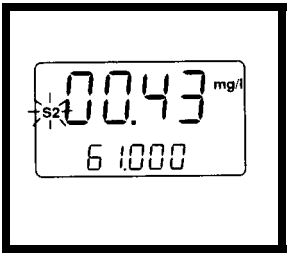
***Note**: If the displayed concentration is correct (digits, decimal position and unit of measure), proceed to Step 8.*

5. Use the **UP ARROW** key to edit the first digit. When correct, press the **RIGHT ARROW** key to select the next digit. Repeat this procedure until the four digits reflect the concentration value of the first standard. Use zeros to fill positions where 1 through 9 are not appropriate. If there are any errors, proceed with the next step. Errors can be corrected later.

6. Press the **RIGHT ARROW** key. The decimal point will begin flashing. Press the **UP ARROW** key until the decimal is properly positioned.







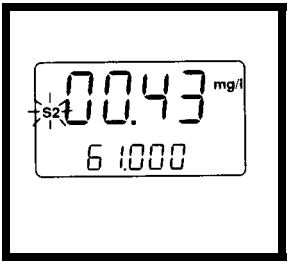
7. Press the **RIGHT ARROW** key. A units indicator will start flashing. Press the **UP ARROW** key until the correct unit is displayed.

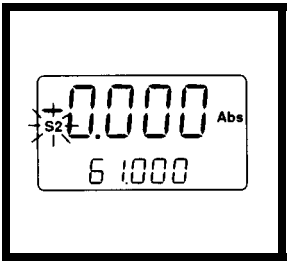
Note: *If any errors have been made to this point of the calibration, correct them now by pressing the* **RIGHT ARROW** *key and repeating Steps 5 through 7.*

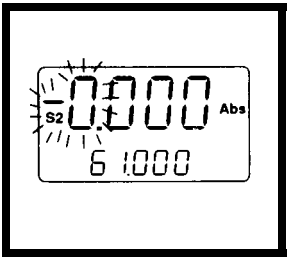
8. Prepare Standard 1 and fill a sample cell to the mark. Cap the cell. If the method will be performed in a direct sunlight environment, a 10-mL cell should be used so the compartment cover can be closed.

9. Place the sample cell containing Standard 1 into the colorimeter. Press **ZERO**. The display will count down and then show another four-digit concentration value. The S2 annunciator will begin flashing.

Note: *If the displayed concentration in Step 9 is correct as is, proceed to Step 11.*







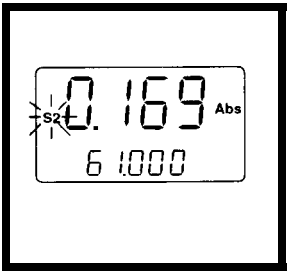
10. Press the **RIGHT ARROW** key. The left digit will begin flashing. Use the arrow keys to edit the display to show the concentration value desired for the upper limit of the calibration range. Changes cannot be made to the decimal position or unit of measure at this time.

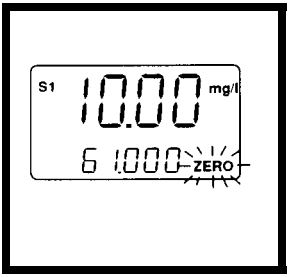
11. Press **READ** . The display will count down and then show a relative absorbance near zero. This step enters the upper limit (S2) value. The S2 annunciator will flash.

Note: *The concentration value of Standard 2 entered here establishes the upper limit of the calibration range. The colorimeter will display measurements above this range, but an overrange condition will exist and the accuracy may be questionable.*

12. Press the **RIGHT ARROW** key. The left digit and the S2 annunciator will flash. Use the arrow keys to enter the correct absorbance difference. *See Figure 4*. Be sure to observe the polarity sign. If a negative number appears and you wish to edit a positive number, use the **UP ARROW** key to step through the negative numbers to reach the positive.

Note: *Negative slope calibrations (where standard 1 has a greater absorbance than standard 2) can be entered. Be sure the edited absorbance value has the correct polarity before proceeding to Step 13.*





13. Press **READ**. This enters the absorbance difference between the standard limits.

14. Press **CAL**. The calibration is automatically completed and stored in the filter module memory for the program number ending in .000. The display will show the concentration value for standard 1 and the ZERO indicator will be flashing. *Refer to paragraph 2.2.4.3,* Measurement of Samples, to perform the measurement or to review concentration values of S1 and S2.

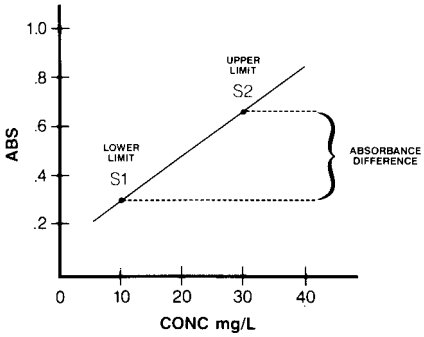
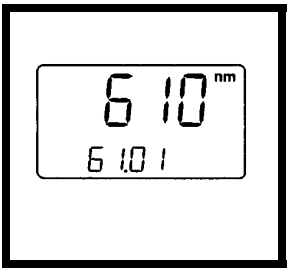


FIGURE 4 **CALIBRATION WITH RELATIVE ABS AND ONE STANDARD**

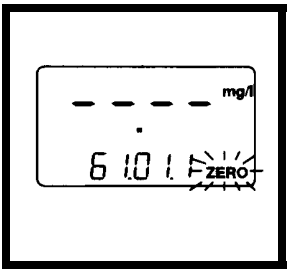
2.2.4.3 Measurement of Samples With User-Entered Method

This procedure provides instructions for using a user-entered method after the calibration has been entered by one of the methods previously described in Calibration Using Two Prepared Standards, *paragraph 2.2.4.1* or Calibration Using a Relative Absorbance With One Standard, *paragraph 2.2.4.2*. For specific instructions using factory programmed methods and special methods requiring user-entered calibrations,see the procedure packet supplied with your filter module.

