UV/VIS
Spectrophotometer

User's Manual

7-2000-UV-MN

09.22.21

WARNING! This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

LaMotte®

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CONTENTS

OPERATION

■ General Precautions

The apparatus described in this manual is designed to be used by properly trained personnel in a suitable equipped laboratory. For the correct and safe use of this apparatus it is essential that laboratory personnel follow generally accepted safe procedures in addition to the safety precautions called for in this manual. Read the instruction manual before attempting to set up or operate this instrument. Failure to do so could result in personal injury or damage to the equipment.

The covers on this instrument may be removed for servicing. However, the inside of the power supply unit is a hazardous area and its cover should not be removed under any circumstances. There are no serviceable components inside this power supply unit. Avoid touching the high voltage power supply at all times.

The spectrophotometer should not be stored or used in a wet or corrosive environment. Care should be taken to prevent water or reagent chemicals from wet tubes or cuvettes from entering the Spectrophotometer chamber.

Never put wet tubes in the spectrophotometer.

■ Safety Precautions

***WARNING:** Reagents marked with an * are considered to be potential health hazards. To view or print a Safety Data Sheet (SDS) for these reagents go to www.lamotte.com. Search for the four digit reagent code number listed on the reagent label, in the contents list or in the test procedures. Omit any letter that follows or precedes the four digit code number. For example, if the code is 4450WT-H, search 4450. To obtain a printed copy, contact LaMotte by email, phone or fax.

Emergency information for all LaMotte reagents is available from Chem-Tel: (US, 1-800-255-3924) (International, call collect, 813-248-0585)

Keep equipment and reagent chemicals out of the reach of young children.

■ Power Supply

Electrical

The power supply is auto-ranging (100-230V). Two power cords are supplied. The power cord shall be inserted in a socket provided with a protective earth contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

Warning

Any interruption of the protective conductor inside or outside the apparatus or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

Whenever it is likely that the protection has been impaired, the apparatus shall be made inoperative and be secured against any unintended operation. NEVER touch or handle the power supply due to the high voltage.

The protection is likely to be impaired if, for example, the apparatus

- Shows visible damage
- Fails to perform the intended measurements
- Has been subjected to prolonged storage under unfavorable conditions.
- Has been subjected to severe transport stresses

Radio Interference

For compliance with the EMC standards referred to in the EC Declaration of Conformity, it is necessary that only shielded cables are used when connecting the instrument to computers and accessories.

■ Components

Spectrophotometer Tubes

Spectrophotometer tubes which have been scratched through excessive use should be discarded and replaced with new ones. Dirty tubes should be cleaned on both the inside and outside. Fingerprints on the exterior of the tubes can cause excessive light scattering and result in errors. Handle the tubes carefully, making sure the bottom half of the tube is not handled.

LaMotte Company makes every effort to provide high quality spectrophotometer tubes. However, wall thicknesses and diameter of tubes may still vary slightly. This may lead to slight variations in results (e.g. if a tube is turned while in the sample chamber, the reading will likely change slightly). To eliminate this error put the tubes into the sample chamber with the same orientation every time. The tubes that are included with the spectrophotometer have an index mark to facilitate this. If possible, use the same tube to scan the blank and scan the sample.

The glass spectrophotometer tubes can only be used above 260 nm.

Cuvettes

One quartz cuvette is included. Quart cuvettes may be used in the visible and ultraviolet ranges but must be used below 260 nm. Glass cuvettes are only suitable for the visible region above 260 nm. For the most accurate results, use the same cuvette for the blank and the test sample.

Sample Holders

The spectrophotometer is supplied with two removable sample holders. Each holder is secured to the chamber with screws. The square sample holder will hold 10 mm square cuvettes. The square sample holder should be positioned so that the row of screws on the top is on the right hand side. The universal sample holder will hold round tubes of varying diameters. The universal sample holder should be positioned with the V-channel toward the right side of the chamber and the white roller toward the left side of the chamber. To use the universal sample holder, place the tube between the white roller on the spring loaded arm and the V-channel on the right side of the adapter. Press the tube down on the white roller to retract the arm.

General Operating Procedures

Contents

Qty	Description
1	Spectrophotometer
1	Power Cord
1	Cuvette, Quartz
6	Tubes, Glass, 10 mL
1	Universal Sample Holder
1	Square Sample Holder
1	Dust Cover
1	Manual
1	Quick Start Guide

Replacements and Accessories

Description	Code
Tungsten Halogen Lamp	27290-UVH
Deuterium Lamp	27290-UVD
Cuvette, Quartz (1)	0292-Q
Tubes, Glass, 10 mL (6)	0290-6
K3 Analyst Software, with cable	7-2000-UV-CD

Installation

1. After carefully unpacking the contents, check the materials with the packing list to ensure that everything has been received in good condition.
2. Place the instrument in a suitable location away from direct sunlight. In order to have the best performance from the instrument, keep it as far as possible from any strong magnetic or electrical fields or any electrical device that may generate high-frequency fields. Set the unit up in an area that is free of dust, corrosive gases and strong vibrations.
3. Remove any obstructions or materials that could hinder the flow of air under and around the instrument.
4. Turn on the instrument and allow it to warm up for 15 minutes before taking any readings.

The Keypad

Description of Key Functions

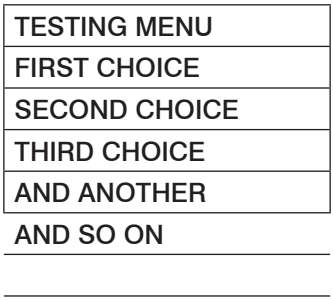
CLEAR/DEL	Clear or delete
SET λ	Set wavelength
LOAD	Load saved curve
0A/100%T	Blank (Set 0A and 100%T) or establish baseline
SAVE	Save data
MODE	Select type of measurement
ESC	Escape or back to previous screen
ENTER	Confirm
^	Scroll up
v	Scroll down
1-9	Numeric keys
PRINT	Print test data
-/.	Minus/Dot

The Display and the Menus

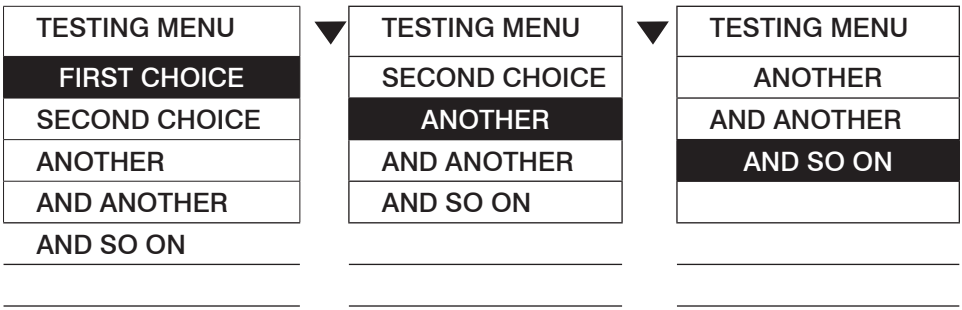
The display allows menu selections to be viewed and chosen. These choices instruct the spectrophotometer to perform specific tasks. The menus are viewed in the display using a general format which is followed from one menu to the next. Each menu is a list of choices or selections.

There are five lines in the display. The top line in each menu is a title or pertinent instruction. The top line does not change unless a new menu is selected. The second line is used in two ways. One way is to display additional information if the top line is insufficient. The second line is also used to display menu choices. The three additional lines are also used for menu choices.

DISPLAY



Think of the menu choices as a vertical list in the display which moves up or down each time an arrow button is pressed. This list or menu is viewed through a window, the menu choice window, in the display. Pushing the arrow buttons brings another portion of the menu into menu choice window. This is referred to as scrolling through the menu.



The highlighted line will have a reverse font – blue figures on a white background. As the menu is scrolled through, different choices will be highlighted. Pressing the **ENTER** button, or other buttons as directed, will select the menu choice that is highlighted

The **ESC** button allows an exit or escape from the current menu and a return to the previous menu. This allows a rapid exit from an inner menu to the main menu by repeatedly pressing the **ESC** button. The spectrophotometer may be turned off at any moment.

Initialization & System Calibration

■ Initialization

1. Turn on the spectrophotometer by pressing the Power Switch (IO) on the back of the instrument. The instrument will automatically run a self-initialization check. The display will show the status of the checking procedure.	Initializing Booting System: Check clock..... LAMOTTE SMART SPECTRO

2.	Initializing Booting System: Check clock..... □ Locating lamp... LAMOTTE SMART SPECTRO

3.	Initializing Booting System: Locating lamp... □ Locating filter... LAMOTTE SMART SPECTRO

4. Press **EXIT** to skip the 15 minutes warm up. Not recommended.	Initializing 15 : 00 Booting System: Locating filter..... □ Warm up 15 min... Press ESC to skip...

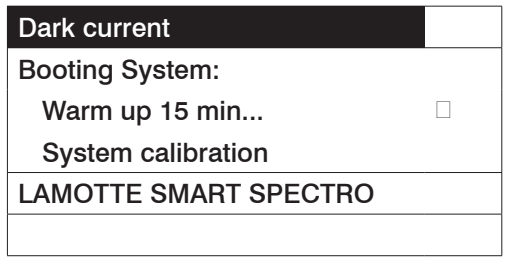
5. Press **ENTER** to select **NO** and skip the system calibration and go to the Main menu. Or Press ^ to go to **YES**. Press **ENTER** to select **YES** and begin the System calibration. Press **EXIT** to skip the 15 minutes warm up. Not recommended.	Initializing 15 : 00 Booting System: Warm up 15 min... □ System calibration... Please select : NO

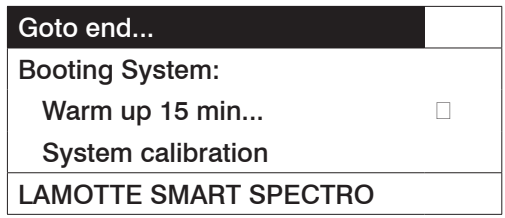
System Calibration

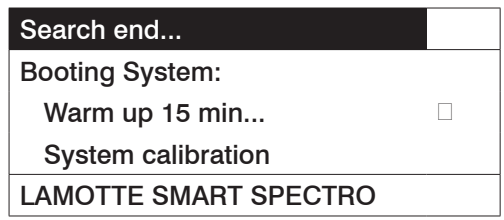
After the 15 minute warm up, choose to run a full System Calibration or not. The system calibration mode is used to establish or re-establish the accuracy of the wavelength selection process. Normally, the System Calibration procedure should be run after the spectrophotometer is turned on and allowed to warm up for 15 minutes or if operating conditions (temperature, humidity, etc.) change significantly. If previously saved data is lost the instrument will automatically run the system calibration.

