



Thermo Scientific Orion AquaMate

UV-Vis and Vis Spectrophotometers

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CHAPTER 1 Spectrophotometer Introduction

Spectrophotometer Overview

Thermo Scientific™ Orion™ AquaMate™ UV-Vis and Vis spectrophotometers offer the following features and benefits:

- Easy operation using the 260+ preprogrammed methods for common colorimetric reagents
- Flexibility to create new methods for additional reagents or samples – create new methods using calibration standards or update methods using published wavelengths and equations
- Use a variety of vial sizes with the included 3-position vial holder carousel and update the vial position on the carousel with a key press – the sample changer keypad moves the carousel to the desired location for easy vial switching
- Performance verification tests ensure wavelength accuracy and instrument functionality, plus built-in filters allow for wavelength verification with no additional equipment required
- Additional functions include standard curve concentration measurements, wavelength scanning, multiple fixed-wavelength measurements, absorbance ratio and difference
- One year instrument warranty

The Orion AquaMate 8000 UV-Vis spectrophotometer measures in the 190 nm to 1100 nm wavelength range using a Xenon Flash lamp that requires no warm-up time and has a five-year average lifespan.

The Orion AquaMate 7000 Vis spectrophotometer measures in the 325 to 1100 nm wavelength range using a Tungsten lamp, designed for easy replacement using the factory pre-aligned lamp and base.

Packing List

Orion AquaMate 8000 UV-Vis Spectrophotometer

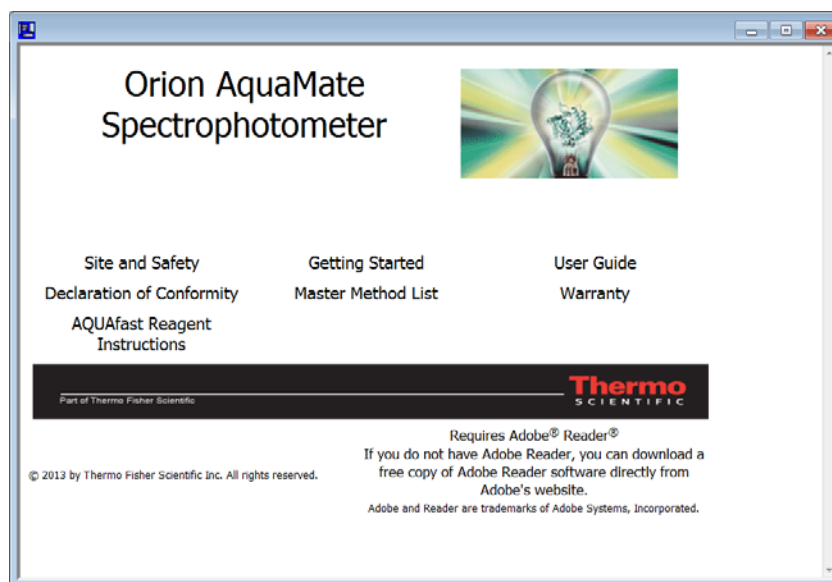
- UV-Vis Spectrophotometer
- Preprogrammed Methods on USB memory stick, Catalog Number AQ0USB
- 6-position vial holder carousel, Catalog Number AQ006C
- 3-position vial holder carousel, Catalog Number AQ003C
- 1-position vial holder carousel, Catalog Number AQ001C
- AquaMate user documentation CD
- Printed instrument test report
- Dust cover
- USB cable
- 110V US/Japan power cord, Catalog Number AQ110V
- 220V Euro power cord, Catalog Number AQ220V
- 240 V UK/Singapore power cord, Catalog Number AQ240V

Orion AquaMate 7000 Vis Spectrophotometer

- Vis Spectrophotometer
- Preprogrammed Methods on USB memory stick, Catalog Number AQ0USB
- 3-position vial holder carousel, Catalog Number AQ003C
- AquaMate user documentation CD
- Printed instrument test report
- Dust cover
- USB cable
- 110V US/Japan power cord, Catalog Number AQ110V
- 220V Euro power cord, Catalog Number AQ220V
- 240 V UK/Singapore power cord, Catalog Number AQ240V

Note: The China/Australia/New Zealand power cord, Catalog Number AQCHNV, must be ordered separately.

Orion AquaMate User Documentation CD



The Orion AquaMate user documentation CD includes the following:

- Orion AquaMate Vis and UV-Vis Spectrophotometer User Guide
- Orion AQUAfast Reagent Chemistry Instructions for Orion AquaMate Spectrophotometers
- Orion AquaMate Master Method List
- Orion AquaMate Site and Safety Information
- Orion AquaMate Getting Started Guide
- Orion AquaMate Declaration of Conformity
- Orion Laboratory Product Warranty Card
- USB Driver

Intended Use

Please read this user manual thoroughly. Any use outside of these instructions may invalidate the instrument warranty and cause permanent damage to the instrument.

Safety and Special Notices

Make sure you follow the precautionary statements presented in this user manual. The safety and other special notices appear in boxes.

Safety and special notices include the following:

Note: Contains helpful supplementary information

Important: Instructions that must be followed to avoid damaging system hardware or data loss

Caution: Statements that indicate a hazardous situation that, if not avoided, could result in minor or moderate injury

Warning: A hazardous situation that, if not avoided, could result in death or serious injury

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This document is not part of any sales contract between Thermo Fisher Scientific Inc. and a purchaser. This document shall in no way govern or modify any terms and conditions of sale, which terms and conditions of sale shall govern all conflicting information between the two documents.

For Research Use Only. This instrument is not a medical device and is not intended to be used for the prevention, diagnosis, treatment or cure of disease.



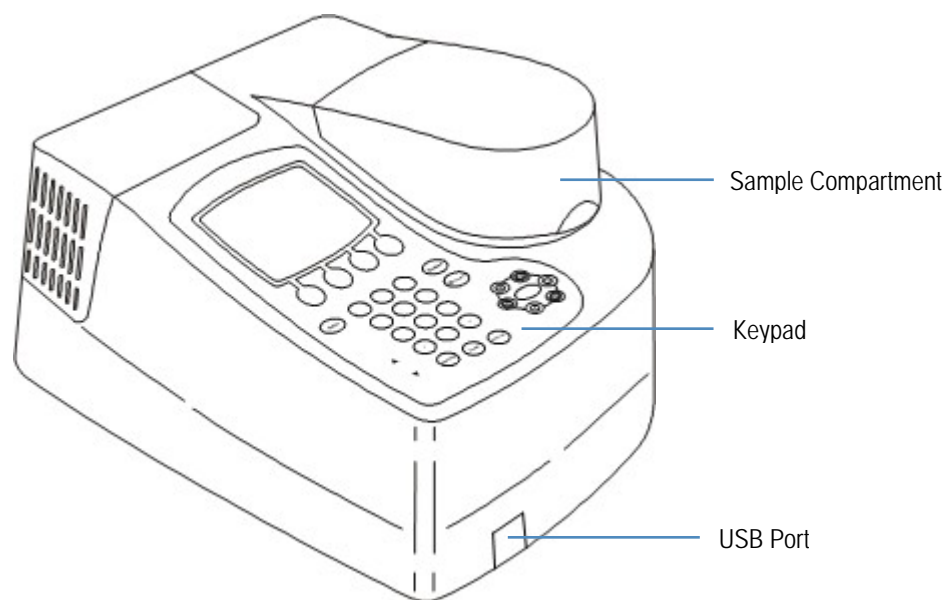
Warning: Avoid an explosion or fire hazard. This instrument is not designed for use in an explosive atmosphere.

2

CHAPTER 2 Spectrophotometer Basics

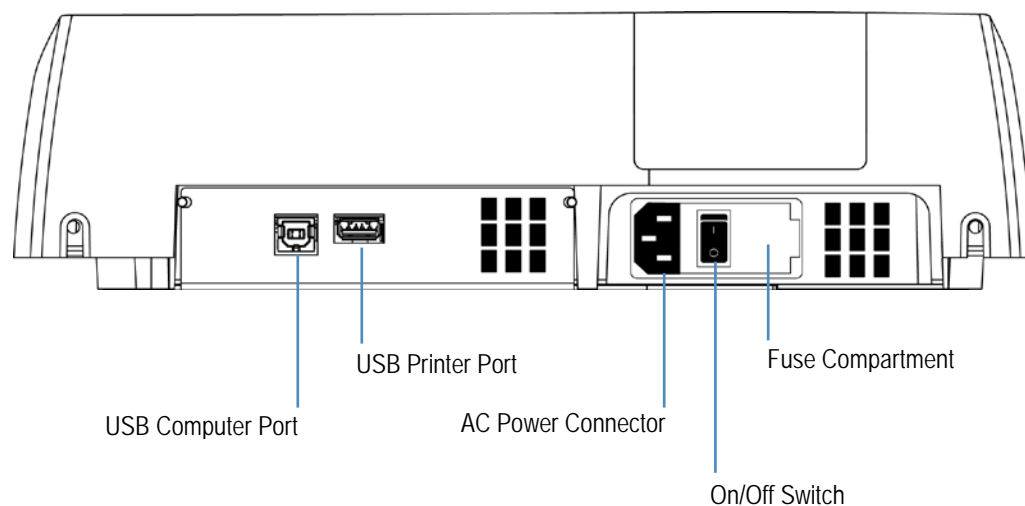
Spectrophotometer Components

The following are some of the major components visible on the outside of the instrument:



Instrument Connections





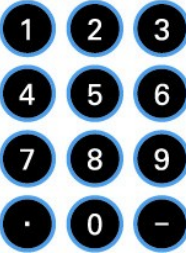




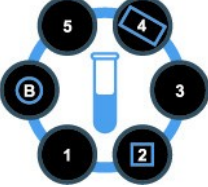
The following connectors are on the back of the instrument.



Warning: Avoid shock hazard. Always turn off the instrument and unplug it from the wall outlet or power strip before you unplug the power cord from the instrument connector.

Instrument Keypad



Keys	Function
	Function keys - Press to perform the action shown above each key on the instrument display. The function keys will change depending on the displayed screen. Some function keys may not be active on the display.
	Escape key - Press to clear a value being entered or return to a previous screen.
	Clear key - Press to clear the last character entered.
	Enter key - Press to accept highlighted, entered or selected values or press to advance to the next parameter or screen.
	Numeric keys - Use to enter numbers, a decimal point or minus sign to make a value negative.
	Arrow keys - Press to move the location of the cursor or press to highlight a value or option from a list of selections.
	Utility key - Press to access the utility menu and instrument setup options.
	Test key - Press to access the test menu with list of available analysis modes.
	Print key - Press to export results to a printer or computer (when PC is selected in the utility menu).
	Sample changer keys - Press to select the location of the vial to be measured. B is the blank position and 1-5 are the sample positions when using the Auto 6 sample positioner setting and B is the blank position and 2 and 4 are the sample positions when using the Auto 3 sample positioner setting.

Vial Holder Carousels

The Orion AquaMate 8000 and Orion AquaMate 7000 instruments include the three-position vial holder carousel preinstalled in the sample compartment. The three-position carousel has one adjustable 13 to 25 mm round vial holder in position B, one 10 mm square vial holder in position 2 and one 20 to 50 mm (long path) rectangular vial holder in position 4.

The Orion AquaMate 8000 instrument also includes the six-position vial holder carousel and the one-position vial holder carousel for 10 mm square vials and traditional spectrophotometer applications, allowing you to take advantage of the full capabilities of the instrument.