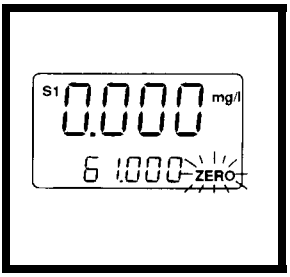
PROCEDURE



l. If the colorimeter is off, press **I/O**. The upper display will show wavelength and the lower display will show the software version number. Verify the appropriate filter module is installed.

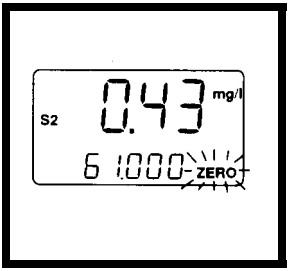


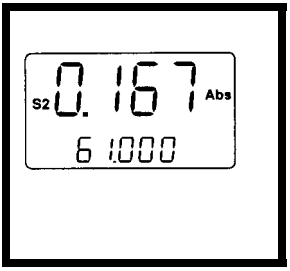
2. After about 2 seconds, the display will show a concentration format, a program number and the ZERO prompt.

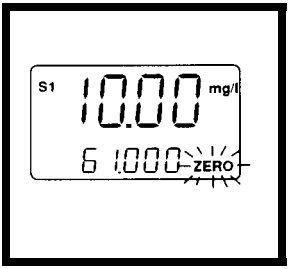


3. Press **PROGRAM** to select the user program number (ends in .000). The ZERO annunciator will be flashing. The display will show the concentration of Standard 1 used to calibrate this program.

Note: *To zero the colorimeter on the S1 value shown in the display, proceed to Step 7. To zero on the S2 standard, press the* **UP ARROW** *key and proceed to Step 7. To review the calibration data, go to Step 4.*



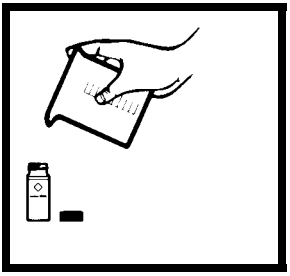




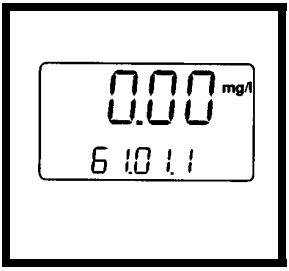
4. Press the **UP ARROW** key. The display will show the concentration of S2.

5. If you wish to check the relative absorbance value of S2, press the **UP ARROW** key again for the absorbance value of Standard 2 used for this calibration.

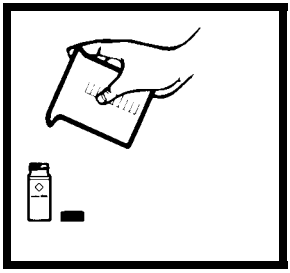
6. One more press of the **UP ARROW** key returns the display to the concentration of S1. Leave the concentration that you wish to zero on, in the display.



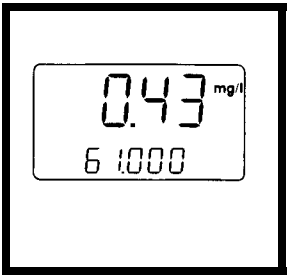
7. Prepare a standard equal in concentration to that displayed. This is usually the blank solution, (often untreated sample or deionized water). Fill a sample cell of the same size used in the calibration to the mark with this standard. Cap the cell.



8. Place the sample cell containing the standard in the colorimeter and press **ZERO**. The display will count down and then give the concentration of the standard. The ZERO and STANDARD annunciators will turn off.



9. Prepare the unknown sample and fill a clean sample cell to the mark. Cap the cell.



10. Place the sample cell containing the unknown sample in the colorimeter and press **READ**. The display will count down and then give the concentration of the test solution. Numerous unknown samples can now be read without re-zeroing each time.

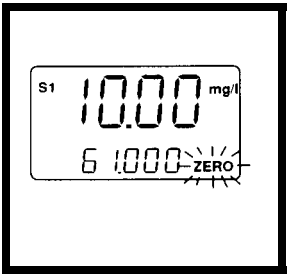
Note: *Pressing the* **ABS/%T** *key successively will show displays of relative absorbance and percent transmittance equivalents of the concentration measurement. Pressing* **PROGRAM** *will return the instrument to the concentration reading.*

Note: *For best accuracy, the colorimeter should be zeroed prior to each measurement as described above using a solution equal in concentration to that used for the zeroing solution previously.*

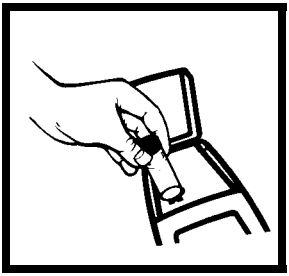
2.2.4.4 Re-zeroing a User Entered Method

The colorimeter can be zeroed on either the S1 or S2 solutions at any time, while using the user-entered method, by following the procedure below.