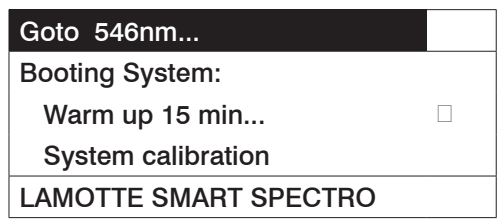
If NO is chosen, the instrument will use the previously saved calibration data and the display will move to the main menu and will be ready to use.

If YES is selected, the instrument will go through the system calibration. The display will show the system calibration process.









The system calibration is complete and the instrument is ready for use and will go to the main menu.

12:30	05/03/14
1 Programmed Tests	
2 User Defined Tests	
3 %T/Abs	
4 DNA/Protein	

GENERAL TESTING PROCEDURES

■ Programmed Tests

Introduction

The Programmed Tests mode is used to run all LaMotte Programmed Tests with LaMotte test reagent systems. This is also where Test Sequences are set up and edited.

1. Press the power switch on the back of the instrument to turn the instrument on. The **Initializing** screen will appear.	Initializing Booting System: Locating filter... System calibration... Please select : NO
2. Press **ENTER** to select **No**. The main menu screen will appear.	12 : 00 05/03/14 1 Programmed Tests 2 User Defined Tests 3 %T/Abs 4 DNA/Protein
3. Scroll to Programmed Tests.	12 : 00 05/03/14 1 Programmed Tests 2 User Defined Tests 3 %T/Abs 4 DNA/Protein

4. Press **ENTER** to select Programmed Tests. In the Programmed Tests menu there are three alterable sequences and one All Tests fixed sequence.	Programmed 1 Sequence 1 2 Sequence 2 3 Sequence 3 4 All Tests

Testing With LaMotte Programmed Tests

The following is a step by step example of how to run a test from the Programmed Tests/All Tests menu. These test procedures are designed to be used with LaMotte Spectrophotometer reagent systems.

1.	Initializing 15 : 00 Booting System: Locating filter ... Warmup 15 min... LAMOTTE SMART SPECTRO

2. Turn spectrophotometer **ON**. Allow instrument to warm up for 15 minutes. Or press **ESC** to skip warm up.	Initializing Booting System: Warm up 15 min... System calibration... Please select : NO

3. Press **ENTER** to select **No** and skip the system calibration. Or press ^ and press **ENTER** to select **YES** and begin the system calibration.	12 : 00 05/03/14 1 Programmed Tests 2 User Defined Tests 3 %T/Abs 4 DNA/Protein

4. Press **ENTER** to select Programmed Tests.	Programmed 1 Sequence 1 2 Sequence 2 3 Sequence 3 4 All Tests

5. Scroll to and press **ENTER** to select All Tests.	All Tests **1 Alkalinity-UDV** 2 Aluminum 3 Ammonia-N LF Press “Enter” to Run

6. Scroll to the desired test. The spectrophotometer is ready to scan the blank. The proper wavelength has been selected.	All Tests 13 Ca & Mg Hard-UDV 14 Carbohydrazide **15 Chlorine** Press “Enter” to Run

7. Insert the blank. Press **ENTER** to scan the blank. Wait for the instrument to blank. The blank has been stored.	Chlorine		515nm
	0.000A		99.9%T
	No.	Abs	ppm

8. Insert the reacted sample. Press **ENTER** to scan the sample. The result will be displayed.	Chlorine		515nm
	0.209		
	No.	Abs	ppm
	*01	0.212	0.309

9. Press **PRINT** to print the result when connected to a printer. Turn the spectrophotometer **OFF**. Or insert another sample into chamber, close lid, press **ENTER** to scan another sample. Or press **ESCAPE** to exit to a previous menu or make another menu selection.	

Quick Start

1. Press the power switch on the back of the instrument to turn the instrument on. The **Initializing** screen will appear.	Initializing 15 : 00 Booting System: Locating filter ... Warmup 15 min... LAMOTTE SMART SPECTRO

2. Press **ENTER** to select Programmed Tests.	Programmed 1 Sequence 1 2 Sequence 2 3 Sequence 3 4 All Tests

3. Scroll to and press **ENTER** to select All Tests.	All Tests 1 Alkalinity-UDV 2 Aluminum 3 Ammonia-N LF Press “Enter” to Run

4. Scroll to the desired test. The spectrophotometer is ready to scan the blank. The proper wavelength has been selected.	All Tests 13 Ca & Mg Hard-UDV 14 Carbohydrazide 15 Chlorine Press “Enter” to Run

5. Insert the blank. Press **ENTER** to scan the blank. Wait for the instrument to blank. The blank has been stored.	Chlorine		515nm
	0.000A		99.9%T
	No.	Abs	ppm

6. Insert the reacted sample. Press **ENTER** to scan the sample. The result will be displayed.	**Chlorine**		**515nm**
	0.209		
	No.	**Abs**	**ppm**
	***01**	**0.212**	**0.309**

7. Press **PRINT** to print. Insert another sample and press **ENTER**. Press **ESCAPE** to exit. Or turn spectrophotometer **OFF**.	

Sequences of Tests

All Tests is a fixed sequence containing the LaMotte Programmed Tests.

Any of the lamotte programmed tests may be placed in these sequences in whatever testing order that is preferred. Some examples of typical sequences are given below.

Modification of the alterable sequence is accomplished with the **LOAD** and **CLEAR/DEL** buttons. Pressing **EXIT** while in a sequence menu will escape back to the **Programmed Tests** menu. Pressing the power button at any time will turn the spectrophotometer off.

SEQUENCE 1
60 Molybdenum LR
79 Phosphate
9 Bromine LR
76 pH TB
15 Chlorine
86 Silica HI
45 Hydrazine
32 Copper DDC
51 Iron Bipyr

SEQUENCE 2
1 Aluminum
35 Cyanide
41 Fluoride
53 Iron Phen
55 Manganese L
64 Nitrate N LR
26 COD Low
77 Phenols
78 Phosphate L
90 Sulfide LR

SEQUENCE 3
3 Ammonia-N L F
32 Copper DDC
64 Nitrate-N LR
67 Nitrite-N LR
74 pH CPR
78 Phosphate L
85 Silica Lo

Setup and Edit Sequences

The three test sequences (**Sequence 1, Sequence 2**, and **Sequence 3**) can be edited. This allows a sequence or test that is used frequently to be set up for easy access. The order of the sequence can be arranged to suit the needs of the user. Any combination, and order of tests from **All Tests** may be placed into these sequences. **User Defined Tests** cannot be added to these sequences but are saved in a separate **Favorite Tests** sequence

1. Scroll to and select **Programmed Tests**.	Programmed 1 Sequence 1 2 Sequence 2 3 Sequence 3 4 All Tests

2. Scroll to and select **All Tests**.	All Tests 1 Alkalinity-UDV 2 Aluminum 3 Ammonia-N LF Press “Enter” to Run

3. Scroll to the desired test.	All Tests 2 Aluminum 3 Ammonia-N LF 3 Ammonia-N LS Press “Enter” to Run

4. Press **LOAD**.	Programmed 1 Sequence 1 2 Sequence 2 3 Sequence 3 Press “ENTER” to Run

5. Scroll to the sequence where the test will be loaded (**Sequence 1**, **Sequence 2**, or **Sequence 3**). Press **ENTER**.	Programmed 1 Sequence 1 2 Sequence 2 3 Sequence 3 Press “Enter” to Load

6. Press **ENTER**. The test will be loaded to the test sequence. The **All Tests** menu will be diplayed.	All Tests 1 Alkalinity-UDV 2 Aluminum 3 Ammonia-N LF Press “Enter” to Run

7. To remove a test from a sequence, highlight the test and press **CLEAR/DEL**. Scroll to **YES**.	Sequence 1 4 Ammonia-N LS 2 Aluminum 1 Alkalinity-UDV Are you sure : YES

8. Press **ENTER** to confirm. The test will be removed from the sequence.	Sequence 1 4 Ammonia-N LS 1 Alkalinity-UDV Press “Enter” to Run

■ User Defined Tests

A curve for an undefined test method must be defined and established before quantitative tests can be run. The instrument has an open platform that allows custom curves to be established. The established curves will be saved as defined tests in the User Defined Test list.

Quantitative
1 Create New Curve
2 Edit Curve
3 Delete Curve
4 Load Curve

This instrument allows the user to:

- Create new curves by standard solution or coefficient
- Edit predefined and saved curves
- Delete predefined and saved curves
- Load predefined and saved curves
- Add predefined and saved curves to the favorite test folder for easy and fast access

A standard curve can be established by using known Standards solution or using a known coefficient.