AquaMate Three-Position Carousel, Catalog Number AQ003C:



Side View



Top View

AquaMate Six-Position Carousel, Catalog Number AQ006C:



AquaMate One-Position Carousel, Catalog Number AQ001C:



A new one-position carousel that holds one 100 mm rectangular vial can now be purchased using Catalog Number AQ100C.

Warning: If the Sample Positioner option is set to Auto6, whenever the **Run Test** function key is pressed to start a measurement, the instrument will initialize the sample positioner and then run the blank in the B location on the sample positioner and measure five samples in the 1-5 locations on the sample positioner.

Selecting and Positioning Vials and Cuvettes

The compatible wavelength range for different types of vials and cuvettes depends on the material used. The path length of test tubes is not as well defined as that of square cuvettes.

Vial / Cuvette Type	Wavelength Range
Optical Glass	360 nm to > 1100 nm
Borosilicate Glass	330 nm to > 1100 nm
Quartz	190 nm to > 1100 nm
Disposable:	
Polystyrene	> 340 nm
Methacrylate	> 300 nm
Acrylic	> 280 nm
UV-transparent	> 220 nm

Note: See the manufacturer's specifications and work within the recommended range.

Position vials and cuvettes so that the clear sides face the light beam, one clear side facing the front of the instrument and the other facing the back.

Note: Always place vials in the instrument in exactly the same orientation in the light beam. An alignment mark on the vial helps orientation the vial consistently and correctly.

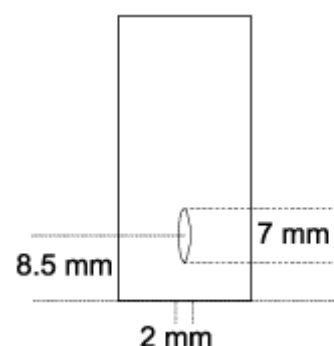
When using small aperture (small volume) cuvettes:

- Always use cuvettes with black masking
- Use the same cuvette for your blank and your samples

Z-dimension

The figure below illustrates the position of the light beam in the instrument. Beam size specifications are shown below.

- Distance from bottom of the vial/cuvette to center of beam (Z-dimension): 8.5 mm
- Beam dimensions: 2 mm (wide) by 7 mm (tall)



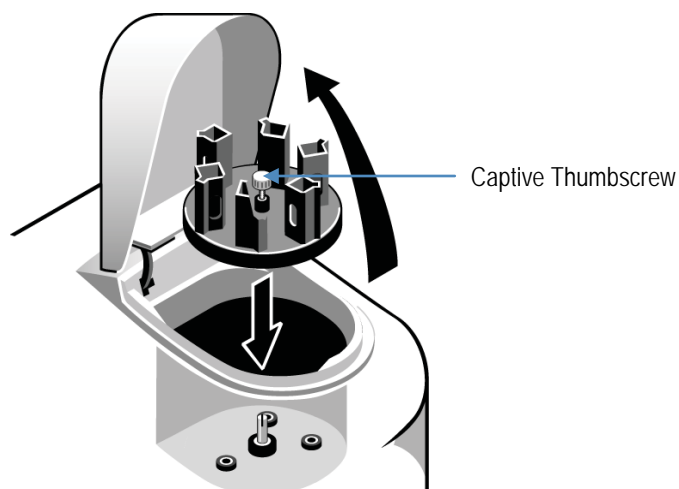
Changing the Vial Holder Carousel

The Orion AquaMate 8000 and Orion AquaMate 7000 instruments have the three-position vial holder carousel preinstalled in the sample compartment. This carousel can be changed to use the six-position vial holder carousel or one-position vial holder carousel.

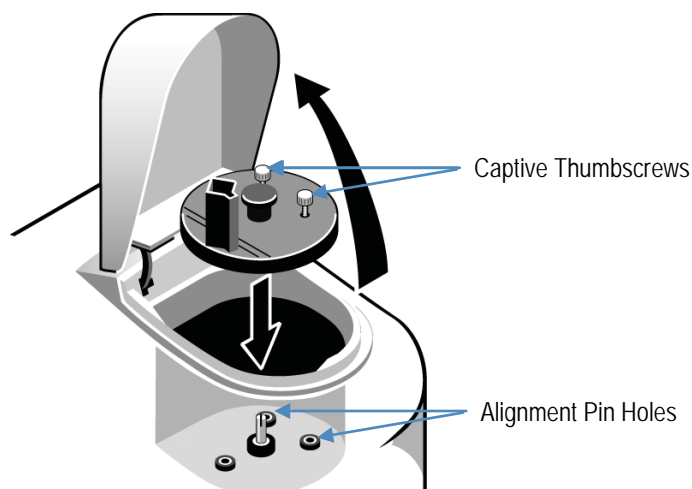
Installing the Six-Position or One-Position Vial Holder Carousel

1. Open the sample compartment door and let it rest on its hinge.
2. Remove the preinstalled three-position vial holder carousel. Loosen the captive thumbscrew and pull straight up on the carousel to lift it out of the sample compartment.
3. With one hand, carefully lower the six-position or one-position carousel straight down into the sample compartment.

Six-Position Carousel



One-Position Carousel



4. With the other hand, tighten the captive thumbscrew or thumbscrews.
5. Close the sample compartment door.

Note: If the carousel is not aligned correctly, you will not be able to tighten the thumbscrews.

Sample Positioner Setting for the Vial Holder Carousel

The instrument allows the use of various vial holder carousels to take measurements. When selecting the test parameters, the Sample Positioner setting determines how the instrument will work with the installed vial holder carousel to obtain readings in the test measurement screen. The **Sample Changer** keys on the instrument keypad are also be used for certain settings.

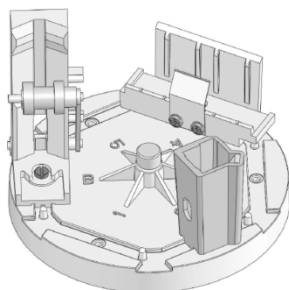
Sample Positioner Settings

Water Analysis				4:20pm 25Mar15				Advanced A-%T-C				4:17pm 25Mar15			
BLANK								BLANK							
Test Name				-----				Test Name				1-Cell Platform			
Measurement Mode				Absorbance				Measurement Mo				Manual 6			
Wavelength				546.0nm				Wavelength				Auto 3			
1pt Adjust				Off				Ref. Wavelength				Auto 6			
Reverse Color				Off				Delay Time (mi)							
Sample Positioner				Manual 3				Sample Positioner				Press ↑ or ↓ to select			
ID# (0=OFF)				1				Number of Samples				Press ENTER			
Statistics				Off				More parameters...							
Auto Print				On											
Auto Save Data				Off											
More parameters...															
Press ↑ or ↓ to select item to change.								Press ↑ or ↓ to select item to change.							
		Save		Stored		Run									
		Test		Tests		Test									

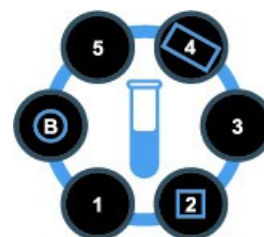
Setting	Description
Manual 3	This setting is only used in the Water Analysis test type. Use the Sample Changer keys to position the carousel with the desired vial holder in the beam pathway for measurement. Positions B, 2 and 4 are selectable.
Auto 6	Measure one blank and five samples without changing vials on the carousel. The instrument automatically measures the blank and advances the carousel to measure the remaining samples in positions 1 through 5.
Auto 3	Measure one blank and two samples without changing vials on the carousel. The instrument automatically measures the blank and advances the carousel to measure the samples in positions 2 and 4.
Manual 6	Measure the blank and up to five samples on the carousel. Use the Sample Changer keys to position the carousel to the appropriate position for sample measurement. Place the blank vial in the B position and samples in position 1-5. Regardless of the carousel position, the carousel automatically goes to the B position and measures the blank when the Measure Blank function key is pressed. Use the Sample Changer keys to select different positions for samples.
1-Cell Platform	Measure the blank and all samples using one position on the carousel. Place the blank in the holder, measure the blank, remove the blank, place a sample in the holder, measure the sample, remove the sample and repeat for all samples. The Sample Changer keys do not function in this setting.

Note: When the carousel is installed and Manual 6 is selected, the instrument always considers the vial in the B position as a blank. This means that even after measuring the blank the first time, samples can only be placed in positions 1 through 5.

Three-Position Vial Holder Carousel



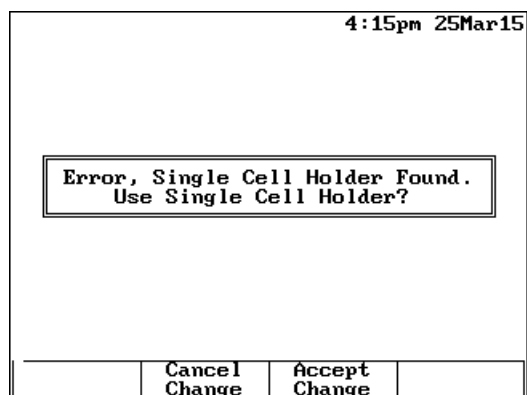
Corresponding Sample Changer Keys



Initialization of the Vial Holder Carousel

When the **Run Test** function key is pressed to start a measurement, the instrument will display the message “Calibrating and Checking Turret, Please Wait” while it attempts to initialize the vial holder carousel (Sample Positioner) at the blank (B) position. With the AquaMate three-position carousel, the instrument will rotate the carousel to the default position and then rotate the carousel back to the last selected measurement position (B, 2 or 4). This ensures that the vial holder is properly positioned in the beam.

If a one-position vial holder carousel has been installed, the message “Error, Single Cell Holder found. Use Single Cell Holder?” will appear. Press the **Accept Change** function key to continue or install the AquaMate three-position carousel and press the **Cancel Change** function key.



If the six-position vial holder carousel has been installed, the instrument will initialize to the blank (B) position. After it has initialized the carousel, the instrument will proceed to the test measurement screen.

Note: To prevent a Fatal Error message when removing the vial holder carousel, always return to the main menu or the test parameter menu before removing the carousel. If the carousel is removed while in the test measurement screen, the instrument will display “Fatal Error: 8 Press Esc to return to main menu.” If this message is displayed, press the **esc** key and then press the **Run Test** function key to re-initialize the vial holder carousel.

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CHAPTER 3 Orion AquaMate Instrument Setup

Entering Parameter Values

The following instructions outline the use of the Orion AquaMate instrument keypad with various menus, settings and controls.

Numeric Entry

Highlight the desired parameter (i.e. Wavelength) and start typing the numeric value. The Entry window will open with the range of the parameter shown below. Type the desired value and then press the **enter** key.

Advanced A-%T-C		1:13pm 25Mar15	
		BLANK	

Test Name			
Measurement Mode		Absorbance	
Wavelength		546.0nm	
Ref. Wavelength Correction		Off	
Delay Time (min:sec)		0:00	
Sample Positioner		Auto 6	
Number of Samples		1	
More parameters...			
Entry: 2			
Enter Wavelength (190.0 - 1100.0)			

Menu Selection

Highlight the desired parameter (i.e. Units) and press the **enter** key to display the selection list. Press the **▲** or **▼** key to highlight the appropriate item on the list and press the **enter** key.