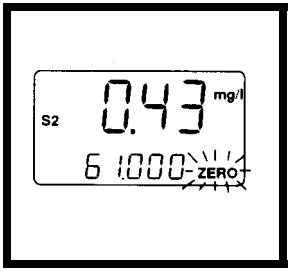
PROCEDURE



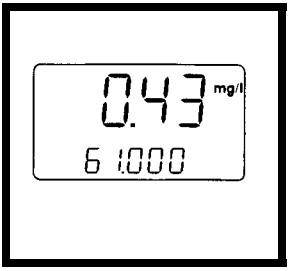
1. Press **ZERO** . The concentration value of S1 will be displayed.



2. If you wish to zero on the S1 solution, insert a sample cell containing a solution with the concentration equal to that displayed and press **ZERO** again. If you wish to zero on the S2 solution, perform Step 3 instead of this step.



3. To zero on the S2 solution, press the **UP ARROW** key. The concentration value of the S2 solution will be displayed.



4. Insert a sample cell containing a solution with the concentration equal to that in the display and press **ZERO** again. The S2 and ZERO annunciators will stop flashing.

2.3 Operational Notes

2.3.1 General

For best results with the Model DR/700 Colorimeter, please read and observe the following recommended rules:

- Always cap the sample cells to prevent spillage.
- When taking a reading, colorimeter should be on a level, stationary surface.
- Extreme turbidity and color in the sample can affect the colorimeter readings.
- If operating in direct sunlight, the sample compartment cover should be closed when zeroing and taking readings. Cover can remain open when operating under normal indoor lighting. The colorimeter should be zeroed and the measurement taken in the same light environment.
- Do not leave a sample cell in the cell compartment for long periods.
- Empty the cell compartment and remove the batteries when storing the colorimeter for extended periods.
- Do not allow filter module to become wet or dirty. The carrying case is the recommended storage package.
- Always use clean, scratch-free sample cells.
- Mark sample cells with a reference mark that provides the best optical match between cells used for blank and test solution and use the marks to place the cells in the cell compartment with the same orientation each time. Absorbance matching and cell orientation marks are determined by measuring the absorbance of clear water. *Refer to paragraph 2.3.3 Matching Sample Cells.*

2.3.2 Using Sample Cells

Sample cells must be kept clean and free of fingerprints; water droplets on the outside surface must be wiped dry. Handle cells by the cap to avoid fingerprints. Nicked or extensively scratched sample cells should be replaced for optimum accuracy and reproducibility.

Because imperfections in the glass cause variations between sample cells, best accuracy will be obtained if optically matched cells are used when measuring blank and treated samples. *Refer to Matching Sample Cells in paragraph 2.3.3.* Also, repeatability is improved if the sample cells are oriented in the

same position in the cell compartment every time. An index mark can be placed on the cell marking band for this purpose.

2.3.3 Matching Sample Cells

Sample cells can be optically matched in your colorimeter to improve the accuracy and repeatability of measurements. Because different cells are used for zeroing the instrument and taking the measurement, optical variations in the cells can be compensated for by using matched cells. To match two or more cells, proceed as follows:

1. Clean each cell thoroughly.

2. Fill each cell to the mark (10 or 25-mL, depending on cell size) with deionized water and install the cap.

3. Arbitrarily choose any cell to be the master. Place a mark on the marking band and place the cell into the colorimeter with the mark aligned with the index in the front of the cell compartment well. *See Figure 5.*

4. Verify that a filter module is installed and turn on the colorimeter by pressing the **I/O** key.

5. When the display shows the concentration format, press the **ABS/%T** key once to change to the absorbance mode.

6. Press the **ZERO** key. When the countdown ends, the display will read 0.000 Abs.

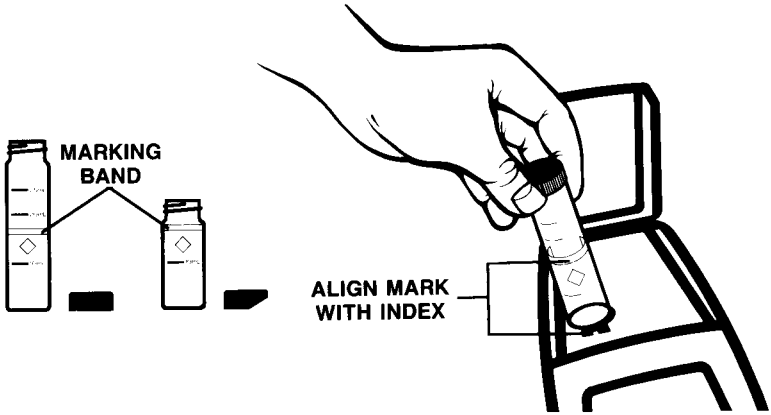


FIGURE 5 **CELL ORIENTATION**

7. Press the **READ** key. Record the reading.

8. Remove the master sample cell and replace it with one of the cells to be matched with the master. Press the **READ** key and wait for the absorbance reading. Compare the reading with the reading in Step 7. If the reading is within 3 milliabsorbance units of the reading from the master cell, place a mark on the cell's marking band in line with the index in the front of the cell compartment well. If the reading is not within 0.003 Abs of the reading from the master cell, rotate the cell in the instrument slightly and take another reading. Read and compare the reading again. Repeat until the readings of the two cells are within the 0.003 Abs tolerance.