Create a New Curve – By Standard Solution

1. Press the power switch on the back of the instrument to turn the instrument on. The **Initializing** screen will appear.	Initializing 15 : 00 Booting System: Locating filter ... Warmup 15 min... LAMOTTE SMART SPECTRO

2. Press **ENTER** to select **No**.	Initializing Booting System: Locating filter... System calibration... Please select : NO

3. The main menu screen will appear.	12 : 00 05/03/14 1 Programmed Tests 2 User Defined Tests 3 %T/Abs 4 DNA/Protein

4. Scroll to **User Defined Tests**.	12 : 00 05/03/14 1 Programmed Tests 2 User Defined Tests 3 %T/Abs 4 DNA/Protein

5. Press **ENTER** to select User Defined Tests. The Quantitative menu will be displayed.	Quantitative 1 Create New Curve 2 Edit Curve 3 Delete Curve 4 Load Curve

6. Press **ENTER** to select **(1)**. Create New Curve.	Create Curve **1 By Standards** 2 By Coefficient

7. Use ^ and v to select **(1) By Standards**. Press **ENTER** to confirm the selection.	Standard **1 Unit** 2 WL 3 Curve Select Unit : **ppm**

8. **Select the Units** 1 Unit is highlighted. Use ^ and v to scroll through the unit list (ppm, ppb, ng/ul, ng/ml, g/l, mg/l, %). Press **ENTER** to confirm the unit selection.	Standard 1 Unit ppm **2 WL** 3 Curve Enter WL : 515_

9. **Select the Wavelength** Use **(0)** to **(9)** numerical keys to enter the desired wavelength (i.e. 500 nm). Press **ENTER** to confirm the wavelength selection.	Standard 1 Unit ppm 2 WL **3 Curve** Curve Mode : **Linear**

10. **Select the Curve Type** There are two kinds of curves; Linear or Linear through zero. Press ^ and v to choose, Press **ENTER** to confirm the curve selection.	Standard 2 WL 500nm 2 Curve Linear **4 No of Stds** Enter number (2-8) : 2_

11. **Select the Number of Standards** Enter how many standards will be used to establish the curve. A minimum of two standards is required. Up to a maximum of eight standards can be used. Use the numerical keys to enter the number of standards. Press **ENTER** to confirm the selection.	Standard 3 Curve Linear 4 No of Stds 2 5 Repeat Times Enter number (1-3) : 3_

12. **Select the Number of Repetitions** Up to 3 standard solutions of the same concentration standard can be measured. The average will be used for the final calculation. Use the numerical key to enter the desired repeat times of measurement for each standard concentration. Insert the blank reference first before pressing **ENTER**. Press **ENTER**.	Goto 500nm 546nm

13. **Scan the Reference Blank** Insert the blank reference. Press **ENTER** to blank.	Blanking... 546nm

14. **Measure the Standards** After the parameters are set up and the reference is blanked the instrument will automatically proceed to measure the standards. In this example: 1) Two standards 2) Three repetitions for each standard concentration.	Std#1 500nm Input Conc. 1=

Follow the step by step instruction on the display to measure the standard samples.

• Enter the concentration value of the first sample solution of the first standard.(i.e. 0.05). Press **ENTER** to confirm. The concentration value will be displayed on the screen.	Std#1	500nm
	Input Conc. 1=0.05	

• Insert the first sample of the first standard into the cuvette holder in the optical path.	Std#1	500nm
	1 0.050	
	Insert 1-1 Enter	

• Press **ENTER** to measure it. The measured absorbance value will be displayed. • Enter the concentration value of the second sample of the first standard. Insert that solution into the cuvette holder in the optical path. Press **ENTER** to measure it.	Std#1	500nm
	1 0.050	0.918
	2 0.050	
	Insert 1-2 Enter	

• Repeat the same procedures for the third sample of the first standard.	Std#1	500nm
	1 0.050	0.918
	2 0.050	0.680
	3 0.050	
	Insert 1-3 Enter	

	Std#1		500nm
	1 0.050		0.918
	2 0.050		0.680
	3 0.050		0.495
	Confirm?	Y	

After the last sample of the first standard is measured the display will show **Confirm? Y** with Y highlighted. Review and press **ENTER** to confirm the measurements.

Follow the instructions on the display to measure the rest of the standards.

Note: To measure the first standard again if an error occurs, use ^ and v to switch to Confirm? N. Press **ENTER** to repeat the measurements.

Std#2	500nm
Input Conc. 2=0.052	

Std#2	500nm
1 0.052	
Insert 2-1 Enter	

Std#2	500nm
1 0.052	0.918
2 0.052	
Insert 2-2 Enter	

Std#2	500nm
1 0.052	0.918
2 0.052	0.680
3 0.052	
Insert 2-3 Enter	

After the last standard sample solution has been measured the display will show **Confirm? Y**. To continue to processing the data. Select **Y**.

Std#2	500nm
1 0.052	0.918
2 0.052	0.680
3 0.052	0.495
Confirm to Continue?	Yes

15. **Save the Curve** The display will show **Confirm to Save? Yes**. Press **ENTER** to save the curve in the memory for future use.	Std#2	500nm
	1 0.052	0.918
	2 0.052	0.680
	3 0.052	0.495
	Confirm to Save?	Yes

If **Confirm to Save? No** is selected and confirmed,the curve will not be saved and the curve will be displayed on the screen. Use to switch the display between the curve and the equation. Press **ENTER** to start the sample test. (The curve will be used for one-time test only.)

The newly established curve can be saved:

1) In sequence in the first available slot after the last saved curve on the list

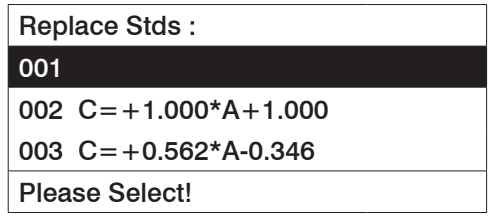
2) to replace a standard curve

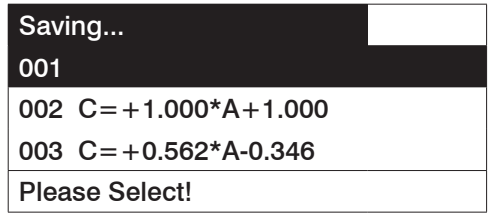
3) to the previously deleted curve slot that is open

The established curve is saved by default to the next available slot in the numerical sequence unless another slot is chosen.

16. When **Yes** is selected the slot after the last saved curve will be highlighted. Press **ENTER** to save in that slot. (Take note of the sequence number of the saved curve). To save the curve in any other open slot or to replace an existing saved curve, use ^ and v to highlight the open slot or saved curve. Press **ENTER** to save.	Saving	500nm
	1 0.052	0.918
	2 0.052	0.680
	3 0.052	0.495

Up to 200 curves can be saved. The 201 curve will replace the 001 curve and be saved in the 001 slot. To choose a slot other than 001 for the new curve, use ^ and v to choose another slot.



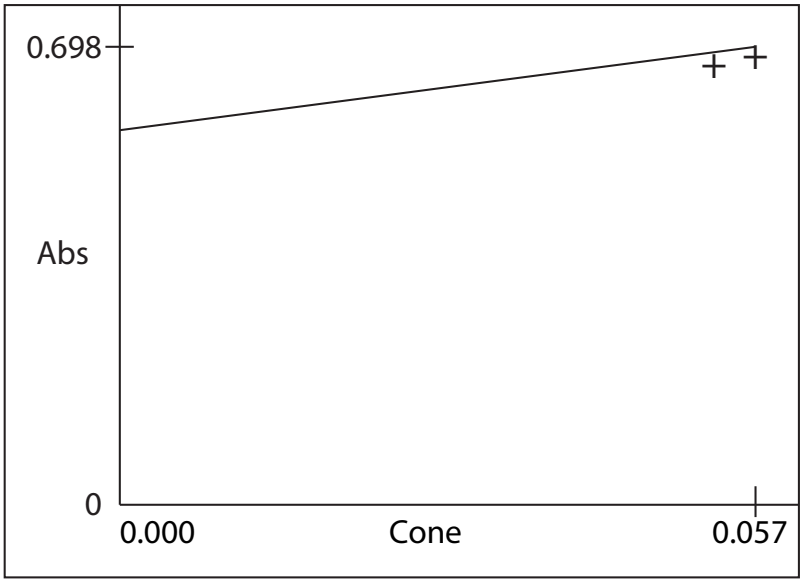


17. **Replace a Previously Saved Curve**

To save the new curve in another open slot or to replace an existing previously saved curve, use the ^ and v to highlight the open slot or saved curve, press **ENTER** to save.

18. **Display the Curve and Equation**

The standard curve will be displayed regardless of the choice to save or not save the curve. Use ^ and v to switch the display between the curve and the equation. If the curve has not been saved before, it can be saved now by pressing the **SAVE** button.



001	500nm
Conc=K*Abs+B	
K=+0.562	
B+=-0.341	
r=0.990	

19. Press **ENTER** to start to test unknown samples.

(Go to page 38)

Create a New Curve – By Coefficient

1. Press the power switch on the back of the instrument to turn the instrument on. The **Initializing** screen will appear.	Initializing 15 : 00 Booting System: Locating filter ... Warmup 15 min... LAMOTTE SMART SPECTRO

2. Press **ENTER** to select **No**.	Initializing Booting System: Locating filter... System calibration... Please select : NO

3. The main menu screen will appear.	12 : 00 05/03/14 1 Programmed Tests 2 User Defined Tests 3 %T/Abs 4 DNA/Protein

4. Scroll to **User Defined Tests**.	12 : 00 05/03/14 1 Programmed Tests 2 User Defined Tests 3 %T/Abs 4 DNA/Protein

5. Press **ENTER** to select User Defined Tests. The Quantitative menu will be displayed.	Quantitative 1 Create New Curve 2 Edit Curve 3 Delete Curve 4 Load Curve

6. Press **ENTER** to select **(1)**. Create New Curve.	Create Curve 1 By Standards 2 By Coefficient

7. Use ^ and v to highlight **2 By Coefficient**. Press **ENTER** to confirm the selection.	Coefficient 1 Unit 2 WL 3 Coef. K= Select Unit : ppm

8. **Select the Units** Use ^ and v to scroll through the unit list (ppm, ppb, ng/ul, ng/ml, g/l, mg/l, %). Press **ENTER** to confirm the unit selection.	Coefficient 1 Unit 2 WL 3 Coef. K= Input WL : 546

9. **Select the Wavelength** Use (0)~(9)numerical keys to enter the desired wavelength (i.e. 500 nm). Press **ENTER** to confirm the wavelength selection.	Coefficient 1 Unit 2 WL 3 Coef. K= Input K : 0.000

10. **Enter the Slope K Value of the Standard Curve**	Coefficient 1 Unit ppm 2 WL 500nm 3 Coef. K= Input K= 0.05_

Press **ENTER**.