Advanced A-ZT-C 1:15pm 25Mar15

Test Name	ppm
Measurement Mo	ppb
Wavelength	g/L
Ref. Wavelength	mg/L
Delay Time (mi	mg/mL
Conc of Standa	µg/mL
Factor	M/L
Units	mM/L
Sample Positio	IU
Number of Samp	pM/µL
	ng/µL
More parameter	[Unit] -----
	Press ↑ or ↓ to select
	Press ENTER

Press ↑ or ↓ to

	Edit	
	[Unit]	

On/Off Toggle

Highlight the desired parameter and press the **enter** key to toggle the parameter On or Off.

```

Advanced A-ZT-C          1:16pm 25Mar15
                        BLANK

Test Name                -----
Measurement Mode          Conc/Std
Wavelength                546.0nm
Ref. Wavelength Correction Off
Delay Time (min:sec)     0:00
Conc of Standard          Undefined
Factor                    Undefined
Units                     C
Sample Positioner         Auto 6
Number of Samples         1

More parameters...

Press ↑ or ↓ to select item to change.

```

Alphanumeric Entry

Highlight the desired parameter (i.e. Test Name) and press the **enter** key. The Create Test Name window will open. Press the **▲** or **▼** key to highlight a character, press the **Add Character** function key and repeat until the desired name is shown. Press the **Accept Name** function key to save the entered name.

```

Create Test Name                               1:19pm 25Mar15
ABCDEF GHI JKLMNOPQRSTUVWXYZ0123456789
abcdefghijklmnopqrstuvwxyz_*/p()#

Test Name = Copper_01

Press ↑ or ↓ to select character.

Delete   Delete   Add   Accept
Name     Character Character Name

```

Setting Utility Menu Options

Use the Utility menu to view the current software revision, instrument serial number and remaining lamp life; to set instrument parameters including printer/computer interface, date and time, standby, baseline expiration, keypad beeper, language and screen contrast; and to access a directory of all stored tests, USB drive files and calculator function. The utility parameters cannot be set or changed when the instrument is performing a measurement.

To access the Utility menu, press the **utility** key on the instrument keypad.

Utility	1:20pm 25Mar15
Software Revision:	1.004
Instrument Serial Number:	2W2R091104
Printer	Off
Date/Time Setup	1:20pm 25Mar15
Standby	30 min
Baseline Expiration (hr:min)	Off
Beeper	Off
Language	English
% of lamp life used	0.62%
Screen Contrast	
Printout Contrast	
Stored Tests Directory	
USB Drive Files	
Calculator	
Press ↑ or ↓ to select parameter.	
<div></div> <div></div> <div></div> <div></div>	

Note: The battery backup saves changes automatically, even when the instrument power is off.

Printer Setting

1. In the Utility menu, press the ▲ or ▼ key to highlight the Printer option and press the enter key to open the printer menu.
2. If interfacing the instrument with a computer, press the ▲ or ▼ key to highlight the PC option and then press the enter key to set the PC option to On.

Utility	1:27pm 25Mar15
Software Revision:	1.004
Instrument Serial Number:	2W2R091104
Printer	
Date/Time Setu	Internal Off
Standby	PC On
Baseline Expir	External Off
Beeper	
Language	Press ↑ or ↓ to select
% of lamp life	Press ENTER to change
Screen Contr	Press ESC to exit
Printout Contr	
Stored Tests Directory	
USB Drive Files	
Calculator	
Press ↑ or ↓ to select parameter.	
<div></div> <div></div> <div></div> <div></div>	

3. If interfacing the instrument with an external printer, press the ▲ or ▼ key to highlight the External option and then press the enter key to set the External option to On.
4. Press the esc key to return to the main Utility menu.

Paper printouts with text and graphics can be generated using a USB printer attached to the instrument via the USB port. To ensure that the instrument can output information correctly to the printer, select an appropriate device. The instrument is able to print to external printer that supports HP PCL 5.0 format and later and have printer function only (not multi-functional printers). PCL format does not support HP “Windows” printers.

Note: The instrument is compatible with most HP PCL printers and brands other than HP will also be supported if they use the PCL5 communications protocol. It is your responsibility to determine whether the printer is compatible with the instrument.

Alternatively, displayed ASCII text can be sent to a computer using a USB connection. Enabling the computer as the printing device sends ASCII data to the computer via the USB connection to the computer; however, no graphics are sent.

Installing the USB Driver from the User Documentation CD

1. Connect the USB computer cable to the USB communication port on the back of the AquaMate spectrophotometer.
2. Insert the Orion AquaMate User Documentation DVD into the computer CD/DVD drive.
3. Connect the USB computer cable to a USB port on the computer.
4. Open the computer Device Manager window.
5. Double-click the Spectrophotometer option under Other Devices in the Device Manager.
6. Click the Update Driver button on the Spectrophotometer Properties window.
7. Click the Browse my computer for driver software button.
8. Click the Browse button.
9. Select the appropriate USB driver folder from the Orion AquaMate User Documentation DVD in the computer CD/DVD drive and click the OK button.
 - a. Select the Vista32 folder when using a 32-bit Microsoft 7 or Vista operating system.
 - b. Select the Vista64 folder when using 64-bit Microsoft 7 or Vista operating system.
 - c. Select the XP32 folder when using a Microsoft XP operating system.
10. Click the Next button.
11. Wait while the USB driver software is located and installed.
 - a. Approve any security messages by clicking the Install button.
12. Once the installation of the USB driver software is complete, click the Close button.
13. Record the COM port number of the USB connection in the Device Manager window.

Date/Time Setup Setting

1. In the Utility menu, press the ▲ or ▼ key to highlight the Date/Time Setup option and press the **enter** key to open the Date/Time Setup menu.

Utility		1:29pm 25Mar15	
Set Date		25Mar15	
Time Format		am/pm	
Set Time		1:29pm	
Press ↑ or ↓ to select item to change.			
Set	Set	Set	
Day	Month	Year	

2. To set the date, press the ▲ or ▼ key to highlight the Set Date option.
 - a. Press the **Set Day** function key, use the numeric keypad to enter the day value and press the **enter** key.
 - b. Press the **Set Month** function key, press the ▲ or ▼ key to highlight the correct month and press the **enter** key.
 - c. Press the **Set Year** function key, use the numeric keypad to enter the year value and press the **enter** key.
3. To set the time format, press the ▲ or ▼ key to highlight the Time Format option and press the **enter** key to toggle the format between am/pm and 24 hours.
4. To set the time, press the ▲ or ▼ key to highlight the Set Time option.
 - a. Press the **Set Hour** function key, use the numeric keypad to enter the hour value and press the **enter** key.
 - b. Press the **Set Minute** function key, use the numeric keypad to enter the minute value and press the **enter** key.
 - c. When using the am/pm time format, press the **Set AM/PM** function key until the correct setting is shown.

Standby Setting

To prolong the life of the lamp, the spectrophotometer is pre-set at the factory to automatically go into standby mode after 15-30 minutes of inactivity. To change this setting, press the ▲ or ▼ key to highlight the Standby option, press the enter key, press the ▲ or ▼ key to highlight the desired standby setting and press the enter key to save the setting.

Utility		2:04pm 25Mar15	
Software Revision:		1.004	
Instrument Serial Number:		2W2R091104	
Printe			
Date/T			
Standb	Standby Mode OFF		
Baseli	Go into Standby Mode now		
Beeper	Go into Standby Mode in 15 min		
Langua	Go into Standby Mode in 30 min		
% of l	Go into Standby Mode in 60 min		
Screen	Go into Standby Mode in 90 min		
Printo	Press ↑ or ↓ to select		
Stored	Press ENTER		
USB Dr			
Calculator			
Press ↑ or ↓ to select parameter.			

Baseline Expiration Setting

If be performing scans on samples, a time limit can be set for which a collected baseline will be valid. This is particularly useful when measurements are made in a production setting across multiple shifts or when the nature of the blank sample changes dramatically with time.

To set the baseline expiration time, press the ▲ or ▼ key to highlight the Baseline Expiration (hr:min) option, press the enter key, use the numeric keypad to enter the time value and press the enter key to save the setting.

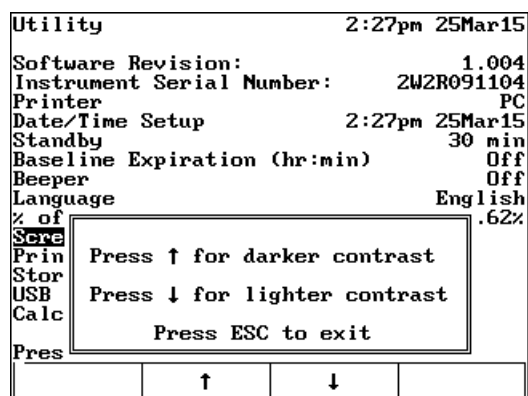
Utility		2:11pm 25Mar15	
Software Revision:		1.004	
Instrument Serial Number:		2W2R091104	
Printer		PC	
Date/Time Setup		2:11pm 25Mar15	
Standby		30 min	
Baseline Expiration (hr:min)		Off	
Beeper		Off	
Language		English	
% of lamp life used		0.62%	
Screen Contrast			
Printout Contrast			
Stored Tests Directory			
Entry:			
Enter time (00:10 - 24:00, 0=OFF)			

Beeper Setting

The instrument will emit an audible beep each time a key is pressed when the beeper option is on. To change this setting, press the ▲ or ▼ key to highlight the Beeper option and press the enter key to toggle the setting between Off and On.

Screen Contrast Setting

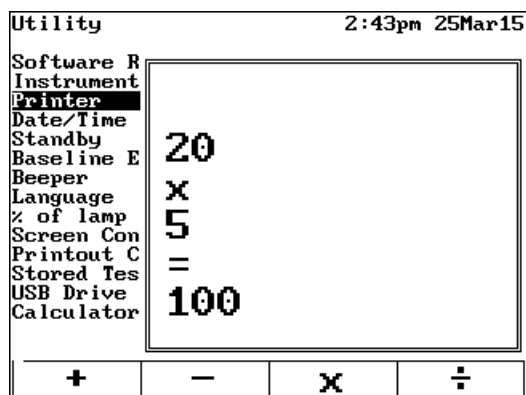
Adjust the screen contrast on the instrument to make it easier to read the display. To set the screen contrast, press the ▲ or ▼ key to highlight the Screen Contrast option, press the enter key, press the ↑ function key or ↓ function key to adjust the contrast and press the esc key to save the setting.



Calculator Function

To use the calculator function, press the ▲ or ▼ key to highlight the Calculator option and press the enter key.

1. Use the numeric keypad to enter the first value
2. Press the + function key, - function key, x function key or ÷ function key.
3. Use the numeric keypad to enter the second value.
4. Press the enter key to perform the calculation.



Managing Stored Tests

The instrument uses test method files that contain the parameters and settings needed to run the test, including those for the [Sample Positioner Setting](#). After setting the test parameters, assign a unique test name and save the test, to either the internal instrument memory or USB memory stick, so the test can be recalled and run without having to set the parameters again. The instrument can save approximately 90 tests to its internal memory. Tests saved to the internal memory will be maintained by battery backup when the instrument is powered off.

To access the Test Types menu, press the **test** key on the instrument keypad. The list of all available test techniques will be shown. Use the following instructions as a general guide when setting up various test methods.

Test Types		10:35am 26Mar15	
Water Analysis Advanced A- λ T-C Standard Curve Absorbance Ratio Absorbance Difference Kinetics Scanning 3-Point Net Multiwavelength Performance Verification			
Press \uparrow or \downarrow to select			
Smart		Stored	Basic
Start		Tests	ATC

Naming and Saving a Test

When naming a test, enter the name using 8 to 16 alphanumeric characters. The selected test type will determine the maximum number of alphanumeric characters for the test name. The instrument will emit an audible beep when the maximum number of characters has been entered. When saving a test, it can be saved to an external memory device using the front USB port or saved to the instrument's internal memory.