9. Verify the match by rezeroing the colorimeter on the master cell and rereading the cell or cells being matched. Be sure the marks are aligned with the index in the front of the cell compartment well. The cells should be ready for use.

10. Repeat the procedure for the remaining cells intended for matching.

INSTALLATION/MAINTENANCE

SECTION 3 INSTALLATION/MAINTENANCE

3.1 Preparation For Use

3.1.1 Unpacking

Remove the colorimeter and accessories from the shipping containers and inspect each item for any damage that may have occurred during shipment. Verify that the following items, plus any optional accessory items ordered, are present:

- Carrying Case
- DR/700 Colorimeter, with one filter module of choice
- Sample Cells, w/caps, 10-mL size (2)
- Sample Cells, w/caps, 25-mL size (2)
- Batteries, AA alkaline (4)
- DR/700 AccuVac Vial Adapter
- COD Vial Adapter (provided with 420-nm, 610-nm modules only)
- Clippers, for opening reagent pillows
- Instrument Manual, Procedure Manual w/3-Ring Binder
- Filter Module(s), (ordered separately)

If any items are missing or damaged, please contact the Customer Service Department, Hach Company, Loveland, Colorado for instructions. The toll-free number is **800-227-4224**. For customers outside the USA, contact the Hach office or authorized distributor serving you.

3.1.2 Battery Installation

The colorimeter operates on battery power. Four AA alkaline cells are supplied with the instrument and must be installed by the operator *as shown in Figure 6.* Correct battery polarity is indicated on the battery holder. If optional rechargeable batteries are to be used, they are installed in the same manner after initally being charged for 14 to 16 hours in an external battery charger.

3.1.3 Filter Module Installation

Filter modules are inserted in the bottom of the colorimeter as *shown in Figure 7*. The module

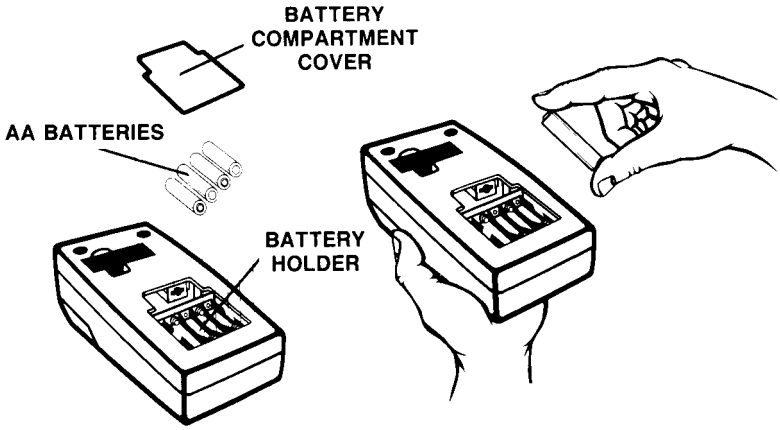


FIGURE 6 **BATTERY INSTALLATION**

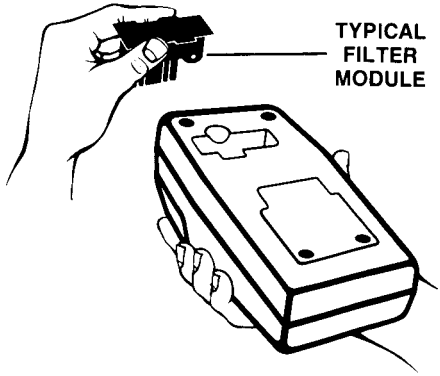


FIGURE 7 **FILTER MODULE INSTALLATION**

opening is keyed such that the filter module cannot be inserted improperly. Press the module in until its base is flush with the bottom of the instrument case. Before using the colorimeter, perform a lamp intensity adjustment with each filter module installed in the colorimeter. This will permanently store the optimum lamp intensity setting for each particular filter module, and further adjustment should not be necessary unless the lamp is replaced. *Refer to paragraph 2.2.2.*

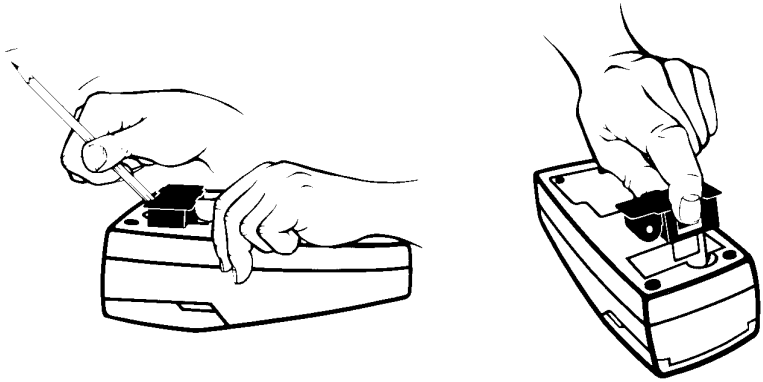


FIGURE 8 FILTER MODULE REMOVAL

The filter modules latch in position when fully installed. When removing a module, the latch must be disengaged by pressing on the finger grip while pulling the module out. *See Figure 8.*

3.1.4 DR/700 AccuVac Vial Adapter Installation

The DR/700 AccuVac Vial Adapter is needed only when using the Hach AccuVac Reagent Vials. Illustrated test procedures are provided in the procedure manual for each AccuVac method.