11. **Enter the Intercept B Value**	Coefficient
	2 WL 500nm
	3 Coef. K=0.050
	3 Coef. B=
	Input B= 0.1_

Press **ENTER**.

12. **Save the Curve** The display will show **Confirm to Save? Yes**. Press **ENTER** to save the curve in the memory for future use.	Coefficient
	2 WL
	3 Coef. K=0.050
	3 Coef. B=0.100
	Confirm to Save : YES

13. When **Yes** is selected the slot after the last saved curve will be highlighted. Press **ENTER** to save in that slot. (Take note of the sequence number of the saved curve). To save the curve in any other open slot or to replace an existing saved curve, use ^ and v to highlight the open slot or saved curve. Press **ENTER** to save.	Saving 500nm
	1 0.052 0.918
	2 0.052 0.680
	3 0.052 0.495

Up to 200 curves can be saved. The 201 curve will replace the 001 curve and be saved in the 001 slot. To choose a slot other than 001 for the new curve, use ^ and v to choose another slot.

Replace Stds :
001
002 C=+1.000*A+1.000
003 C=+0.562*A-0.346
Please Select!

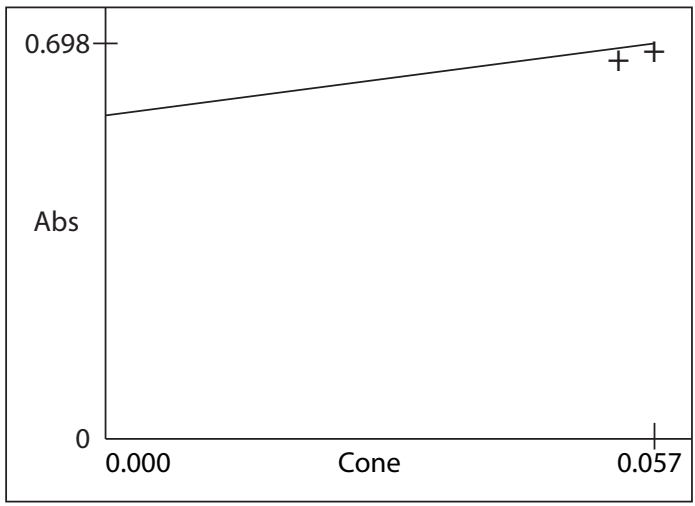
Saving...
001
002 C=+1.000*A+1.000
003 C=+0.562*A-0.346
Please Select!

14. **Replace a Previously Saved Curve**

To save the new curve in another open slot or to replace an existing previously saved curve, use the ^ and v to highlight the open slot or saved curve, press **ENTER** to save.

15. **Display the Curve and Equation**

The standard curve will be displayed regardless of the choice to save or not save the curve. Use ^ and v to switch the display between the curve and the equation. If the curve has not been saved before, it can be saved now by pressing the **SAVE** button.



001	500nm
Conc=K*Abs+B	
K=+0.562	
B+=-0.341	
r=0.990	

16. Press **ENTER** to start to test unknown samples.

(Go to page 38).

Edit Curve

At the Quantitative menu...	Quantitative
	1 Create New Curve
	2 Edit Curve
	3 Delete Curve
	4 Load Curve

1. Use ^ and v to highlight **2 Edit Curve**. Press **ENTER** to confirm the selection.	Edit Curve
	001 C=+0.562*A-0.341
	002 C=+0.050*A+0.100
	Please Select!

1. Use ^ and v to highlight **2 Edit Curve**. Press **ENTER** to confirm Press **ENTER** and **Edit Unit**, Wavelength and any other parameter setting. Then run the standards measurement with the new standards solutions to re-establish the curve. The newly established curve will replace the previously saved curve.	

Note: Press **ESC** to cancel editing before measuring the new standards.

Delete Curve

At the Quantitative menu...	Quantitative 1 Create New Curve 2 Edit Curve 3 Delete Curve 4 Load Curve

1. Use ^ and v to highlight **3 Delete Curve**. Press **ENTER** to confirm the selection.	Delete Curve 001 C=+0.562*A-0.341 002 C=+0.050*A+0.100 Please Select!

2. Use ^ and v to highlight the curve to be deleted. Press **ENTER** to confirm your selection.	Delete Curve 001 C=+0.562*A-0.341 002 C=+0.050*A+0.100 Please Select!

3. The default setting to confirm the selection is No. Use ^ and v to switch to Yes and press **ENTER** to confirm to continue the deleting process. Press **ESC** to cancel delete and return to the previous screen.	**Delete Curve** **001 C=+0.562*A-0.341** **002 C=+0.050*A+0.100** **Deleting Curve?? NO**

Note: Press **ESC** to cancel editing before measuring the new standards.

4. To avoid possible an accidental deletion, **Are you sure: NO** is displayed. Press **ESC** to stop the deleting process.	**Delete Curve** **001 C=+0.562*A-0.341** **002 C=+0.050*A+0.100** **Are you sure : NO**

5. To delete the curve, switch to Yes using ^ and v button. Press **ENTER** to permanently remove the curve from the memory.	**Delete Curve** **001 C=+0.562*A-0.341** **002 C=+0.050*A+0.100**

Now the sequence slot is open.	**Delete Curve** **001** **002 C=+0.050*A+0.100** **Please Select!**

Load Curve to Run

At the Quantitative menu...	Quantitative **1 Create New Curve** 2 Edit Curve 3 Delete Curve 4 Load Curve

1. Use ^ and v to highlight **4 Load Curve**. Press **ENTER** to go to the Load Curve screen.	Load Curve **001 C=+0.562*A-0.341** 002 C=+0.050*A+0.100 Press “Enter” to Run

2. Press **ENTER** to load the highlighted curve and run the test.	Loading... **001 C=+0.562*A-0.341** 002 C=+0.050*A+0.100 Press “Enter” to Run

Load Curve to Favorite Tests

Favorite Tests is designed for easy access to the most frequently used curves.

At the Quantitative menu...	Quantitative **1 Create New Curve** 2 Edit Curve 3 Delete Curve 4 Load Curve

1. Use ^ and v to highlight **4 Load Curve**. Press **ENTER** to get into the Load Curve screen.	Load Curve **001 C=+0.562*A-0.341** 002 C=+0.050*A+0.100 Press “Enter” to Run

2. Use ^ and v to highlight the curve. Press **LOAD** to load the curve to **Favorite Tests**.	Loaded!! 001 C=+0.562*A-0.341 002 C=+0.050*A+0.100 Press “Enter” to Run

Note: The curve will also be kept in the general saved curve list.

Favorite Tests

Favorite Tests is alterable sequence that allows a series of User Defined Tests that are run frequently to be set up. The curves may be placed in the sequence in whatever testing order is preferred. Programmed Tests cannot be added to this sequence but are saved in separate sequences (Sequence 1, Sequence 2, and Sequence 3) in the Programmed Tests menu.

1. Press the power switch on the back of the instrument to turn the instrument on. The **Initializing** screen will appear.	Initializing 15 : 00 Booting System: Locating filter ... Warmup 15 min... LAMOTTE SMART SPECTRO

2. Press **ENTER** to select **No**.	Initializing Booting System: Locating filter... System calibration... Please select : NO

3. The main menu screen will appear.	12 : 00 05/03/14 1 Programmed Tests 2 User Defined Tests 3 %T/Abs 4 DNA/Protein

4. Scroll to **User Defined Tests**.	12 : 00 05/03/14 1 Programmed Tests 2 User Defined Tests 3 %T/Abs 4 DNA/Protein

5. At the Quantitative menu ,use ^ and v to highlight **5 Favorite Tests**.	Quantitative 2 Edit Curve 3 Delete Curve 4 Load Curve 5 Favorite Tests

6. Press ENTER to confirm the selection.	Favorite Tests 001 C=+0.562*A-0.341 002 C=+0.050*A+0.100 Press “Enter” to Run

7. Select the desired curve in the favorite tests list and press **ENTER** to run test.	

8. To remove a curve from the Favorite Tests folder highlight the curve and press **CLEAR/DEL**. Then reconfirm the selection to remove the curve.	Favorite Tests 001 C=+0.562*A-0.341 002 C=+0.050*A+0.100 Are you sure : NO

	Removing... 001 C=+0.562*A-0.341 002 C=+0.050*A+0.100

	Favorite Tests 002 C=+0.050*A+0.100 Press “Enter” to Run

■ Run a Test Using a Standard Curve

Follow the instruction described in the previous section in this manual to load the standard curve.

1. Place a blank reference in the optical path. Press 0A/100%T to blank.

+0.562*A-0.341		500nm
Blanking...		
No.	ABS	ppm

2. Place a sample in the optical path and press ENTER to measure. The Absorbance and Transmittance value of the current sample will be displayed. The concentration value and the Absorbance value of the sample will be logged into the table.

+0.562*A-0.341		500nm
0.*19A 12.0%T		
No.	ABS	ppm
* 01	0.919	0.175

3. Repeat the above procedure to measure the other samples.

+0.562*A-0.341		500nm
0.*680 20.8%T		
No.	ABS	ppm
01	0.919	0.175
*02	0.680	0.041

4. To delete a test result in the table, move ***** to highlight the test result and press **CLEAR**/**DEL** to delete it.
5. Press **PRINT** to print the test results.