1. After setting the test parameters, highlight Test Name and press the **enter** key.

Water Analysis		10:47am 26Mar15	
		BLANK	
Test Name			
Measurement Mode	Absorbance		
Wavelength	510.0nm		
1pt Adjust	Off		
Reverse Color	Off		
Sample Positioner	Manual 3		
ID# (0=OFF)	1		
Statistics	Off		
Auto Print	On		
Auto Save Data	Off		
More parameters...			
Press \uparrow or \downarrow to select item to change.			
	Save	Stored	Run
	Test	Tests	Test

2. In the Create Test Name screen, use the function keys to delete the test name, delete a character in the name or add characters to the name and then accept the entered name.

Create Test Name		11:21am 26Mar15	
ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789 abcdefghijklmnopqrstuvwxyz_*/()#			
Test Name = TEST_12345			
Press ↑ or ↓ to select character.			
Delete Name	Delete Character	Add Character	Accept Name

- a. To delete the entire displayed test name, press the **Delete Name** function key and to delete individual characters, press the **Delete Character** function key.
 - b. To enter characters, press the ▲ or ▼ key to highlight the desired character, press the **Add Character** function key to select the highlighted character and repeat until the desired name has been entered shown.
 - c. To save the entered test name, press the **Accept Name** function key.
3. The instrument will return to the test parameters menu.

Water Analysis		11:22am 26Mar15	
		BLANK	
Test Name	TEST_12345		
Measurement Mode	Absorbance		
Wavelength	510.0nm		
1pt Adjust	Off		
Reverse Color	Off		
Sample Positioner	Manual 3		
ID# (0=OFF)	1		
Statistics	Off		
Auto Print	On		
Auto Save Data	Off		
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save Test	Stored Tests	Run Test

4. Press the **Save Test** function key to save the test name and test parameters.
 - a. Press the ▲ or ▼ key to highlight Save as an internal test, Save test to the USB drive or Save test to internal and USB and press the **enter** key.
 - b. Press the **Accept Name** function key.
 - i. If the test name already exists, press the **enter** key to overwrite the existing test or press the **esc** key to cancel and rename the test with a unique name.
 - c. Press the ▲ or ▼ key to highlight Include as a SmartStart test or Do not include as a SmartStart test and press the **enter** key.
 5. The test name will be shown with [Saved] after the name.

Water Analysis		11:25am 26Mar15	
		BLANK	
Test Name		TEST_12345[Saved]	
Measurement Mode		Absorbance	
Wavelength		510.0nm	
1pt Adjust		Off	
Reverse Color		Off	
Sample Positioner		Manual 3	
ID# (0=OFF)		1	
Statistics		Off	
Auto Print		On	
Auto Save Data		Off	
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save	Stored	Run
	Test	Tests	Test

Loading Saved Test Files

All saved test files can be loaded from the internal instrument memory or USB memory stick using the main Utility menu.

1. Press the **utility** key to access the Utility menu.
2. Press the **▲** or **▼** key to highlight Stored Tests Directory and press the **enter** key.
3. Select the location of the saved test files to be loaded.
 - a. To load saved test files from the internal memory, press the **▲** or **▼** key to highlight Load internal test and press the **enter** key.
 - b. To load saved test files from the USB memory stick, press the **▲** or **▼** key to highlight Load test from USB drive and press the **enter** key.
4. Press the **▲** or **▼** key to highlight the desired test and press the **Load Test** function key.
5. The test will be loaded in the corresponding test technique menu.

Note: Saved test files on the USB memory stick can be viewed or deleted by selecting the USB Drive Files option in the Utility menu.

Alternatively, saved test files can also be loaded using their specific test technique menu.

1. Press the **test** key to open the Test Types menu.
2. Press the **▲** or **▼** key to highlight the desired test technique and press the **enter** key.
3. Press the **Stored Tests** function key.
4. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive as the test location and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the desired test and press the **Load Test** function key.
6. The test will be loaded in the test technique menu.

Locking/Unlocking Tests using the Password

Use the password "4363797" to lock test parameters so they cannot be overwritten or deleted. The password can also be removed to allow editing of the test parameters.

Note: The password cannot be changed. Tests stored on a USB memory stick cannot be locked or unlocked.

1. Press the **utility** key to access the Utility menu.
2. Press the **▲** or **▼** key to highlight Stored Tests Directory and press the **enter** key.
3. Press the **▲** or **▼** key to highlight Load internal test and press the **enter** key.
4. Press the **▲** or **▼** key to highlight a test and press the **Lock Unlock** function key.
5. Enter "4363797" as the password using the numeric keypad and press the **enter** key.

Deleting a Test

1. Press the **utility** key to access the Utility menu.
2. Press the **▲** or **▼** key to highlight Stored Tests Directory and press the **enter** key.
3. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive as the test location and press the **enter** key.
4. Press the **▲** or **▼** key to highlight a test and press the **Delete Test** function key.

Using the SmartStart Test Feature

The SmartStart feature lets you customize the instrument by placing the most frequently used test methods on the first menu. Immediately after the instrument initializes, a simple menu containing only the SmartStart tests appears.

- If you select one test as a SmartStart test, when the instrument is powered on it will automatically load this test for immediate measurement.
- If you select more than one test as SmartStart tests, when the instrument is powered on it will automatically display a menu containing only those tests.

Note: The default menu can always be accessed by pressing the **test** key.

Setting a SmartStart Test

1. Press the **utility** key to access the Utility menu.

Utility		9:59am 26Mar15
Software Revision: 1.004		
Instrument Serial Number: 2W2R091104		
Printer PC		
Date/Time Setup 9:59am 26Mar15		
Standby 30 min		
Baseline Expiration (hr:min) Off		
Beeper Off		
Language English		
% of lamp life used 0.62%		
Screen Contrast		
Printout Contrast		
Stored Tests Directory		
USB Drive Files		
Calculator		
Press ↑ or ↓ to select parameter.		

2. Press the ▲ or ▼ key to highlight Stored Tests Directory and press the **enter** key.
3. Press the ▲ or ▼ key to highlight Load internal test and press the **enter** key.
4. Press the ▲ or ▼ key to highlight the appropriate test and press the **Select Test** function key. An arrow icon (>) next to the test name indicates the test has been selected for the SmartStart menu.

Utility Test Directory		10:07am 26Mar15
Water Analysis		
AC2009 26Mar15		
>AC4P71 26Mar15		
>AC4P72 26Mar15		
Press ↑ or ↓ to select test.		
Select Test	Lock Unlock	Delete Test Load Test

5. Press the **esc** key to return to the Utility menu.
6. Press the **test** key to access the Test Types menu.
7. Press the **Smart Start** function key to open the Smart Start menu.
8. Press the ▲ or ▼ key to highlight a test and press the **enter** key to start the test.

4

CHAPTER 4 **Water Analysis Test Menu**

Preprogrammed Methods

Thermo Scientific Orion AquaMate 8000 UV-Vis and AquaMate 7000 Vis spectrophotometers include a USB memory stick that contains over 260 preprogrammed methods for use with Thermo Scientific™ Orion™ AQUAfast™, Merck and CHEMetrics reagent chemistries. Preprogrammed methods provide values for the test parameters required to run specific reagent chemistries on the instrument, including wavelength, vial path length, concentration factors/curves and measurement unit.

All preprogrammed methods are stored on the USB memory stick, so operators can select and load only the methods needed for their applications. Up to 90 methods can be stored on the AquaMate spectrophotometer and stored methods can be added or removed as needed. Operators can also modify preprogrammed methods or create their own custom methods, so additional parameters and test methods can be added at any time.

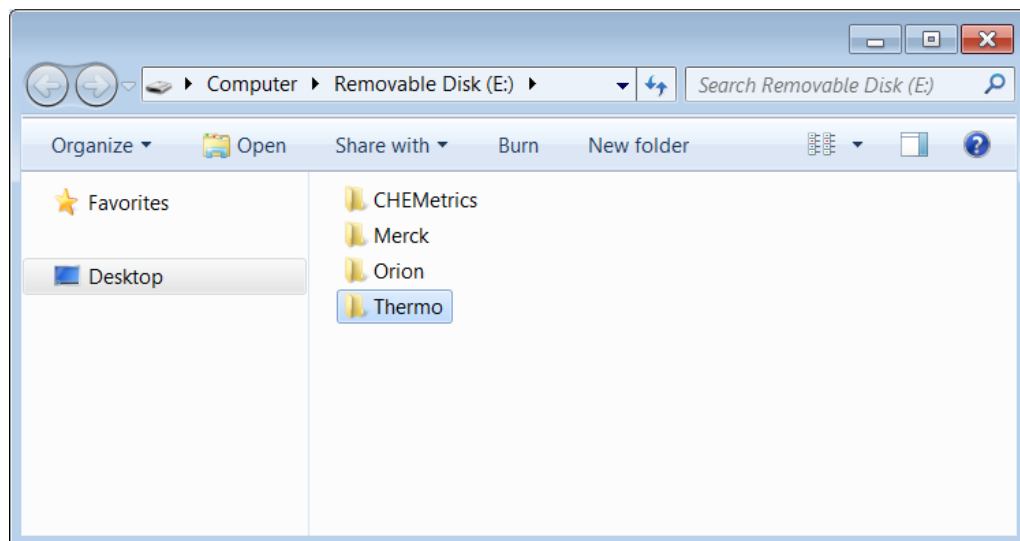
AquaMate instruments allow a one point adjustment on any preprogrammed method using a known standard to correct for variations in batch to batch reagent chemistries.

The following instructions are for using Orion AQUAfast reagent, Merck or CHEMetrics chemistries with the AquaMate spectrophotometer. Preprogrammed methods use a specific vial size (path length) in the formula and the vial size specified in these instructions must be used for accurate analysis. The majority of AQUAfast reagent methods use a 24mm round vial, Cat. No. AC2V24 or 16mm round vial, Cat. No. AC2V16. Other vial sizes are noted in the individual reagent chemistry instructions.

Loading and Running a Water Analysis Method on the AquaMate Instrument

The USB memory stick included with the AquaMate spectrophotometers contains over 260 preprogrammed methods for use with Orion AQUAfast, Merck and CHEMetrics reagent chemistries. Methods can be accessed directly from the USB memory stick when connected to the AquaMate spectrophotometer or up to 90 methods can be stored on the instrument for quick and easy access.

The USB memory stick contains four folders: Thermo, Orion, Merck and CHEMetrics. The Thermo folder is empty and all methods to be loaded on the AquaMate spectrophotometer need to be copied to the Thermo folder. The Orion, Merck and CHEMetrics folders contain preprogrammed methods specific to that manufacturer.



- Information for methods in the Orion folder is available in this user guide and the *Thermo Scientific Orion AquaMate Master Methods List* document.
- Information for methods in the Merck and CHEMetrics folders is available in the *Thermo Scientific Orion AquaMate Master Methods List* and on the manufacturer's website.