3.2 Cleaning

Maintain the colorimeter, filter modules and sample cells as clean as possible, and store in the carrying case when not in use. Filter modules not in use should be stored in the antistatic bags in which they were received. Wipe up spills promptly. The color filter surfaces in the filter module can be wiped clean with a water-dampened cotton swab. Sample cells should be washed with detergent and rinsed thoroughly with demineralized water. Avoid scratching the glass surfaces of the cell and wipe off any fingerprints before inserting it into the cell compartment for measurement.

3.2.1 Cleaning the Filter Module Circuit Board

If necessary, the filter module circuit boards may be cleaned to remove salts or other ionic substances from the instrument circuit board. **This procedure will not remove oils or other organic contamination.**

1) Fill a beaker with a solution of 25% deionized water and 75% isopropyl alcohol. The solution level should cover the circuit board portion of the module, not the color filter portion. Use of other types of alcohol besides isopropyl may damage the circuit board.

2) Soak the module for 30 minutes. Periodically swirl the module during the 30-minute period.

3) Blow the module out with instrument grade or ionized air to remove any trapped liquid.

4) If the color filter accidentally comes in contact with the solution, use a cotton swab to gently clean the filter glass.

3.3 Battery Replacement

AA alkaline batteries are typically suitable for up to 500 tests. A low battery indicator will flash when battery replacement is needed. *Refer to Battery Installation paragraph 3.1.2.*

WARNING

Batteries may explode if recharged or disposed of in a fire.

ADVERTENCIA

Las pilas pueden explotar si se recargan o se tiran al fuego.

AVISO

Bateris pode explodir se for recarregada ou descartada em fogo.

ATTENTION

La pile peut exploser si elle est rechargee ou mise au feu pour evacuation.

WARNHINWEIS

Bei Aufladen oderBeseitigung in Feuer kann die Batterie explodieren.

If after changing batteries the colorimeter keys do not function at all and the **I/O** key will not turn the colorimeter on or off when the batteries are known to be good, a cold start should be performed. A cold start is performed by removing one of the batteries for one to two minutes (to allow circuits to discharge), installing the battery again and then turning the instrument on with the **I/O** key. If the lockup still exists, contact a Hach service center or your authorized distributor.

3.4 Lamp Replacement

Figure 9 illustrates the lamp installation and electrical connections. A small screwdriver is needed to remove and install the lamp leads in the terminal block. Back the screws out partially to remove the leads of the old lamp. The lamp holder locks in place in the lamp socket with bayonet-style projections which engage with a clockwise quarter turn of the lamp assembly. To remove the old lamp, turn the lamp assembly counterclockwise.

Install the replacement lamp assembly in reverse order of removal. It will be necessary to perform a lamp intensity adjustment procedure on all filter modules when installation of the new lamp is complete. *Refer to paragraph 2.2.2*

NOTE

Remove batteries or disconnect the battery eliminator before replacing the lamp. Failure to do so may result in irreversible electrical damage to the instrument.

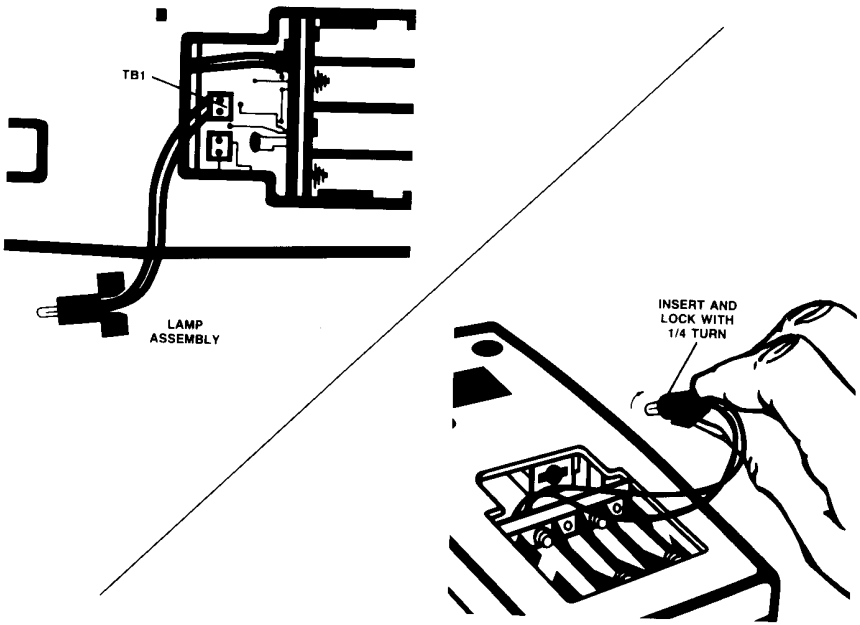


FIGURE 9 **LAMP REPLACEMENT**

SECTION 4 TROUBLESHOOTING

4.1 Introduction

Troubleshooting by the operator is generally limited to performing two diagnostic tests and responding to error codes displayed when certain predetermined limits are exceeded. If the colorimeter does not perform properly in the diagnostic tests or an error condition cannot be corrected, contact a Hach service center for assistance. *Refer to Section 6.*