■ %T/Absorbance

1. Press the power switch on the back of the instrument to turn the instrument on. The **Initializing** screen will appear.	Initializing 15 : 00 Booting System: Locating filter ... Warmup 15 min... LAMOTTE SMART SPECTRO

2. Press **ENTER** to select **No**.	Initializing Booting System: Locating filter... System calibration... Please select : NO

3. The main menu screen will appear.	12 : 00 05/03/14 1 Programmed Tests 2 User Defined Tests 3 %T/Abs 4 DNA/Protein

4. Scroll to **%T/Abs**.	12 : 00 05/03/14 1 Programmed Tests 2 User defined tests 3 %T/Abs 4 DNA/Protein

5. Press ENTER to select **%T/Abs**. The display will show the current wavelength setting.	%T/Abs 546nm *0.000A* *100.0%T*

6. Press **SET** λ to reset the wavelength. Enter the desired wavelength.	**%T/Abs** **546nm** *0.000A* *100.0%T* **Enter WL : 500_**

7. Press **ENTER** to confirm the wavelength. The instrument will go from the previous wavelength (546 nm) to the desired wavelength (500 nm).	**%T/Abs** **500nm** *0.000A* *100.0%T*

Note: At this point, the instrument must be blanked before measuring a sample.

8. Fill a clean cuvette or tube with distilled or deionized water or other specified solvent. This is the Blank. Wipe the cuvette with a lint-free wipe to remove fingerprints and droplets of liquid.

9. Place the Blank in chamber. Close the lid.

10. Press **0A/100%T** to set 0.000A or 100%T. The instrument will set the blank. Note: If "Energy low!" is displayed the reference may be too dark or the light beam energy from the lamp is too weak.	**%T/Abs** **500nm** *Blanking*

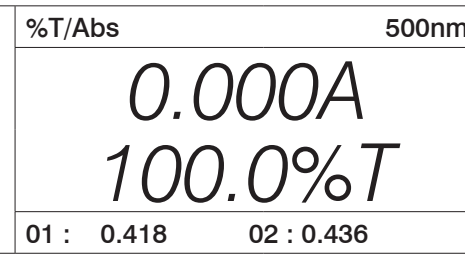
11. Remove the Blank.

12. Rinse a cuvette or tube with a small amount of sample solution. Fill the cuvette or tube with the sample. Wipe to remove fingerprints or moisture.

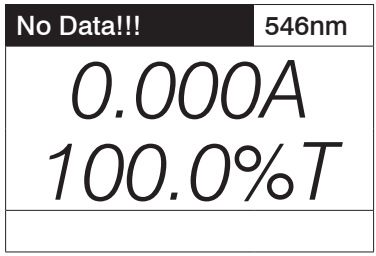
13. Put the Sample in the chamber. Close the lid.

14. The Sample test result will be displayed.

15. Press **ENTER** to confirm and log the result. Up to 20 test results can be logged. When the 21st test result is confirmed the first test result will be automatically removed from the list.



Note: Press **CLEAR/DEL** to delete the test result displayed on the right. If no test result is logged on the bottom line, the display will show that **No Data!!!** is available to be deleted.



To print the result press **PRINT**.

■ DNA/Protein

There are three methods to choose for DNA Ratio, RNA ratio and concentrations of RNA, dsDNA, ssDNA and olig. Follow step by step instructions on the display to run the tests.

■ Clock Setup

1. At the main menu select “System Setup”. Choose “Clock Setup” and press **ENTER** to confirm.	System Setup 546nm 1 Clock Setup 2 Dark Current 3 Lamp Service 4 WL Calibration

Set Time

1. Highlight **Set Time**.	Clock Setup 546nm 1 Set Time 12 : 31 : 21 2 Set Date 31-03-11

2. Enter the time in the order of hour, minute and second. For example 19:30:00 stands for 7:30 pm.	Clock Setup 546nm 1 Set Time 12 : 31 : 21 2 Set Date 31-03-11 HH. MM. SS :

Set Date

1. Enter the date in the order of day (DD), month (MM) and year (YY). For example, 31-03-17 stands for March 31, 2014.	Clock Setup 546nm 1 Set Time 12 : 31 : 21 2 Set Date 31-03-17 DD. MM. YY :

■ Dark Current

1. At System Setup select Dark Current to check and refresh the system dark current. The circled value is the live dark current value at 0-gain which should not be zero or negative.	**Dark current** **546nm** **00023 00047 00091** **00180 00362 00720** **01460 02913 00023** **"Enter" to Refresh!**

2. Press **ENTER** to refresh the dark current: Press **PRINT** to view the energy counts at different gain-setting (from 0 to 7).	**Energy** **546nm** **10268** **Set ADM M=0...7**

■ Lamp Service

1. At **System Setup** choose **Lamp Service** to switch the deuterium lamp off when it is not being used to prolong the life of the lamp. Choose **Switch Point** to select the wavelength where the instrument will switch between the Tungsten Halogen lamp and the deuterium lamp.	**Lamp Service** **500nm** **1 Switch D2 : ON** **2 Switch Point**

■ WL Calibration

1. At System Setup select WL Calibration to recalibrate the system and the wavelength.	**Calibration λ** **546nm** **Calibration λ ...???** **Are you sure :** **Yes**

Press **ESC** to return to System Setup without recalibrating the wavelength.

2. Press **ENTER** to select Yes and recalibrate the wavelength. a) Recheck Dark Current	**Dark current** **546nm** Calibration λ ....

b) Move back to initial position.	**Goto end ...** **546nm** Calibration λ ....

c) Search the "0" order light for re-positioning.	**WL...** **546nm** Calibration λ ....

d) Finish wavelength calibration and move to 546nm.	**Goto 546nm** **546nm** Calibration λ ....

■ WL Correction

The wavelength is pre-calibrated and can be recalibrated using the Wavelength Calibration function. If for any reason the wavelength accuracy is off, it can be adjusted by resetting it using the wavelength correction function in the system setup.

1. Choose WL Correction in the System Setup menu. Use ^ and v to select the correction value. Press **ENTER** to confirm the adjustment. The correction range is +8 nm to -7 nm.	**Correction λ** **546nm** **Adjust value :** **+2nm**

■ Firmware Version

1. The firmware version can be confirmed from the System Setup.	**LaMotte** **Model : UV2150** **Software : KL.5.1.12** **Hdwe : U926.42.02.10A**

■ Wavelength Calibration

Under normal conditions the LaMotte UV/VIS Spectrophotometer will retain the wavelength calibration indefinitely. However if the instrument receives a severe shock or is abused, use the following methods to check the wavelength calibration. The procedure requires a didymium wavelength calibration standard, or a holmium oxide wavelength calibration standard.

A didymium wavelength calibration standard has two distinct absorbance peaks at 529 nm and 807 nm. A holmium oxide wavelength calibration standard has a distinct peak at 361 nm. When the instrument is calibrated properly the minimum Transmittance (or maximum Absorbance) should be +2 nm from the target peak values. Note that the specific Transmittance values are not important - only the wavelength where the minimum transmittance (maximum Absorbance) occurs.

Holmium Oxide Wavelength Calibration Standard Method

1. Turn the instrument on and allow it to warm up for 15 minutes.
2. Select %T/Abs.
3. Set the wavelength to 350 nm.
4. Make sure the cuvette holder in the sample compartment is empty. Close the sample compartment lid.
5. Set the Absorbance to zero by pressing 0A/100%T. The reading should be 0.000A. If not, press 0A/100%T again.

6. Place the holmium oxide wavelength calibration standard in the sample compartment and close the lid.
7. Record the Absorbance reading from the display.
8. Advance the wavelength setting by 1 nm and repeat steps 2 to 5.
9. Repeat step 8 until the wavelength setting reaches 370nm.
10. The maximum absorbance reading should be between 359 nm and 363nm.

Didymium Wavelength Calibration Standard Method

1. Turn the instrument on and allow it to warm up for 15 minutes.
2. Select %T/Abs.
3. Set the Wavelength to 800 nm.
4. Make sure the cuvette holder in the sample compartment is empty. Close the sample compartment lid.
5. Set the Absorbance to zero by pressing 0A/100%T. The reading should be 0.000A. If not, press 0A/100%T again.
6. Place the didymium wavelength calibration standard in the sample compartment and close the lid.
7. Record the Absorbance reading from the display.
8. Advance the wavelength setting by 1nm and repeat steps 2 to 5.
9. Repeat step 8 until the wavelength setting reaches 815 nm.
10. The maximum absorbance reading should be between 805 nm and 809 nm.
11. To check a wavelength in the middle range of the instrument, set the wavelength to 522 nm.
12. Make sure the cuvette holder in the sample compartment is empty. Close the sample compartment lid.
13. Set the Absorbance to zero by pressing 0A/100%T. The reading should be 0.000A. If not, press 0A/100%T again.
14. Place the didymium wavelength calibration standard in the sample compartment and close the lid.
15. Record the absorbance reading from the display.
16. Advance the wavelength setting by 1nm and repeat steps 10 to 13.
17. Repeat step 14 until the wavelength setting reaches 536 nm. The maximum absorbance reading should be between 527 nm and 531 nm.

Absorbance Accuracy Checks

Specification: +0.004A at 0.5A

The absorbance accuracy should be checked against a set of neutral density filters accurately calibrated to the NIST standards.

An alternative method using potassium dichromate is described below. Due to the many factors that might affect the results (i.e. temperature, band pass, weighing and diluting errors), this method is less accurate and should only be used as a guide.

Reference: Johnson E
Potassium Dichromate as an absorbance standard
PSG Bulletin 1967, No. 17, page 505

1. Use N/100 sulfuric acid as the solvent and then prepare a solution containing 120 +0.5 mg/L of potassium dichromate.
2. Wash out a square cuvette with solvent, and fill with solvent.
3. Put the cuvette into the sample compartment and close the lid.
4. Select %T/Abs. Set the wavelength to 350 nm.
5. Press OA/100%T to set the reading to 0.000A.
6. Empty the cuvette. Rinse the cuvette with the dichromate solution. Fill the cuvette with the dichromate solution.
7. Put the cuvette into the sample compartment and close the lid.
8. Read the absorbance of the standard from the display. The value should be Calibrated Value + 0.004A. Refer to the notes above when interpreting the result.

Note: It is recommended that the Dark Current be refreshed before performing the check.

Stray Light Check

Specification: Less than 0.3%T at 340nm by ASTM E 387

A good indication as to whether the stray light level is within specification may be obtained as follows:

1. Set the wavelength to 340nm.
2. Select %T/Abs with the sample compartment empty, close the lid and press the 0A/100%T key to set the display to 100.0%.
3. Prepare a solution containing 50 gm/L of sodium nitrite ($NaNO_2$) in distilled water and fill a square cuvette with this solution.
4. Place the cuvette in the sample compartment. Close the lid. The display should read <0.3%T.