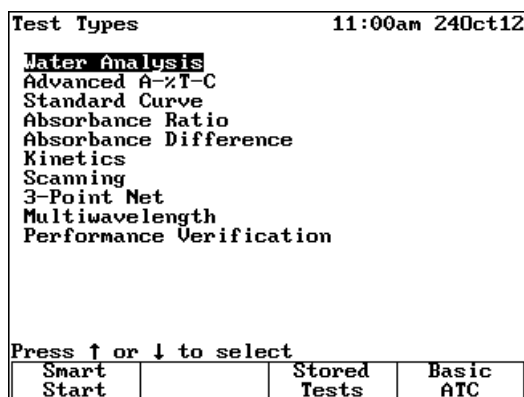
Note: A copy of the methods on the USB memory stick should be saved to a computer or other data source in case the USB memory stick is accidentally deleted or otherwise corrupted.

Loading Test Methods from USB Stick to AquaMate Instrument

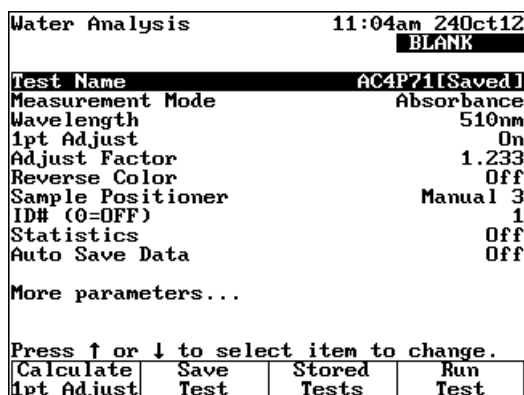
1. Open the AquaMate USB memory stick using a computer.
2. Copy the desired test methods from the Orion, Merck and CHEMetrics folders to the Thermo folder.
3. Remove the USB memory stick from the computer and insert it into the USB port on the front of the AquaMate instrument.
4. When the AquaMate instrument is first powered on, it will display the initial measurement screen. Press the **test** key to access the Test Types menu.



5. Press the **▲** or **▼** key to highlight Water Analysis and press the **enter** key.



6. Press the **Stored Tests** function key.



7. Press the ▲ or ▼ key to highlight Load test from USB drive and press the enter key.

Water Analysis		11:05am 24Oct12	
		BLANK	
Test Name	Load internal test		
Measurement	Load test from USB drive		
Wavelength			
1pt Adjust	Press ↑ or ↓ to select		
Adjust Facto	Press ENTER		
Reverse Colo	Press ESC to exit		
Sample Posit			
ID# (0=OFF)	1		
Statistics	Off		
Auto Save Data	Off		
More parameters...			
Press ↑ or ↓ to select item to change.			

8. Press the ▲ or ▼ key to highlight the test method and press the **Load Test** function key.

Utility Files Directory		11:05am 24Oct12	
AC4P12.WA	26Jun12		
AC4P71.WA	24Oct12		
AC4P72.WA	27Jun12		
CODL00.WA	24Oct12		
More tests...			
Press ↑ or ↓ to select test.			
		Delete Test	Load Test

9. Press the **Save Test** function key.

Water Analysis		11:06am 24Oct12	
		BLANK	
Test Name	CODL00[Saved]		
Measurement Mode	Absorbance		
Wavelength	420nm		
1pt Adjust	Off		
Reverse Color	Off		
Sample Positioner	Manual 3		
ID# (0=OFF)	1		
Statistics	Off		
Auto Save Data	On		
Data File Name	COD		
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save Test	Stored Tests	Run Test

10. Press the ▲ or ▼ key to highlight Save as an internal test and press the enter key.

Water Analysis		11:07am 24Oct12	
		BLANK	
Test Na	Save as an internal test		
Measure	Save test to the USB drive		
Wavelen	Save test to internal and USB		
1pt Adj			
Reverse	Press ↑ or ↓ to select		
Sample	Press ENTER		
ID# (0=	Press ESC to exit		
Statist			
Auto Save Data			On
Data File Name			COD
More parameters...			
Press ↑ or ↓ to select item to change.			

11. Press the **Accept Name** function key.

Create Test Name		11:07am 24Oct12	
ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789			
abcdefghijklmnopqrstuvwxyz_*/()#			
Test Name = CODL00			
Press ↑ or ↓ to select character.			
Press Accept Name to save the test.			
Delete Name	Delete Character	Add Character	Accept Name

12. Press the **▲** or **▼** key to highlight Include as a SmartStart test or Do not include as a SmartStart test and press the **enter** key.

Create Test Name		11:08am 24Oct12	
▲	Include as a SmartStart test		
a	Do not include as a SmartStart test		
	Press ↑ or ↓ to select		
	Press ENTER		
	Press ESC to exit		
T			
Press ↑ or ↓ to select character.			
Press Accept Name to save the test.			

13. Press the **Run Test** function key to begin using the test method. Refer to the specific reagent chemistry instructions for detailed procedures.

Water Analysis		11:09am 24Oct12	
		BLANK	
Test Name		CODL00[Saved]	
Measurement Mode		Absorbance	
Wavelength		420nm	
1pt Adjust		Off	
Reverse Color		Off	
Sample Positioner		Manual 3	
ID# (0=OFF)		1	
Statistics		Off	
Auto Save Data		On	
Data File Name		COD	
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save	Stored	Run
	Test	Tests	Test

Running a Test Method

Running a Test Method from the USB Stick

1. Make sure the test method to be run is in the Thermo folder on the USB stick and the USB stick is connected to the USB port on the front of the AquaMate instrument.
2. Press the **test** key to access the Test Types menu.
3. Press the **▲** or **▼** key to highlight Water Analysis and press the **enter** key.
4. Press the **Stored Tests** function key.
5. Press the **▲** or **▼** key to highlight Load test from USB drive and press the **enter** key.
6. Press the **▲** or **▼** key to highlight the test method and press the **Load Test** function key.
7. Press the **Run Test** function key.

Running a Test Method from the AquaMate Instrument Library

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Water Analysis and press the **enter** key.
3. Press the **Stored Tests** function key.
4. Press the **▲** or **▼** key to highlight Load internal test and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the test method and press the **Load Test** function key.
6. Press the **Run Test** function key.

Running a Test Method from the AquaMate SmartStart Menu

1. Press the **test** key to access the Test Types menu.
2. Press the **SmartStart** function key.
3. Press the **▲** or **▼** key to highlight the test method and press the **Load Test** function key.
4. Press the **Run Test** function key.

Running a Water Analysis Test Method

1. When a preprogrammed test method has been loaded, the following screen will appear.

Water Analysis		3:28pm 26Mar15	
		BLANK	
Test Name	AC4P71[Saved]		
Measurement Mode	Absorbance		
Wavelength	510.0nm		
1pt Adjust	Off		
Reverse Color	Off		
Sample Positioner	Manual 3		
ID# (0=OFF)	1		
Statistics	Off		
Auto Print	On		
Auto Save Data	Off		
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save Test	Stored Tests	Run Test

2. Press the **Run Test** function key. The following screen will appear.

Water Analysis		3:29pm 26Mar15	
Test Name: AC4P71		BLANK	
ID#	Abs 510.0nm	Result mg/L	
---	-----	-----	
Measure Blank			

3. Open the sample compartment door. If the desired sample holder is not in the beam, press the appropriate **Sample Changer** key on the instrument keypad corresponding to the correct vial holder position (**B** for the adjustable round vial holder, **2** for 10 mm square vials and **4** for 20-50 mm rectangular long path vials). If necessary, the instrument will rotate the carousel to place the correct vial holder in the measurement position.
4. Insert a vial containing the blank or zero solution into the sample holder.

Note: Ideally, the same vial should be used or one that has been matched to the sample vial.

5. Close the lid and press the **Measure Blank** function key. The instrument will set the measurement wavelength and perform a blank measurement.

[illegible]

6. Open the lid and remove the vial containing the blank or zero solution.
7. Place the vial containing the sample into the sample holder and close the lid.
8. Press the **Measure Sample** function key. The results will displayed as shown below.

Water Analysis		3:53pm 26Mar15	
Test Name: AC4P71		BLANK	
ID#	Abs 510.0nm	Result mg/L	
1	0.000	0.000	
2	2.549	5.203	
3	2.899	6.066	
Page 1, Samples 1 - 3			
Measure Blank	Save Data		Measure Sample

9. To save the measurements to the USB memory stick, press the **Save Data** function key.

Note: The blank measurement will be remembered as long as you are working in the sample test method. After pressing the **Run Test** function key, the **Measure Sample** function key will be shown if the blank has already been measured and pressing the **Measure Sample** function key will use the previously blank measurement. The blank measurement will be cleared automatically if any test method settings are changed, if the test method is saved or if a new test method is loaded.

Note: When running a reverse color test method, a reagent blank measurement will be required after the measurement of the standard blank. Insert the vial containing the reagent blank and press the **Measure Rgnt Blank** function key. Open the lid and remove the reagent blank. See the [Using the Reverse Color Feature](#) section for detailed instructions.

Note: If the Statistics option is set to Off in the test parameters menu, no Average or Std Dev information will be displayed in the measurement screen.

Using the One Point Adjustment Feature

Use the one point adjustment feature prior to running a preprogrammed test method to ensure accurate measurements. This procedure is recommended each time a new batch of reagents are used to account for variations in batch-to-batch reagent composition and other factors that affect the accuracy of a method with a fixed calibration curve.

When the one point adjustment feature is off, no adjustment is applied when running the test and test results are calculated exactly according to the preprogrammed equation.

1. Load the test method in the Water Analysis test menu.
2. If the 1pt Adjust option is set to Off, press the ▲ or ▼ key to highlight **1pt Adjust** and press the enter key to set the parameter to On.

Water Analysis		9:54am 27Mar15	
		BLANK	
Test Name	AC4P71		
Measurement Mode	Absorbance		
Wavelength	510.0nm		
1pt Adjust	On		
Adjust Factor	1.000		
Reverse Color	Off		
Sample Positioner	Manual 3		
ID# (0=OFF)	1		
Statistics	Off		
Auto Print	Off		
Auto Save Data	Off		
More parameters...			
Press ↑ or ↓ to select item to change.			
Calculate	Save	Stored	Run
1pt Adjust	Test	Tests	Test

3. Prepare a blank, reagent blank (reverse color methods only) and calibration standard with a known concentration within the method range and near the expected sample concentration. Refer to the specific reagent chemistry instructions for detailed information.
4. Press the **Calculate 1pt Adjust** function key.
5. Enter the concentration of the standard using the numeric keypad and press the enter key.

Water Analysis		9:57am 27Mar15	
Test Name: AC4P71		BLANK	
Standard Concentration		0.000 mg/L	
Entry: 1.00			
Enter a number (0.000 to 9999)			

6. Wipe the exterior of the blank vial and place the blank vial into the holder in the sample chamber and close the chamber door.

7. Press the **Measure Blank** function key.
8. Open the sample chamber door and remove the vial from the holder.
9. For reverse color methods only: Wipe the exterior of the reagent blank vial and place the reagent blank vial into the holder in the sample chamber and close the chamber door. Press the **Measure Rgnt Blank** function key. Open the sample chamber door and remove the vial from the holder.
10. Wipe the exterior of the standard vial and place the standard vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Standard** function key.
12. Open the sample chamber door and remove the vial from the holder.
13. The display will show the entered standard concentration, the measured standard concentration without a correction factor and the calculated adjustment correction factor.

Water Analysis		9:59am 27Mar15	
Test Name: AC4P71		BLANK	
Standard Concentration		1.000 mg/L	
Measured Concentration		1.260 mg/L	
Adjust Correction		0.794	
Measure Blank	Accept		Measure Standard

14. Press the **Accept** function key if the calculated adjustment correction factor is acceptable. Typically, a correction factor of 0.7 to 1.3 (within $\pm 30\%$) is acceptable.
15. To save the adjustment correction factor to the test method, press the **Save Test** function key and overwrite the existing test method or save as a new test method.
16. Press the **Run Test** function key. When running a test with an adjustment correction factor in use, the display will show (1pt Adj) next to the test name.