4.2 Display Test

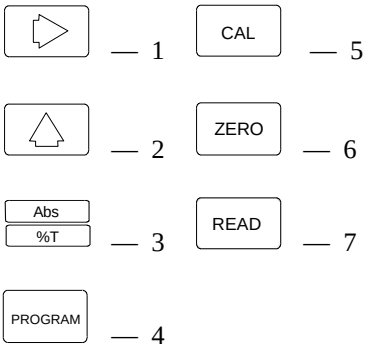
Operation of the display elements can be checked by holding the **I/O** key down at instrument turn-on while observing the display test sequence. Hold the key down until all the annunciators and digital readout elements are verified. The display test sequence will continue to cycle as long as the key is held down.

4.3 Keyboard Test

Each key of the keyboard can be checked easily as follows:

1. With the instrument off, press and hold the **UP ARROW** key while pressing and releasing the **I/O** key. Keep holding the **UP ARROW** key down until a "-2-" appears in the upper display. Disregard the lower display for this test. It is the raw millivolt reading of the photocell output.

2. Now press each key **except** the **I/O** key and verify that a number appears momentarily in the upper display. The following key number scheme will appear:



3. Press the **I/O** key to exit the keyboard check mode.

4.4 Error Indications and Codes

4.4.1 Flashing Maximum Concentration Display

A flashing display of the concentration range maximum value is an indication that the reading taken was beyond the upper end of the factory-entered calibrated range. A sample dilution (prior to treatment) may be necessary to bring the concentration within the range of

the colorimeter. If a diluted sample is measured, multiply the test result by the dilution factor. *Refer to Sample Dilution Techniques in Section 1 of your DR/700 Colorimeter Procedures Manual.*

4.4.2 Flashing Minimum Concentration Display

A flashing minimum concentration value indicates that the sample measured had a concentration value less than zero. It may be caused by a bad choice of blank solution or by sample cells poorly matched.

4.4.3 Flashing S1 and S2 Annunciators

When both standard annunciators are flashing simultaneously, it is an indication that the sample measured was out of range of a user-entered calibration, either underrange or overrange.

4.4.4 Flashing 4.00 Abs Indication

This indication is caused by a relative absorbance reading greater than 4.00. This will occur when a very dark sample is measured.

4.4.5 Flashing 9999 %T Indication

This indication is caused by a relative percent transmittance measurement greater than the instrument's maximum displayable limit.

4.4.6 Flashing 0.0 %T Indication

This indication probably is caused by an electronics failure. It also may be due to a large change in ambient light while measuring a dark sample. If another filter module is available, install it to determine if the problem is with the meter or filter module. Contact a Hach service center. *Refer to the Repair Service Section.*

4.4.7 Flashing Lamp Annunciator

This indication is a precautionary warning and occurs during the zeroing function when there may not be enough light for a valid measurement. Perform a lamp intensity adjustment and try zeroing again. The lamp annunciator will continue to flash until the instrument is zeroed properly.

4.4.8 Error Code E1 (Overrange)

E1 indicates an electronic overrange condition. Perform the lamp intensity adjustment procedure *described in paragraph 2.2.2.* To verify that the problem is not in the filter module, try another module if one is available. The error code display can be cleared by pressing the **PROGRAM** or **I/O** key. If the problem can not be corrected, contact a Hach service

center. *Refer to the Repair Service Section.*

4.4.9 Error Code E2 (Underrange)

E2 indicates an electronic underrange condition caused by a hardware failure. Because it could be caused by the filter module, try another module first if one is available. Contact a Hach service center. *Refer to the Repair Service Section.*

4.4.10 Error Code E3 (No Filter Module Installed)

Error code E3 occurs when the instrument is turned on and a filter module has not yet been installed or is not installed properly. Installing a filter module will correct this condition. Power need not be turned off to install a filter module.

4.4.11 Error Code E4 (User Method Concentration Error)

E4 occurs after the **CAL** key is pressed at the end of a calibration procedure and the same concentration value is entered for both the S1 and S2 standards. Repeat the calibration.

4.4.12 Error Code E5 (User Method Absorbance Error)

This error code occurs after the **CAL** key is pressed at the end of a calibration procedure and the absorbance of S2 minus the absorbance of S1 is equal to or less than 0.005 Abs. Check the standards and repeat the calibration.

4.4.13 Error Code E6 (Low Light)

Low light while zeroing the colorimeter causes an E6 indication. It occurs when the difference between the photodetector amplifier voltage with the lamp off and with the lamp on is less than 1 mV. Either the sample is too dark or the lamp intensity needs adjusting. *Refer to paragraph 2.2.2.* A bad lamp or circuit failure could be the cause of the problem.