Note: It is recommended that you refresh the Dark Current before performing the check.

■ Connect to K3 Analyst

The optional Software (Code 7-2000-UV-CD) performs the following methods for analysis:

- Absorbance/%Transmittance/Concentration at single or multi wavelengths: measure the Absorbance, %Transmittance, Concentration/Standard, or Concentration/Factor at a single wavelength or multi wavelengths within the range of 200~1000 nm
- Standard Curve: create a calibration curve with up to 8 standard solutions at a single wavelength to determine concentrations of unknown samples.
- Kinetics (Absorbance vs. Time Kinetics): measure a sample's absorbance change over a selected period of time, store the test results in data table, and display the results graphically.
- Scanning (Absorbance/Transmittance vs. Wavelength): permit the operator to scan at any wavelength range featuring zoom and peak/valley pick.

Requirements: Win XP or Win 7 operating system, 1GB RAM (1 GHz Pentium processer or better), 500 MB of free space on memory, monitor, mouse, and keyboard

Troubleshooting

■ Trouble Shooting Guide

Problem	Possible	Solution
Instrument inoperative	Power cord not connected to outlet	Plug instrument in.
	Dead power outlet	Change to a different outlet
	Internal fuse blown or defective electronic component	Contact LaMotte technical service or a LaMotte distributor.
	Improper power input	Check the power supply (100V-230V)
Instrument cannot set 100%T (0.000A)	Light beam blocked	Check sample holder. See if holder is properly positioned and nothing is blocking light path.
	Lamp is misaligned	Check to see if light is focused properly on entrance slit of the monochromator. Contact LaMotte Technical Service or a LaMotte distributor.
	Lamp light is weak or lamp is defective	Replace the lamp.
	Defective electronic component	Contact LaMotte technical service or a LaMotte distributor.
Incorrect T% to Absorbance correlation	Bubbles or particles in solution	Check sample preparation and analytical procedure.
	Defective electronic component	Contact LaMotte technical service or a LaMotte distributor.

Display does not change regardless of sample concentration	Concentration reading "frozen"	Sample solution too dark, dilute solution and repeat the measurement.
	Wrong wavelength setting	Check sample procedure and wavelength setting.
	Insufficient sample volume	Fill cuvette with more sample solution.
	Stray sample preparation vapors	Prepare the sample away from the instrument. Use proper ventilation.
	Bubbles or particles in solution	Check sample preparation and analytical procedure.
	Defective electronic component or loose wiring	Contact LaMotte technical service or a LaMotte distributor.
Instrument drift and noise	Lamp not adjusted properly (misalignment)	Check lamp for proper installation. Be sure lamp has not moved during transit.
	Lamp old or defective	Replace with a new lamp.
	Defective or dirty detector or defective electronic component.	Contact LaMotte technical service or a LaMotte distributor.
Incorrect readings obtained	Insufficient sample volume	Fill cuvette with more sample solution.
	Wrong wavelength setting	Check analytical procedure and wavelength setting. Check wavelength accuracy according to procedure in this manual.
	Stray sample preparation vapors	Prepare sample away from instrument. Use proper ventilation.
	Bubbles or particles in solution	Check sample preparation and analytical procedure.
	Instrument out of electronic calibration	Contact LaMotte technical service or a LaMotte distributor.

■ Error Messages

Error messages will be displayed in the instrument detects an error. Each error message represents an error that has occured during the self calibration or during operation.

Error Message	Description	Solution
Locating lamp...X	Instrument unable to locate the lamp change-over switch	Contact LaMotte technical service or a LaMotte distributor.
Locating filter…X	Instrument unable to initialize and/or locate the secondary filter	Contact LaMotte technical service or a LaMotte distributor.
WL Zero-order!		1. Light beam alignment is off or is blocked. 2. Tungsten Halogen lamp is off or dead. 3. Filter wheel is malfunctioning and incorrect filter is brought into the optical path.
Sys energy low!	Pass system calibration and WL calibration but detects light beam energy low	Energy to the detector is low. The 0-order energy count is less than 35000. 1. Light beam alignment is off. 2. Filter wheel is malfunctioning and incorrect filter is brought into the optical path.
WL Sensor 1...X	Unable to locate the WL calibration starting point	If " WL sensor 1 …X" is shown after humming (jamming): Wavelength bar starting sensor is malfunctioning or dead and the bar may be jammed at the bar-front end. Contact LaMotte technical service or a LaMotte distributor.
	Unable to locate the WL calibration starting point	if " WL sensor 1 …X" is shown without humming and wavelength-driving motor does not work, contact LaMotte technical service or a LaMotte distributor. If wavelength-driving motor works, 1) Light beam is misaligned or blocked 2) Lamp is off/dead. Contact LaMotte technical service or a LaMotte distributor.

WL Sensor 2...X	Wavelength bar reaches the back end and triggers the back-end protection sensor	Contact LaMotte technical service or a LaMotte distributor.
System calibration...X	Unable to complete system calibration	If Wavelength-driving motor does not work, contact LaMotte technical service or a LaMotte distributor. If wavelength-driving motor works, 1) Light beam is misaligned or blocked failing to reach the detector. 2) Lamp is off/dead. Contact LaMotte technical service or a LaMotte distributor.
Energy low!!		Lamp not on or dead. 1) Light is on but light beam fails to reach detector. 2) Light may be blocked. 3) Reference is too dark. 4) Light optical path misaligned: not focused on entrance slit; or internal optics off aligned to cause light beam not out from the exit slit to sample compartment. 5) Secondary filter positioning is malfunctioning. Detector PCB malfunctioning (dark current too small or negative or the board is defective). Contact LaMotte technical service or a LaMotte distributor
Energy high!!		1. Secondary filter positioning is malfunctioning. 2. Detector PCB malfunctioning (dark current either too high or the board is defective). Contact LaMotte technical service or a LaMotte distributor.

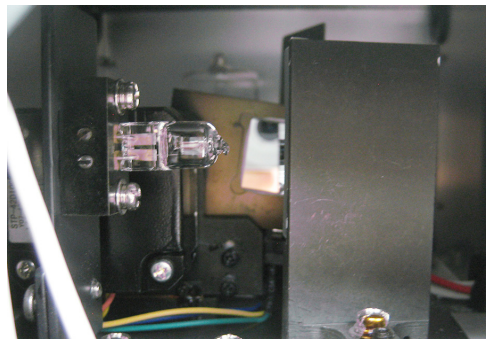
■ Performance

To ensure that the instrument is working within its specification, especially when making measurements of an important nature, carry out performance checks with particular reference to wavelength and absorbance accuracy. Performance checks are detailed in this manual.

■ Tungsten Halogen Lamp Replacement

1. Use a screwdriver to loosen the screws and remove the cover on the back of the instrument.

2. Loosen the 2 lamp-securing screws. Pull the bulb out and replace with a new lamp (12V 20W) of the same type. The filament type must be identical. Secure the new lamp with the locking screw. Tighten the screw firmly but do not over-tighten to avoid damaging or breaking the lamp.



■ Maintenance

Cleaning

Clean with a damp, lint-free cloth.

DO NOT ALLOW WATER TO ENTER THE SPECTROPHOTOMETER CHAMBER OR ANY OTHER PARTS OF THE METER.

Meter Disposal

Waste Electrical and Electronic Equipment (WEEE)

Natural resources were used in the production of this equipment. This equipment may contain materials that are hazardous to health and the environment. To avoid harm to the environment and natural resources, the use of appropriate take-back systems is recommended. The crossed out wheeled bin symbol on the meter encourages you to use these systems when disposing of this equipment.

Take-back systems will allow the materials to be reused or recycled in a way that will not harm the environment. For more information on approved collection, reuse, and recycling systems contact your local or regional waste administration or recycling service.

■ PACKAGING & DELIVERY

Experienced packaging personnel at LaMotte Company assure adequate protection against normal hazards encountered in transportation of shipments. After the product leaves the manufacturer, all responsibility for its safe delivery is assured by the transportation company. Damage claims must be filed immediately with the transportation company to receive compensation for damaged goods.

Should it be necessary to return the instrument, pack instrument carefully in suitable container with adequate packing material. A return authorization number must be obtained from LaMotte Company by calling 1-800-344-3100. Attach a letter with the authorization number to the shipping carton which describes the kind of trouble experienced. This valuable information will enable the service department to make the required repairs more efficiently.

■ LIMITS OF LIABILITY

Under no circumstances shall LaMotte Company be liable for loss of life, property, profits, or other damages incurred through the use or misuse of their products.

■ WARRANTY

LaMotte Company warrants this instrument to be free of defects in parts and workmanship for 1 year from the date of shipment. If it should become necessary to return the instrument for service during or beyond the warranty period, contact our Technical Service Department at 1-800-344-3100 or tech@lamotte.com for a return authorization number or visit www.lamotte.com for troubleshooting help. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. LaMotte Company specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. LaMotte Company's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied. Save the proof of purchase for warranty verification.

■ STATISTICAL AND TECHNICAL DEFINITIONS RELATED TO PRODUCT SPECIFICATIONS

Method Detection Limit (MDL): "The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte."[1] Note that, "As Dr. William Horwitz once stated, 'In almost all cases when dealing with a limit of detection or limit of determination, the primary purpose of determining that limit is to stay away from it.'"[2]

1.CFR 40, part 136, appendix B

2.Statistics in Analytical Chemistry: Part 7 – A Review, D. Coleman and L Vanatta, American Laboratory, Sept 2003, P. 31.

Precision: Precision is the numerical agreement between two or more measurements.[3] The precision can be reported as a range for a measurement (difference between the min and max). It can also be reported as the standard deviation or the relative standard deviation. It is a measure of how close together the measurements are, not how close they are to the correct or true value. The precision can be very good and the accuracy very bad. This is a useful measure of the performance of a test method.