Water Analysis		10:02am 27Mar15	
Test Name: AC4P71(1pt Adj)		BLANK	
ID#	Abs	Result	
	510.0nm	mg/L	
Measure Blank			

Using the Reverse Color Feature

Reverse color methods use a reagent that, when prepared with samples, decreases in color as the concentration of the species being measured in the samples increases. Reverse color methods require the use of both a blank and a reagent blank. The blank is a clear solution (deionized water) with zero absorbance. The reagent blank is a mixture of the reagent and deionized water (or initial reagent and sample, as in the zinc by zincon method) and provides a zero concentration point with the darkest color (highest absorbance). The color of samples prepared with the reagent will decrease as the concentration increases. The following provides an overview how to perform a reverse color method.

1. Load the test method in the Water Analysis test menu. The Reverse Color option should be set to On for the method.

```

Water Analysis                                10:06am 27Mar15
                                           BLANK

Test Name                                AC2009
Measurement Mode                        Absorbance
Wavelength                             580.0nm
1pt Adjust                             Off
Reverse Color                           On
Sample Positioner                       Manual 3
ID# (0=OFF)                             1
Statistics                             Off
Auto Print                             Off
Auto Save Data                          Off

More parameters...

Press ↑ or ↓ to select item to change.

```

	Save	Stored	Run
	Test	Tests	Test

2. Press the **Run Test** function key.
3. Fill a vial with deionized water. Close the vial tightly with the cap. Wipe the exterior of the vial.
4. Place the vial into the holder in the sample chamber and close the chamber door.
5. Press the **Measure Blank** function key to measure the blank.

[illegible]

6. Open the sample chamber door and remove the vial from the holder.

7. Add the reagent or reagents to the vial. Close the vial tightly with the cap and mix the contents. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Rgnt Blank** function key to measure the reagent blank.

Water Analysis		10:10am 27Mar15
Test Name: AC2009		BLANK
ID#	Abs 580.0nm	Result mg/L
-----	-----	-----
Measure Blank		Measure Rgnt Blank

10. Open the sample chamber door and remove the vial from the holder.
11. Empty and rinse the vial and then fill the vial with sample. Add the reagent or reagents to the vial. Close the vial tightly with the cap and mix the contents. Wipe the exterior of the vial.
12. Place the vial into the holder in the sample chamber and close the chamber door.
13. Press the **Measure Sample** function key to display the results.

Water Analysis		10:10am 27Mar15
Test Name: AC2009		BLANK
ID#	Abs 580.0nm	Result mg/L
-----	-----	-----
Measure Blank		Measure Rgnt Blank

Water Analysis		10:12am 27Mar15
Test Name: AC2009		BLANK
ID#	Abs 580.0nm	Result mg/L
-----	-----	-----
1	0.000	0.308
2	0.026	0.259
3	0.079	0.148
Page 1, Samples 1 - 3		
Measure Blank	Save Data	Measure Rgnt Blank

Creating or Modifying a Test Method

How to Define the Test Method Parameters

The Water Analysis test technique can be used with colorimetric reagents in addition to those included on the AquaMate USB memory stick when the test kit manufacturer specifies the wavelength and factor or equation (up to third order polynomials) required for obtaining the concentration of the test kit.

When creating a new test method, the format for entering the factor or equation is:

$$\text{Result} = A + Bx + Cx^2 + Dx^3 \quad \text{where } x \text{ is absorbance at the set wavelength}$$

When x is substituted with **Abs**, the following equation can be used:

$$\text{Result} = A + B \cdot \text{Abs} + C \cdot \text{Abs}^2 + D \cdot \text{Abs}^3$$

where **A** is a numeric value

B is a numeric value multiplied by absorbance

C is a numeric value multiplied by absorbance squared

D is a numeric value multiplied by absorbance cubed

For test kits that specify a simple multiplicative factor, enter the factor as the B value.

For example, a colorimetric test kit provides a factor of 12.68.

The equation is: Result = 12.68*(Abs)

Where Abs is the measured absorbance at the specified wavelength.

Set the factor as: B = 12.68

Water Analysis		10:17am 27Mar15	
		BLANK	
Result= A + BX + CX2 + DX3			
A	0.00000000		
B(or Factor)	12.68000000		
C	0.00000000		
D	0.00000000		
Result Units	mg/L		
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save Test	Stored Tests	Run Test

For test kits that specify an equation, decipher the A, B, C and D factors for the equation.

For example, if the equation given with a test kit is: ppm (mg/L) = 2301 (abs) - 3

The equation is: Result = -3 + 2301*(Abs)

Set the factors as: A = -3

B = 2301

C = 0

D = 0

Water Analysis		10:29am 27Mar15	
		BLANK	
Result= A + BX + CX2 + DX3			
A	-3.00000000		
B(or Factor)	2301.00000000		
C	0.00000000		
D	0.00000000		
Result Units	mg/L		
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save Test	Stored Tests	Run Test

To determine if a test is a reverse color test, use the $\text{Result} = A + B*(\text{Abs}) + C*(\text{Abs})^2 + D*(\text{Abs})^3$ equation. If the **B** value is negative, the test is a reverse color test.

Using the equation $Y = mX + b$, where **m** is the slope and **b** is the y intercept, substitute **Y** with **Result** and **X** with **(Abs)**: $\text{Results} = b + m (\text{Abs})$

For a reverse color equation, the slope is negative and the absorbance (color) decreases as concentration increases. For a standard equation, the slope is positive and absorbance (color) increases as concentration increases.

How to Modify the Test Method Parameters

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Water Analysis and press the **enter** key.
3. Highlight and change the displayed test parameters, including the Wavelength value. If a reverse color test is being programmed, the Reverse Color option must be set to On.

Water Analysis		4:06pm 26Mar15	
		BLANK	
Test Name			
Measurement Mode	Absorbance		
Wavelength	510.0nm		
1pt Adjust	Off		
Reverse Color	Off		
Sample Positioner	Manual 3		
ID# (0=OFF)	Off		
Statistics	Off		
Auto Print	Off		
Auto Save Data	Off		
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save Test	Stored Tests	Run Test

4. Press the **▲** or **▼** key to highlight More parameters... and press the **enter** key.

Water Analysis		4:07pm 26Mar15	
		BLANK	
Result= A + BX + CX2 + DX3			
A	0.00000000		
B(or Factor)	1.00000000		
C	0.00000000		
D	0.00000000		
Result Units	mg/L		
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save Test	Stored Tests	Run Test

5. Press the **▲** or **▼** key to highlight the A, B, C or D factor, press the **enter** key, use the numeric keypad to enter the factor value and press the **enter** key. Repeat for each required equation factor.
6. Save or run the test using the new test parameters.

5

CHAPTER 5 Orion AQUAfast Reagent Chemistry Instructions for Orion AquaMate

Orion AQUAfast Colorimetric Reagents Compatible with Orion AquaMate Instruments

Use the information in the following table to identify the Orion AQUAfast reagent method file name on the USB memory stick and the test parameters associated with each method. This information is also included in the Orion AquaMate Master Methods List available on the Orion AquaMate user documentation CD or on our website at www.thermoscientific.com/water.

Parameter	Part #	Method	Description
Alkalinity	AC2002	AC2002	Alkalinity-M Tablet Reagent
Alkalinity	AC3002P	AC3002P	Alkalinity-P Tablet Reagent
Aluminum	AC2027	AC2027	Aluminum Tablet Reagent
Aluminum	AC4P27	AC4P27	Aluminum Powder Pack & Liquid Reagent
Ammonia	AC2012	AC2012	Ammonia Tablet Reagent
Ammonia	AC4P12	AC4P12	Ammonia Powder Pack Reagent
Ammonia	ACR012	ACR012	Ammonia Low Range Reaction Tube Reagent
Ammonia	ACR011	ACR011	Ammonia High Range Reaction Tube Reagent
Bromine	AC2035	AC203524	Bromine Tablet Reagent
Chloride	AC2017	AC2017	Chloride Tablet Reagent
Chlorine	AC2070	AC207024	Chlorine (Free & Total) Tablet Reagent
Chlorine	AC2071	AC207124	Chlorine (Free) Tablet Reagent
Chlorine	AC2072	AC207224	Chlorine (Total) Tablet Reagent
Chlorine	AC4P71	AC4P71	Chlorine (Free) Powder Pack Reagent

Parameter	Part #	Method	Description
Chlorine	AC4P72	AC4P72	Chlorine (Total) Powder Pack Reagent
Chlorine	AC3072	AC3072	Chlorine (Total) High Range Tablet Reagent
Chlorine Dioxide	AC2099	AC209924	Chlorine Dioxide Tablet Reagent
COD	CODL00	CODL00	COD Low Range Digestion Tube Reagent
COD	CODH00	CODH00	COD Mid Range Digestion Tube Reagent
COD	CODHP0	CODHP0	COD High Range Digestion Tube Reagent
Copper	AC2029	AC202924	Copper (Free & Total) Tablet Reagent
Copper	AC4P29	AC4P29	Copper (Free) Powder Pack Reagent
Cyanuric Acid	AC2098	AC2098	Cyanuric Acid Tablet Reagent
Fluoride	AC2009	AC2009	Fluoride SPADNS Liquid Reagent
Hardness	AC3032T	AC3032TL	Hardness (Total) Low Range Tablet Reagent
Hardness	AC3032T	AC3032TH	Hardness (Total) High Range Tablet Reagent
Hydrazine	AC2030	AC2030	Hydrazine Powder Reagent
Iron	AC2078	AC207824	Iron (II & III) Tablet Reagent
Iron	AC4P78	AC4P78	Iron (Ferro) Powder Pack Reagent
Iron	AC4P79	AC4P79	Iron (Total) Powder Pack Reagent
Manganese	AC2055	AC2055	Manganese Tablet Reagent
Manganese	AC4P54	AC4P54	Manganese Low Range Powder Pack & Liquid Reagent
Manganese	AC4P55	AC4P55	Manganese High Range Powder Pack Reagent
Molybdate	AC4P42	AC4P42	Molybdate/Molybdenum Powder Pack Reagent
Nitrate	ACR007	ACR007	Nitrate Reaction Tube Reagent
Nitrite	AC2046	AC2046	Nitrite Tablet Reagent
Nitrite	AC4P46	AC4P46	Nitrite Powder Pack Reagent
Nitrogen, Total	ACD004	ACD004	Nitrogen (Total) Low Range Digestion Tube Reagent
Nitrogen, Total	ACD007	ACD007	Nitrogen (Total) High Range Digestion Tube Reagent
Ozone	AC3048	AC3048	Ozone Tablet Reagent
pH	AC2001	AC2001	pH Tablet Reagent
pH	AC3001	AC3001	pH Liquid Reagent
Phosphate	AC2095-WA	AC2095	Phosphate (Ortho) Low Range Tablet Reagent
Phosphate	AC2096	AC2096	Phosphate (Ortho) High Range Tablet Reagent
Phosphate	AC4P95	AC4P95	Phosphate (Ortho) Powder Pack Reagent
Phosphate	ACR095	ACR095	Phosphate (Ortho) Reaction Tube Reagent
Phosphate	ACD095	ACD095	Phosphate (Total) Digestion Tube Reagent
Phosphate	ACD095AH	ACD095AH	Phosphate (Acid Hydrolysable) Digestion Tube Reagent
Silica	AC2060	AC2060	Silica Tablet Reagent
Silica	AC2061	AC2061	Silica with Phosphate Removal Tablet Reagent
Silica	AC4P60	AC4P60	Silica Powder Pack Reagent
Sulfate	AC4P82	AC4P82	Sulfate Powder Pack Reagent
Sulfide	AC2016	AC2016	Sulfide Tablet Reagent
Zinc	AC2065	AC2065	Zinc Tablet Reagent

Orion AQUAfast Reagent Instructions

The measurement ranges specified in the following test procedures are based on standard solutions measured under ideal conditions. These ranges may vary due to the type of sample being measured, since various interferences can have a major influence on the accuracy of the method. Due to the fact that each sample is different, the only way to check the tolerance (precision) is the Standard Additions Method. According to this method, first the original sample is tested. Then further samples (2 to 4) are taken and small amounts of a standard solution are added and further results are obtained. The amounts added range from approximately half, up to double the amount present in the sample itself. These supplementary results make it possible to estimate the actual concentration of the original sample by comparison.