4.4.14 Error Code E7 (Lamp Out)

If the lamp is burned out or disconnected, an E7 error code will be displayed. Check the lamp connection, and if that is not the problem, replace the lamp. *Refer to paragraph 3.4.*

4.5 Diagnostics Mode

Diagnostic checks are incorporated in the colorimeter software to help determine the cause of colorimeter malfunctions. If problems occur, perform these checks and record the readings before contacting a service center. The diagnostic sequence is initiated by turning the colorimeter off and then holding the **ABS/%T** key down while

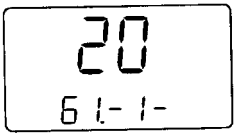
turning on the colorimeter again with the **I/O** key. The checks include:

-1- Power Supply Voltage with lamp on
-2- Power Supply Voltage with lamp off
-3- Lamp Voltage
-4- Lamp Intensity Set Point
-5- Sample Reading (in millivolts) before lamp turns on
-6- Sample Reading (in millivolts) at end of read sequence

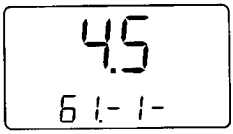
In the following procedure, the complete sequence is performed.

1. Place a sample cell containing clear water into the sample compartment. Close the sample compartment cover.

2. With the colorimeter off, press and hold down the **ABS/%T** key while pressing and releasing the **I/O** key. Hold the **ABS/%T** key until "-1-" appears in the lower display and the countdown begins.



The readings for the complete diagnostics sequence take place at this time. At the end of the countdown, the power supply voltage with lamp on will appear in the upper display.

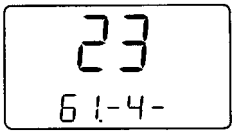


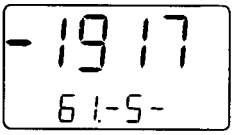
If the reading is less than 4.2 volts, batteries should be replaced (or recharged if NiCad).

3. Press the **UP ARROW** key. Diagnostic -2- will be displayed showing the power supply voltage with lamp off. Voltage should not exceed 5.1 volts.

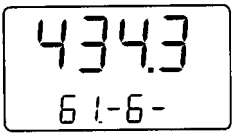
4. Press the **UP ARROW** key to go to the next diagnostic check. The lamp voltage, -3-, will be displayed as follows. The lamp voltage should fall within 2.0 to 3.3 volts.

5. Press the **UP ARROW** key to go to the next diagnostic check. The lamp set point, diagnostic -4- is displayed as shown. It will fall between 1 and 31.





6. Press the **UP ARROW** key to check the sample reading before the lamp turns on. The millivolt reading should be within the -1800 to -2000 mV range. This will be diagnostic check -5-.



7. Press the **UP ARROW** key again to check the sample reading with the lamp on. The millivolt reading should fall within -1000 to +1000 mV range. An out of tolerance reading here may be the result of not doing a lamp intensity adjustment for the filter module installed. Record the reading and perform the lamp intensity adjustment procedure. *Refer to paragraph 2.2.2.* Rerun the diagnostic checks. This will be diagnostic check -6-.

One more press of the **UP ARROW** key will begin the diagnostic sequence again with check -1- and repeat the same readings. To perform another diagnostic sequence with new readings, press the **READ** key. There is no need to turn the colorimeter off at this point to perform a new diagnostic sequence.

8. To return to normal operation, press the **PROGRAM** key.

SECTION 5 REPLACEMENT PARTS AND ACCESSORIES

Cat. No.	Description	Unit
46008-00	Adapter, COD Vial (supplied with 420 nm and 610 nm filter modules)	each
19380-04	Batteries, AA	pkg/4
46479-00	Battery Charger, 115 V, optional	each
46479-01	Battery Charger, 230 V, optional	each
46079-00	Battery Eliminator, 115 V, UL/CSA approved, optional	each
46080-00	Battery Eliminator, 230 V, VDE approved, optional	each
46014-33	Binder, 3-ring	each
46014-88	Procedures Manual	each
46014-66	Dividers, DR/700 Manual	each
46014-22	Documentation Package, DR/700, includes instrument manual and procedures manual	
46076-00	Carrying Case, DR/700	each
968-00	Clippers	each
46025-00	DR/700 AccuVac Vial Adapter	each
46220-00	Filter Module Set, optional [Includes filter modules 42.01 (420 nm), 45.01 (450 nm), 50.01 (500 nm), 52.01 (525 nm), 55.01 (550 nm), 61.01 (610 nm), and 81.01 (810 nm)]	each
46242-00	Filter Module, 420 nm	each
46245-00	Filter Module, 450 nm	each
46248-00	Filter Module, 480 nm	each
46250-00	Filter Module, 500 nm	each
46252-00	Filter Module, 525 nm	each
46255-00	Filter Module, 550 nm	each
46257-00	Filter Module, 575 nm	each
46261-00	Filter Module, 610 nm	each
46269-00	Filter Module, 690 nm	each
46281-00	Filter Module, 810 nm	each
46001-18	Instrument Manual	each
46078-00	Lamp Assembly	each
24276-06	Sample Cell, 1", 10 mL, w/cap	pkg/6
24019-06	Sample Cell, 1", 25 mL, w/cap	pkg/6
24018-12	Sample Cell Cap	pkg/12
272-56	Demineralized Water	4 L

SECTION 6 REPAIR SERVICE

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

In the United States:
Hach Company
100 Dayton Ave.
P.O. Box 907
Ames, Iowa 50010
800-227-4224 (U.S.A. only)
FAX: (515) 232-1276

In Europe, Asia, Africa, Latin America, the Caribbean, the Far East, Indian, or the Pacific Basin:
Hach Company, World Headquarters
P.O. Box 389
Loveland, Colorado, 80539 U.S.A.
Telephone: (970) 669-3050
Fax (970) 669-2932

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

SECTION 7 WARRANTY

Seller warrants equipment of its manufacture against defective materials or workmanship for a period of one year from date of shipment.