3.Skoog, D.A., West, D. M., Fundamental of Analytical Chemistry, 2nd ed., Holt Rinehart and Winston, Inc, 1969, p. 26.

Accuracy: Accuracy is the nearness of a measurement to the accepted or true value.[4] The accuracy can be expressed as a range, about the true value, in which a measurement occurs (i.e. ±0.5 ppm). It can also be expressed as the % recovery of a know amount of analyte in a determination of the analyte (i.e. 103.5 %). This is a useful measure and what most customers are interested in when they want to know about the performance of a test method.

4.Skoog D.A., West D. M., Fundamental of Analytical Chemistry, 2nd ed., Holt Rinehart and Winston, Inc, 1969, p. 26.

Resolution: Resolution is the smallest discernible difference between any two measurements that can be made.5 For meters this is usually how many decimal places are displayed. (i.e. 0.01). For titrations and various comparators it is the smallest interval the device is calibrated or marked to (i.e. 1 drop = 10 ppm, 0.2 ppm for a DRT, or ±half a unit difference for an octaslide or color chart). Note that the resolution many change with concentration or range. In some cases the resolution may be less than the smallest interval, if it is possible to make a reading that falls between calibration marks. This is often done with various comparators. One caveat is, that resolution has very little relationship to accuracy or precision. The resolution will always be less than the accuracy or precision but it is not a statistical measure of how well a method of analysis works. The resolution can be very very good and the accuracy and precision can be very, very bad! This is not a useful measure of the performance of a test method.

5.Statistics in Analytical Chemistry: Part 7 – A Review, D. Coleman and L Vanatta, American Laboratory, Sept 2003, P. 34.

Sensitivity: Sensitivity is the resolution based on how this term is used in LaMotte catalogs. This term is not listed in any of the references. Sometimes it is used for detection limit. It is a confusing term and should be avoided.

Repeatability: Repeatability is the within-run precision.6 A run is a single data set, from set up to clean up. Generally, one run occurs on one day. However, for meter calibrations, a single calibration is considered a single run or data set, even though it may take 2 or 3 days.

6.Jeffery G. H., Basset J., Mendham J., Denney R. C., Vogel's Textbook of Quantitative Chemical Analysis, 5th ed., Longman Scientific & Technical, 1989, p. 130.

Reproducibility: Reproducibility is the between-run precision.7

7.Jeffery G. H., Basset J., Mendham J., Denney R. C., Vogel's Textbook of Quantitative Chemical Analysis, 5th ed., Longman Scientific & Technical, 1989, p. 130.

■ SPECIFICATIONS

INSTRUMENT TYPE: Single beam spectrophotometer

Wavelength Range	190-1100 nm
Spectral Bandpass	4 nm
Wavelength Accuracy	+2 nm
Wavelength Repeatability	+1nm
Stray Radiant Energy	<0.3 @ 220 and 340 nm
Photometric Range	0 to 125%T 0.3 to 2.5 Abs -9999 to 9999
Photometric Accuracy	+ 0.004 @ 0.5A
Display	LCD Graphic 128 x 64
Control and Data Entry	Touch Button Keypad
Data output	For RS232 printer
Power Requirements	90-240Vac, 50-60 Hz
Dimensions	550 W x 400 D x 270 H (mm)
Light Source	Tungsten Halogen/Deuterium
Weight	46 lb/21kg

■ EPA COMPLIANCE

The UV/VIS Spectrophotometer is an EPA-Accepted instrument. EPA-Accepted means that the instrument meets the requirements for instrumentation as found in test procedures that are approved for the National Primary Drinking Water Regulations (NPDWR) or National Pollutant Discharge Elimination System (NPDES) compliance monitoring programs. EPA-Accepted instruments may be used with approved test procedures without additional approval.

■ CE COMPLIANCE

The UV/VIS Spectrophotometer has been independently tested and has earned the European CE Mark of Compliance for electromagnetic compatibility and safety. To view the Declaration of Conformity go to www.lamotte.com.

■ OVERVIEW

The LaMotte UV/VIS Spectrophotometer is a single beam, general purpose instrument designed to meet the needs of the conventional laboratory, It is ideal for various applications, such as: Clinical Chemistry, Biochemistry, Petro-chemistry, Environmental Protection, Food and Beverage Labs, Water and Waste Water Labs and other fields of quality control and research.

The LaMotte UV/VIS Spectrophotometer features a digital display of the photometric result, easy operation and wavelength range of 190 nm to 1100 nm. The LaMotte UV/VIS Spectrophotometer is ideal for measurements in the ultraviolet and visible wavelength regions of the electromagnetic spectrum.

The spectrophotometer consists of five parts:

1) Tungsten Halogen and deuterium lamp to supply the light

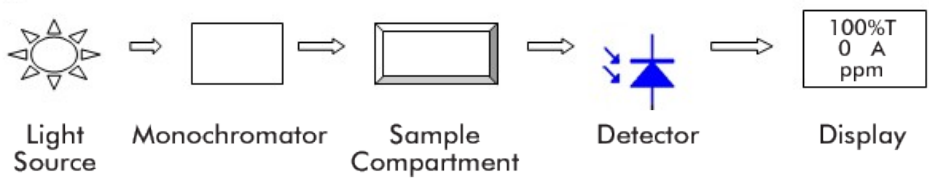
2) A monochromator to isolate the wavelength of interest and eliminate the unwanted second order radiation

3) A sample compartment to accommodate the sample solution

4) A detector to receive the transmitted light and convert it to an electrical signal

5) A digital display to indicate absorbance, transmittance, or test unit.

The block diagram below illustrates the relationship between these parts.



Light from the lamp is focused on the entrance slit of the monochromator where the collimating mirror directs the beam onto the grating. The grating disperses the light beam to produce the spectrum, a portion of which is focused on the exit slit of the monochromator by a collimating mirror. From here the beam is passed to a sample compartment through one of the filters, which helps to eliminate unwanted second order radiation from the diffraction grating. Upon leaving the sample compartment, the beam is passed to the silicon photodiode detector and causes the detector to produce an electrical signal that is displayed on the digital display.

■ WATER SAMPLING FOR CHEMICAL ANALYSIS

Taking Representative Samples

The underlying factor to be considered for any type of water sampling is whether or not the sample is truly representative of the source. To properly collect a representative sample:

- Sample as frequently as possible.
- Collect a large sample or at least enough to conduct whatever tests are necessary.
- Make a composite sample for the same sampling area.
- Handle the sample in such a way as to prevent deterioration or contamination before the analysis is performed.
- Perform analysis for dissolved gases such as dissolved oxygen, carbon dioxide, and hydrogen sulfide immediately at the site of sampling. These factors, as well as samples for pH testing, cannot be stored for later examination.
- Make a list of conditions or observations which may affect the sample. Other considerations for taking representative samples are dependent upon the source of the sample. Taking samples from surface waters involves different considerations than taking samples from impounded and sub-surface waters.

Sampling of Open Water Systems

Surface waters, such as those found in streams and rivers, are usually well mixed. The sample should be taken downstream from any tributary, industrial or sewage pollution source. For comparison purposes samples may be taken upstream and at the source of the pollution.

In ponds, lakes, and reservoirs with restricted flow, it is necessary to collect a number of samples in a cross section of the body of water, and where possible composite samples should be made to ensure representative samples.

To collect samples from surface waters, select a suitable plastic container with a tight fitting screw cap. Rinse the container several times with the sample to be tested, then immerse the container below the surface until it is filled to overflowing and replace the cap. If the sample is not to be tested immediately, pour a small part of the sample out and reseal. This will allow for any expansion. Any condition which might affect the sample should be listed.

Sub-surface sampling is required to obtain a vertical profile of streams, lakes, ponds, and reservoirs at specific depths. This type of sampling requires more sophisticated sampling equipment.

For dissolved oxygen studies, or for tests requiring small sample sizes, a Water Sampler (LaMotte Code 1060) will serve as a sub-surface or in-depth sampler. This weighted device is lowered to the sampling depth and allowed to rest at this depth for a few minutes. The water percolates into the sample chamber displacing

the air which bubbles to the surface. When the bubbles cease to rise, the device has flushed itself approximately five times and it may be raised to the surface for examination. The inner chamber of the sampling device is lifted out and portions of the water sample are carefully dispensed for subsequent chemical analysis.

A Snap-Plunger Water Sampler (LaMotte Code 1077) is another "in-depth" sampling device which is designed to collect large samples which can be used for a multitude of tests. Basically, this collection apparatus is a hollow cylinder with a spring loaded plunger attached to each end. The device is cocked above the surface of the water and lowered to the desired depth. A weighted messenger is sent down the calibrated line to trip the closing mechanism and the plungers seal the sample from mixing with intermediate layers as it is brought to the surface. A special drain outlet is provided to draw off samples for chemical analysis.

Sampling of Closed System

To obtain representative samples from confined water systems, such as pipe lines, tanks, vats, filters, water softeners, evaporators and condensers, different considerations are required because of chemical changes which occur between the inlet and outlet water. One must have a basic understanding of the type of chemical changes which occur for the type of equipment used. Also, consideration should be given to the rate of passage and retaining time for the process water.

Temperature changes play an important part in deciding exactly what test should be performed. Process water should be allowed to come to room temperature, 20–25°C, before conducting any tests.

When drawing off samples from an outlet pipe such as a tap, allow sample to run for several minutes, rinsing the container several times before taking the final sample. Avoid splashing and introduction of any contaminating material.

■ FILTRATION

When testing natural waters that contain significant turbidity due to suspended solids and algae, filtration is an option. Reagent systems, whether EPA, Standard Methods, LaMotte or any others, will generally only determine dissolved constituents. Both EPA and Standard Methods suggest filtration through a 0.45 micron filter membrane, to remove turbidity, for the determination of dissolved constituents.** To test for total constituents, organically bound and suspended or colloidal materials, a rigorous high temperature acid digestion is necessary.