Test methods and ranges are subject to change without notice. For a list of the most up-to-date test methods, visit www.thermoscientific.com/water.

Recommendations for Avoiding Measurement Errors

- Thoroughly clean vials, caps and stir rods after each analysis in order to prevent carry-over errors. Even minute reagent residues lead to incorrect measurements.
- Ensure that the outer walls of the vials are dry and clean before performing the analysis. Fingerprints or water droplets on the light entry surfaces of the vials lead to incorrect measurements.
- Blank and measurement procedures should be performed using the same vial whenever possible, since different vials can possess slightly different tolerances.
- Always take all readings with capped vials.
- Bubbles on the inside walls of the vial can lead to incorrect measurements. To prevent this, cap the vial and remove the bubbles by swirling the vial before performing the test.
- Always add the reagent to the sample straight from the foil. The reagent should never touch fingers or hands.
- Major temperature differentials between the instrument and environment can lead to incorrect measurements - i.e. due to the formation of condensate in the area of the lens or on the vial. Specified tolerances at $T = 20\text{ }^{\circ}\text{C}$.
- For the best results, use a pipette to measure and add samples to vials or beakers.

AC2002 Alkalinity-M (Alkalinity to pH 4.3) Tablet Test

Acid/Indicator Method

5 – 200 mg/l CaCO_3

1. Load and run the AC2002 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Alka-M Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Sample** function key to display the result in mg/l total alkalinity.

Notes:

- The terms total alkalinity, alkalinity-m, m-value and alkalinity to pH 4.3 are identical.
- For accurate results, exactly 10 ml of water sample must be taken for the test.

AC3002P Alkalinity-P (Alkalinity to pH 8.2) Tablet Test

Acid/Indicator Method

5 – 300 mg/l CaCO_3

1. Load and run the AC3002P method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Alka-P Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Sample** function key to display the result in mg/l total alkalinity.

Notes

- The terms alkalinity-p, p-value and alkalinity to pH 8.2 are identical.
- For accurate test results, exactly 10 ml of water sample must be taken for the test.
- This method was developed from a volumetric procedure for the determination of alkalinity-p. Due to undefined conditions, the deviations from the standardized method may be greater.

AC2027 Aluminum Tablet Test

Eriochrome Cyanine R Method

0.01 – 0.3 mg/l Al

1. Load and run the AC2027 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Aluminum No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod and mix well to dissolve the tablet completely.
7. Add one Aluminum No. 2 Tablet straight from the foil into the same vial. Crush the tablet with a clean stir rod and mix well to dissolve the tablet completely.
8. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
9. Wait for a reaction period of 5 minutes.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l aluminum.

Notes:

- Before use, clean the vials and the measuring beaker with hydrochloric acid (approximately 20%). Rinse them thoroughly with deionized water.
- To get accurate results the sample temperature must be between 20 °C and 25 °C.
- A low test result may be given in the presence of fluorides and polyphosphates. The effect of this is generally insignificant unless the water has fluoride added artificially.

AC4P27 Aluminum Powder Pack & Liquid Test

Eriochrome Cyanine R Method

0.01 – 0.25 mg/l Al

1. Load and run the AC4P27 method.
2. Use two clean AQUAfast 24mm round vials, Cat. No. AC2V24 and mark one as the blank.
3. Pour 20 ml of sample into a 100 ml beaker.
4. Add the contents of one Aluminum ECR F20 Powder Pack straight from the foil into the sample in the beaker. Dissolve the powder using a clean stirring rod.
5. Wait for a reaction period of 30 seconds.
6. Add the contents of one Hexamine F20 Powder Pack straight from the foil into the same sample in the beaker. Dissolve the powder using a clean stirring rod.
7. Add 1 drop of Aluminum ECR Masking Reagent into the vial marked as blank. Add 10 ml of the prepared sample to the same vial (this is the blank vial).
8. Add the remaining 10 ml of the prepared sample to the second vial (this is the sample vial).
9. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
10. Wait for a reaction period of 5 minutes.
11. Place the blank vial into the holder in the sample chamber and close the chamber door.
12. Press the **Measure Blank** function key to measure the blank.
13. Open the sample chamber door. Remove the blank vial from the holder.
14. Place the sample vial into the holder in the sample chamber and close the chamber door.
15. Press the **Measure Sample** function key to display the result in mg/l aluminum.

Notes:

- Before use, clean the vials and the measuring beaker with hydrochloric acid (approximately 20%). Rinse them thoroughly with deionized water.
- To get accurate results the sample temperature must be between 20 °C and 25 °C.
- A low test result may be given in the presence of fluorides and polyphosphates. The effect of this is generally insignificant unless the water has fluoride added artificially.

AC2012 Ammonia Tablet Test

Indophenole Blue Method

0.02 – 1 mg/l N (Ammonia as Nitrogen)

1. Load and run the AC2012 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Ammonia No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Add one Ammonia No. 2 Tablet straight from the foil into the same sample in the vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 10 minutes.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l ammonia as N.

Notes:

- The tablets must be added in the correct sequence.
- The Ammonia No. 1 tablet will only dissolve completely after the Ammonia No. 2 tablet has been added.
- The temperature of the sample is important for full color development. At a temperature below 20 °C, the reaction period is 15 minutes.
- Conversion: $\text{mg/l NH}_4 = \text{mg/l N} \times 1.29$
 $\text{mg/l NH}_3 = \text{mg/l N} \times 1.22$

AC4P12 Ammonia Powder Pack Test

Salicylate Method

0.01 – 0.8 mg/l N (Ammonia as Nitrogen)

1. Load and run the AC4P12 method.
2. Use two clean AQUAfast 24mm round vials, Cat. No. AC2V24.
3. Pour 10 ml of deionized water into the first vial (this is the blank vial).
4. Pour 10 ml of sample into the second vial (this is the sample vial).
5. Add contents of one Ammonia Salicylate F10 Powder Pack straight from the foil into each vial. Close the vials tightly with the caps and swirl or invert several times to mix.
6. Wait for a reaction period of 3 minutes.
7. Add contents of one Ammonia Cyanurate F10 Powder Pack straight from the foil into each vial. Close the vials tightly with the caps and swirl or invert several times to mix. Wipe the exteriors of the vials.
8. Wait for a reaction period of 15 minutes.
9. Place the blank vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Blank** function key to measure the blank.
11. Open the sample chamber door. Remove the blank vial from the holder.
12. Place the sample vial into the holder in the sample chamber and close the chamber door.
13. Press the **Measure Sample** function key to display the result in mg/l ammonia as N.

Notes:

- Extremely basic or acidic water samples should be adjusted to pH 7 with a 0.5 mol/l (1 N) sulfuric acid solution or 1 mol/l (1 N) sodium hydroxide solution.

Interference	Interference Levels and Treatments
Calcium	Greater than 1000 mg/l CaCO_3
Iron	Interferes at all levels. To correct, determine the concentration of iron in the sample by performing a total iron test. Add the same iron concentration to the deionized water (step 3). Iron will be blanked out successfully.
Magnesium	Greater than 6000 mg/l CaCO_3
Nitrate	Greater than 100 mg/l $\text{NO}_3\text{-N}$
Nitrite	Greater than 12 mg/l $\text{NO}_2\text{-N}$
Phosphate	Greater than 100 mg/l $\text{PO}_4\text{-P}$
Sulfate	Greater than 300 mg/l SO_4
Sulfide	Intensifies the color
Glycine, Hydrazine, Color, Turbidity	Less common interferences such as hydrazine and glycine will cause intensified colors in the prepared sample. Turbidity and color will give erroneous high values. Samples with severe interferences require distillation.

ACR012 Ammonia Low Range Reaction Tube Test

Salicylate Method

0.02 – 2.5 mg/l N (Ammonia as Nitrogen)

1. Load and run the ACR012 method.
2. Open one 16 mm reaction vial and add 2 ml of deionized water (this is the blank vial).
3. Open a second 16 mm reaction vial and add 2 ml of sample (this is the sample vial).
4. Add the contents of one Ammonia Salicylate F5 Powder Pack straight from the foil into each vial.
5. Add contents of one Ammonia Cyanurate F5 Powder Pack straight from the foil into each vial.
6. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
7. Wait for a reaction period of 20 minutes.
8. Place the blank vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Blank** function key to measure the blank.
10. Open the sample chamber door. Remove the blank vial from the holder.
11. Place the sample vial into the holder in the sample chamber and close the chamber door.
12. Press the **Measure Sample** function key to display the result in mg/l ammonia as N.

Notes:

- Strong alkaline or acidic water samples must be adjusted to approximately pH 7 before analysis (use 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide).
- If chlorine is known to be present, add one drop of 0.1 mol/l sodium thiosulfate for each 0.3 mg/l Cl_2 in a one liter water sample.
- Iron interferes with the test. The interferences can be eliminated as follows: Determine the amount of total iron present in the water sample. To produce the blank add an iron standard solution with the same iron concentration to the vial instead of deionized water.
- Conversion: $\text{mg/l NH}_4 = \text{mg/l N} \times 1.29$
 $\text{mg/l NH}_3 = \text{mg/l N} \times 1.22$

ACR011 Ammonia High Range Reaction Tube Test

Salicylate Method

1 – 50 mg/l N (Ammonia as Nitrogen)

1. Load and run the ACR011 method.
2. Open one 16 mm reaction vial and add 0.1 ml of deionized water (this is the blank vial).
3. Open a second 16 mm reaction vial and add 0.1 ml of sample (this is the sample vial).
4. Add the contents of one Ammonia Salicylate F5 Powder Pack straight from the foil into each vial.
5. Add the contents of one Ammonia Cyanurate F5 Powder Pack straight from the foil into each vial.
6. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
7. Wait for a reaction period of 20 minutes.
8. Place the blank vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Blank** function key to measure the blank.
10. Open the sample chamber door. Remove the blank vial from the holder.
11. Place the sample vial into the holder in the sample chamber and close the chamber door.
12. Press the **Measure Sample** function key to display the result in mg/l ammonia as N.