The liability of Seller under this warranty is limited, at Seller's option, solely to (1) repair, (2) replacement with equivalent Hach equipment, or (3) an appropriate credit adjustment not to exceed the original sales price of equipment returned to the Seller, provided that:

a) Buyer promptly notifies Seller in writing on discovery of the defects, stating where applicable, the product type and serial numbers and fully describing the circumstances giving rise to the claim. Seller must receive such notification within the applicable warranty period in order for this warranty to apply.

b) On receipt of written instructions from Seller, Buyer returns the equipment as instructed with transportation charges prepaid by the Buyer, and

c) Seller's examination of such equipment disclosed to its satisfaction that the defects have not resulted from any negligence, misuse, improper installation, accident or unauthorized repair or alteration by the Buyer. Seller's determination of the cause and nature of the failure of the equipment shall be final.

This warranty does not include limited life electrical components which deteriorate with age such as batteries, lamps, photocells, electrodes, etc. In the case of equipment and accessories not manufactured by the Seller, but furnished with equipment of Seller's manufacture, Seller's liability is limited to whatever warranty is extended by the manufacturers thereof and transferable to the Buyer.

This warranty is applicable to the original Buyer only and shall be in lieu of and exclude all other warranties, expressed or implied, including, but not limited to, any implied warranty of merchantability or fitness. The foregoing shall constitute the sole and exclusive remedy of Buyer and the sole and exclusive liability of Seller, whether Buyer's claims shall be for breach of warranty or negligence. Seller neither assumes nor authorizes any person to assume for it any other obligation or liability in connection with the sale of the equipment. In no event shall Seller be liable for special, incidental or consequential damages.

If Seller finds that Buyer has returned the equipment without cause, Seller shall notify Buyer and return the equipment at Buyer's expense; in addition, Seller may, at its sole discretion, impose a charge for testing and examination of any equipment so returned.

HACH COMPANY
WORLD HEADQUARTERS
P.O. Box 389
Loveland, Colorado 80539-0389
Telephone: (970) 669-3050
FAX: (970) 669-2932

FOR TECHNICAL ASSISTANCE, PRICE INFORMATION AND ORDERING:
In the U.S.A. - **Call toll-free 800-227-4224**
Outside the U.S.A. - **Contact the HACH office or distributor serving you.**
On the Worldwide Web - **www.hach.com**; E-mail - **techhelp@hach.com**

QUICK REFERENCE CARD
DR/700 Portable Colorimeter
Model 46000

Concentration Measurements with Hach Stored Methods:

1. Select and install appropriate filter module. *Refer to paragraph 3.1.3 in the Instrument Manual.*
2. Select the appropriate procedure from your manual for this filter module.
3. Follow the instructions given in the procedure.

Absorbance Measurements

1. Select and install appropriate filter module. *Refer to paragraph 3.1.3 in the Instrument Manual.*
2. Press the **ABS/%T** key once.
3. Place the zero solution blank into sample compart-ment and press the **ZERO** key.
4. Place prepared sample into the sample compartment and press the **READ** key.

Percent Transmittance Measurements

1. Select and install appropriate filter module. *Refer to paragraph 3.1.3 in the Instrument Manual.*
2. Press the **ABS/%T** key twice.
3. Place the zero solution blank into sample compart-ment and press the **ZERO** key.
4. Place prepared sample into the sample compartment and press the **READ** key.

(Error Codes and Indications are listed on the reverse side)

Error Codes

E1: Overrange. *Refer to paragraph 4.4.8.*

E2: Underrange. *Refer to paragraph 4.4.9.*

E3: Filter module not installed or improperly installed.

E4: User method calibration error. *Refer to paragraph 4.4.11.*

E5: User method absorbance error. *Refer to paragraph 4.4.12.*

E6: Low light. *Refer to paragraph 4.4.13.*

E7: Lamp out. *Refer to paragraph 4.4.14.*

Error Indications

Flashing maximum concentration display: Concentration exceeds upper calibration limit. *Refer to paragraph 4.4.1.*

Flashing minimum concentration display: Concentration less than value of zero solution. *Refer to paragraph 4.4.2.*

Flashing S1 and S2 annunciators: Out of range measurement. *Refer to paragraph 4.4.3.*

Flashing 4.00 Abs indication: Relative absorbance exceeds 4.00. *Refer to paragraph 4.4.4.*

Flashing 9999 %T indication: Relative %T exceeds 9999. *Refer to paragraph 4.4.5.*

Flashing 0.0 %T indication: Large change in ambient light or possible electronics failure. *Refer to paragraph 4.4.6.*

Flashing lamp annunciator: Low light during zeroing. *Refer to paragraph 4.4.7.*