**LaMotte offers a filtering apparatus: syringe assembly (Code 1050) and membrane filters, 0.45 micron, (Code 1103).

■ AN INTRODUCTION TO COLORIMETRIC ANALYSIS & SPECTROSCOPY

Most test substances in water are colorless and undetectable to the human eye. To test for their presence we must find a way to "see" them. The LaMotte UV/VIS Spectrophotometer can be used to measure any test substance that is itself colored or can be reacted to produce a color. In fact a simple definition

of colorimetry is “the measurement of color” and a colorimetric method is “any technique used to evaluate an unknown color in reference to known colors”. In a colorimetric chemical test the intensity of the color from the reaction must be proportional to the concentration of the substance being tested. Some reactions have limitations or variances inherent to them that may give misleading results. Many such interferences are discussed with each particular test instruction. In the most basic colorimetric method the reacted test sample is visually compared to a known color standard. However, accurate and reproducible results are limited by the eyesight of the analyst, inconsistencies in the light sources, and the fading of color standards.

To avoid these sources of error, a colorimeter or spectrophotometer can be used to photoelectrically measure the amount of colored light absorbed by a colored sample in reference to a colorless sample (blank).

White light is made up of many different colors or wavelengths of light. A colored sample typically absorbs only one color or one band of wavelengths from the white light. Only a small difference would be measured between white light before it passes through a colored sample versus after it passes through a colored sample. The reason for this is that the one color absorbed by the sample is only a small portion of the total amount of light passing through the sample. However, if we could select only that one color or band of wavelengths of light to which the test sample is most sensitive, we would see a large difference between the light before it passes through the sample and after it passes through the sample.

The difference in the amount of monochromatic light transmitted through a colorless sample (blank) and the amount of monochromatic light transmitted through a test sample is a measurement of the amount of monochromatic light absorbed by the sample. In most colorimetric tests the amount of monochromatic light absorbed is directly proportional to the concentration of the test factor producing the color and the path length through the sample. However, for a few tests the relationship is reversed and the amount of monochromatic light absorbed is inversely proportional to the concentration of the test factor.

The choice of the correct wavelength for testing is important. It is interesting to note that the wavelength that gives the most sensitivity (lower detection limit) for a test factor is the complementary color of the test sample. For example the Nitrate-Nitrogen test produces a pink color proportional to the nitrate concentration in the sample (the greater the nitrate concentration, the darker the pink color). A wavelength in the green region should be selected to analyze this sample since a pinkish-red solution absorbs mostly green light.

■ REAGENT BLANK

Some tests will provide greater accuracy if a reagent blank is determined to compensate for any color or turbidity resulting from the reagents themselves. A reagent blank is performed by running the test procedure on 10 mL of demineralized or deionized water. Use sample water to scan the blank. Insert the reacted reagent blank in the colorimeter chamber and scan the sample. Note the result of reagent blank. Perform the tests on the sample water as described.

Subtract results of reagent blank from all subsequent test results.

NOTE: Some tests require a reagent blank to be used as the scanned blank..

■ SELECTING AN APPROPRIATE WAVELENGTH

The most appropriate wavelength to use when creating a calibration curve is usually the one which gives the greatest change from the lowest reacted standard concentration to the highest reacted standard concentration. However, the absorbance of the highest reacted standard concentration should never be greater than 2.0 absorbance units. Scan the lowest and highest reacted standards at different wavelengths using the %T/ABS mode to find the wavelength which gives the greatest change in absorbance without exceeding 2.0 absorbance units. Use this wavelength to create a calibration curve.

Below is a list of suggested wavelength ranges for the color of the reacted samples. Use these as a starting point.

Sample Color	Wavelength Range, nm
Yellow	350-450
Yellow-Orange	450-490
Orange	490-510
Pink	510-570
Red	570-600
Green and Blue	600-750

■ CALIBRATION CURVES

The UV/VIS Spectrophotometer contains precalibrated tests for the LaMotte reagent systems. The first step in using a non-LaMotte reagent system with the UV/VIS Spectrophotometer is to create a calibration curve for the reagent system. To create a calibration curve, prepare standard solutions of the test factor and use the reagent system to test the standard solutions with the UV/VIS Spectrophotometer.

The results are plotted to create a calibration curve. The calibration curve may then be used to identify the concentration of an unknown sample .

PROCEDURE

1. Prepare 2 or 8 standard solutions of the factor being tested. The concentration of these standards should be evenly distributed throughout the range of the reagent system, and should include a 0 ppm standard (distilled water, in most cases). For instance, the solutions could measure 0, 10%, 30%, 50%, 70%, and 90% of the system's maximum range.

2. Select the appropriate %T/ABS wavelength. Be sure to select the appropriate wavelength for the color produced by the reagent system.
3. Use the unreacted 0 ppm standard to standardize the spectrophotometer by using it to scan blank.
4. Following the individual reagent system instructions, react each standard solution including 0 ppm.

■ PREPARING DILUTE STANDARD SOLUTIONS

Standard solutions should be prepared to create a calibration curve. Standard solutions can be prepared by diluting a known concentrated standard by specified amounts. A chart or computer spreadsheet can be created to determine the proper dilutions. Use volumetric flasks and volumetric pipets for all dilutions.

1. In Column A – Record the maximum concentration of test as determined by the range and path length.
2. In Column B – Record the percent of the maximum concentration the standard solution will be.
3. In Column C – Calculate the final concentration of the diluted standard solutions by multiplying the maximum concentration (In Column A) by the % of maximum concentration divided by 100. (C = A x).
4. In Column D – Record the final volume of the diluted sample (i.e. volume of volumetric flask).
5. In Column E – Record the concentration of the original standard.
6. In Column F – Calculate the milliliters of original standard required (C x D/E = F).

A sample chart appears below:

A	B	C=A x B/100	D	E	F=C x D/E
Maximum concentration of test	% of Maximum concentration	Final concentration of Diluted Standard	Volume of Standard	Concentration of Original Standard	mL of Original Standard Required
10.0 ppm	90	9.0 ppm	100 mL	1000 ppm	0.90 mL
10.0 ppm	70	7.0 ppm	100 mL	1000 ppm	0.70 mL
10.0 ppm	50	5.0 ppm	100 mL	1000 ppm	0.50 mL
10.0 ppm	30	3.0 ppm	100 mL	1000 ppm	0.30 mL
10.0 ppm	10	1.0 ppm	100 mL	1000 ppm	0.10 mL
10.0 ppm	0	0 ppm	100 mL	1000 ppm	0 mL

■ STANDARD ADDITIONS

A common method to check the accuracy and precision of a test is by standard additions. In this method a sample is tested to determine the concentration of the test substance. A second sample is then "spiked" by the addition of a known quantity of the test substance. The second sample is then tested. The determined concentration of the spiked sample should equal the concentration of the first plus the amount added with the spike. The procedure can be repeated with larger and larger "spikes." If the determined concentrations do not equal the concentration of the sample plus that added with the "spike", then an interference may exist.

For example, a 10.0 mL water sample was determined to contain 0.3 ppm iron. To a second 10.0 mL sample, 0.1 mL of 50 ppm iron standard was added. The concentration of iron due to the "spike" was (0.10 mL x 50 ppm)/10.0 mL = 0.50 ppm. The concentration of iron determined in the spiked sample should be 0.3 + 0.5 = 0.8 ppm iron.

(Note: any error due to the increased volume from the "spike" is negligible).

LaMotte offers a line of calibration standards which can be used to generate calibration curves and perform standard additions.

■ SAMPLE DILUTION TECHNIQUES & VOLUMETRIC MEASUREMENTS

If a test result gives an **OUT OF RANGE** message then the sample concentration could be over range or under range. If it is over range, the sample must be diluted. Then the test should be repeated on the diluted sample to obtain a reading which is in the concentration range for the test. (Note: This is not true for colorimetric determination of pH.)

Example: Measure 5 mL of the water sample into a graduated cylinder. Add demineralized water until the cylinder is filled to the 10 mL line. The sample has been diluted by one-half, and the dilution factor is therefore 2. Perform the test procedure, then multiply the resulting concentration by 2 to obtain the test result.

The following table gives quick reference guidelines on dilutions of various proportions. All dilutions are based on a 10 mL volume, so several dilutions will require small volumes of the water sample. Graduated pipets should be used for all dilutions.

Size of Sample	Deionized Water to Bring Volume to 10 mL	Multiplication Factor
10 mL	0 mL	1
5 mL	5 mL	2
2.5 mL	7.5 mL	4
1 mL	9 mL	10
0.5 mL	0.5 mL	20

If the above glassware is not available, dilutions can be made with the spectrophotometer tube. Fill the tube to the 10 mL line with the sample then transfer it to another container. Add 10 mL volumes of demineralized water to the container and mix. Transfer back 10 mL of the diluted sample to the tube and follow the test procedure. Continue diluting and testing until a reading, which is in the concentration range for the test, is obtained. Be sure to multiply the concentration found by the dilution factor (the number of total 10 mL volumes used).

Example:

10 mL of sample is diluted with three 10 mL volumes of demineralized water; the dilution factor is four.

■ INTERFERENCES

LaMotte reagent systems are designed to minimize most common interferences. Each individual test instruction discusses interferences unique to that test. Be aware of possible interferences in the water being tested.

The reagent systems also contain buffers to adjust the water sample to the ideal pH for the reaction. It is possible that the buffer capacity of the water sample may exceed the buffer capacity of the reagent system and the ideal pH will not be obtained. If this is suspected, measure the pH of a reacted distilled water reagent blank using a pH meter. This is the ideal pH for the test. Measure the pH of a reacted water sample using the pH meter. If the pH is significantly different from the ideal value, the pH of the sample should be adjusted before testing.

Chlorine interferences can be removed with the use of glycine. Very high levels of chloramines may interfere if the test result is not read immediately. Oxidized manganese interferes but can be removed with arsenite. Bromine and iodine interferes but can be removed with a thioacetamide blank correction.

Interferences due to high concentration of the substance being tested, can be overcome by sample dilution.

■ STRAY LIGHT INTERFERENCE

Normal indoor lighting causes no interference with the UV/VIS Spectrophotometer. Always be sure the sample chamber lid is closed when scanning blanks or samples.