Notes:

- Strong alkaline or acidic water samples must be adjusted to approximately pH 7 before analysis (use 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide).
- If chlorine is known to be present, add one drop of 0.1 mol/l sodium thiosulfate for each 0.3 mg/l Cl_2 in a one liter water sample.
- Iron interferes with the test. The interferences can be eliminated as follows: Determine the amount of total iron present in the water sample. To produce the blank, add an iron standard solution with the same iron concentration to the vial instead of deionized water.
- Conversion: $\text{mg/l NH}_4 = \text{mg/l N} \times 1.29$
 $\text{mg/l NH}_3 = \text{mg/l N} \times 1.22$

AC2035 Bromine Tablet Test

DPD Method

0.05 – 13 mg/l Br₂

1. Load and run the AC203524 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l bromine.

Notes:

- Alternatively, the AC203510 method can be used with 10mm square vials and the AC203550 method can be used with 50mm rectangular vials. All blank and sample volumes must remain the same as those specified in these instructions, so samples may need to be prepared in separate containers and then transferred into the selected vial.
- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of bromine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- Preparing the sample: When preparing the sample, the escape of bromine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagent tablet therefore contains a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).

- Exceeding the measuring range: Concentrations above 22 mg/l bromine can lead to results showing 0 mg/l. In this event, the water sample must be diluted with water free of bromine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Oxidizing agents such as chlorine or ozone interfere as they react in the same way as bromine.

AC2017 Chloride Tablet Test

Silver Nitrate/Turbidity Method

0.5 – 25 mg/l Cl

1. Load and run the AC2017 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Chloride T1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Add one Chloride T2 Tablet straight from the foil into the same vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl gently until the tablet is dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 2 minutes.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l chloride.

Notes:

- Ensure that all particles of the tablet are dissolved – chloride causes an extremely fine distributed turbidity with a milky appearance. Heavy shaking leads to bigger sized particles that can cause false readings.
- High concentrations of electrolytes and organic compounds have different effects on the precipitation reaction.
- Ions that also form deposits with silver nitrate in acidic media, such as bromides, iodides and thiocyanates, interfere with the analysis.
- Highly alkaline water should, if necessary, be neutralized using nitric acid before analysis.

AC2070 Chlorine (Free & Total) Tablet Test

DPD Method

0.01 – 6 mg/l Cl₂

1. Load and run the AC207024 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l free chlorine.
12. Open the sample chamber door and remove the vial from the holder.
13. Add one DPD No. 3 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
14. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
15. Wait for a reaction period of 2 minutes.
16. Place the vial into the holder in the sample chamber and close the chamber door.
17. Press the **Measure Sample** function key to display the result in mg/l total chlorine.

Notes:

- Alternatively, the AC207010 method can be used with 10mm square vials and the AC207050 method can be used with 50mm rectangular vials. All blank and sample volumes must remain the same as those specified in these instructions, so samples may need to be prepared in separate containers and then transferred into the selected vial.
- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.

Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.

- For individual testing of free and total chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3).
- Preparing the sample: When preparing the sample, the escape of chlorine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 10 mg/l chlorine using tablets can lead to results showing 0 mg/l. In this event, the water sample must be diluted with water free of chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Turbidity can lead to errors. The use of the DPD No. 1 tablet in samples with high calcium ion contents and/or high conductivity can lead to turbidity of the sample and therefore incorrect measurements.
- Oxidizing agents such as bromine or ozone interfere as they react in the same way as chlorine.

AC2071 Chlorine (Free) Tablet Test

DPD Method

0.01 – 6 mg/l Cl_2

1. Load and run the AC207124 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l free chlorine.

Notes:

- Alternatively, the AC207110 method can be used with 10mm square vials and the AC207150 method can be used with 50mm rectangular vials. All blank and sample volumes must remain the same as those specified in these instructions, so samples may need to be prepared in separate containers and then transferred into the selected vial.
- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- For individual testing of free and total chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3).
- Preparing the sample: When preparing the sample, the escape of chlorine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment. Strong alkaline or acidic water samples

must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).

- Exceeding the measuring range: Concentrations above 10 mg/l chlorine using tablets can lead to results showing 0 mg/l. In this event, the water sample must be diluted with water free of chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Turbidity can lead to errors. The use of the DPD No. 1 tablet in samples with high calcium ion contents and/or high conductivity can lead to turbidity of the sample and therefore incorrect measurements.
- Oxidizing agents such as bromine or ozone interfere as they react in the same way as chlorine.

AC2072 Chlorine (Total) Tablet Test

DPD Method

0.01 – 6 mg/l Cl₂

1. Load and run the AC207224 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 4 Tablet (or one DPD No. 1 Tablet and one DPD No. 3 Tablet) straight from the foil into the vial. Crush the tablet with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
10. Wait for a reaction period of 2 minutes.
11. Place the vial into the holder in the sample chamber and close the chamber door.
12. Press the **Measure Sample** function key to display the result in mg/l total chlorine.

Notes:

- Alternatively, the AC207210 method can be used with 10mm square vials and the AC207250 method can be used with 50mm rectangular vials. All blank and sample volumes must remain the same as those specified in these instructions, so samples may need to be prepared in separate containers and then transferred into the selected vial.
- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- For individual testing of free and total chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3).
- Preparing the sample: When preparing the sample, the escape of chlorine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.

- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 10 mg/l chlorine using tablets can lead to results showing 0 mg/l. In this event, the water sample must be diluted with water free of chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Turbidity can lead to errors. The use of the DPD No. 1 tablet in samples with high calcium ion contents and/or high conductivity can lead to turbidity of the sample and therefore incorrect measurements.
- Oxidizing agents such as bromine or ozone interfere as they react in the same way as chlorine.

AC4P71 Chlorine (Free) Powder Pack Test

DPD Method

0.02 – 2 mg/l Cl_2

1. Load and run the AC4P71 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add the contents of one Chlorine Free-DPD / F10 Powder Pack straight from the foil into the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents (approximately 20 seconds). Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Sample** function key to display the result in mg/l free chlorine.

Notes:

- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- For individual testing of free and total chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3).
- Preparing the sample: When preparing the sample, the escape of chlorine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 2 mg/l chlorine using powder packs can lead to results showing 0 mg/l. In this event, the water sample must be diluted with water free of chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Oxidizing agents such as bromine or ozone interfere as they react in the same way as chlorine.

AC4P72 Chlorine (Total) Powder Pack Test

DPD Method

0.02 – 2 mg/l Cl_2

1. Load and run the AC4P72 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add the contents of one Chlorine Total-DPD / F10 Powder Pack straight from the foil into the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents (approximately 20 seconds). Wipe the exterior of the vial.
8. Wait for a reaction period of 3 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l total chlorine.

Notes:

- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- For individual testing of free and total chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3).
- Preparing the sample: When preparing the sample, the escape of chlorine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 2 mg/l chlorine using powder packs can lead to results showing 0 mg/l. In this event, the water sample must be diluted with water free of chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Oxidizing agents such as bromine or ozone interfere as they react in the same way as chlorine.

AC3072 Chlorine (Total) High Range Tablet Test

KI / Acid Method

5 – 200 mg/l Cl₂

1. Load and run the AC3072 method.
2. Fill a clean AQUAfast 16 mm round vial, Cat. No. AC2V16, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Chlorine HR (KI) Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Add one Acidifying GP Tablet straight from the foil into the same vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l chlorine.

Notes:

- Oxidizing agents interfere as they react in the same way as chlorine.

AC2099 Chlorine Dioxide Tablet Test

DPD Method

0.02 – 11 mg/l ClO_2

Chlorine Dioxide Measurement in Absence of Chlorine

1. Load and run the AC209924 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l chlorine dioxide.

Chlorine Dioxide Measurement in Presence of Chlorine

1. Load and run the AC209924 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
8. Fill a second clean AQUAfast 24mm round vial with 10 ml of sample. Add one Glycine Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved.
9. Transfer the contents of the second vial into the first vial.

10. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
11. Place the vial into the holder in the sample chamber and close the chamber door.
12. Press the **Measure Sample** function key to display the result in mg/l chlorine dioxide.

Notes:

- Alternatively, the AC209950 method can be used with 50mm rectangular vials. All blank and sample volumes must remain the same as those specified in these instructions, so samples may need to be prepared in separate containers and then transferred into the selected vial.
- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine dioxide may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- Preparing the sample: When preparing the sample, the escape of chlorine dioxide gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagent tablet therefore contains a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the tablet is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 19 mg/l chlorine dioxide can lead to results showing 0 mg/l. In this event, the water sample must be diluted with water free of chlorine dioxide. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Oxidizing agents such as chlorine or ozone interfere as they react in the same way as chlorine dioxide.

CODL00 COD Low Range Digestion Tube Test

Dichromate Digestion Method

0 – 150 mg/l O₂

1. Open one 16 mm COD reaction vial and add 2 ml of deionized water (this is the reagent blank vial).
2. Open a second 16 mm reaction vial and add 2 ml of sample (this is the sample vial).
3. Close the vials tightly with the caps and gently invert the vials several times to mix the contents. **CAUTION:** *The vials will become hot during mixing.*
4. Heat the vials for 120 minutes in the preheated reactor at a temperature of 150 °C.
5. **CAUTION:** *The vials will be hot.*
Remove the vials from the reactor and allow them to cool to 60 °C or less. Gently invert the vials several times to mix the contents while still warm. Allow the vials to cool to room temperature before measuring. Wipe the exteriors of the vials.
6. Load and run the CODL00 method.
7. Fill a clean AQUAfast 16mm round vial, Cat. No. AC2V16, with deionized water (this is the blank vial). Close the vial tightly with the cap. Wipe the exterior of the vial.
8. Place the blank vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Blank** function key to measure the blank.
10. Open the sample chamber door. Remove the blank vial from the holder.
11. Place the reagent blank vial into the holder in the sample chamber and close the chamber door.
12. Press the **Measure Rgnt Blank** function key to measure the reagent blank.
13. Open the sample chamber door. Remove the reagent blank vial from the holder.
14. Place the sample vial into the holder in the sample chamber and close the chamber door.
15. Press the **Measure Sample** function key to display the result in mg/l oxygen.

Notes:

- Reverse color methods use a reagent that, when prepared with samples, decreases in color as the concentration of the species being measured in the samples increases. Reverse color methods require the use of both a blank and a reagent blank. The blank is a clear solution (deionized water) with zero absorbance. The reagent blank is a mixture of the reagent and deionized water and provides a zero concentration point with the darkest color (highest absorbance). The color of samples prepared with the reagent will decrease as the concentration increases for this method.

- Run samples and blanks with the same batch of vials. The blank is stable when stored in the dark and can be used for further measurements with vials of the same batch.
- Do not place the hot vials in the sample chamber. Cool the vials to room temperature for final measurements.
- Suspended solids in the vial lead to incorrect measurements. For this reason, it is important to place the vials carefully in the sample chamber. The precipitate at the bottom of the sample should be not suspended.
- Clean the outside of the vials with a towel. Fingerprints or other marks must be removed.
- Samples can be measured when the chloride content does not exceed 1000 mg/l.
- In exceptional cases, compounds contained in the water cannot be oxidized adequately, so results may be lower than reference methods.

CODH00 COD Mid Range Digestion Tube Test

Dichromate Digestion Method

0 – 1500 mg/l O₂

1. Open one 16 mm COD reaction vial and add 2 ml of deionized water (this is the blank vial).
2. Open a second 16 mm COD reaction vial and add 2 ml of sample (this is the sample vial).
3. Close the vials tightly with the caps and gently invert the vials several times to mix the contents. **CAUTION:** *The vials will become hot during mixing.*
4. Heat the vials for 120 minutes in the preheated reactor at a temperature of 150 °C.
5. **CAUTION:** *The vials will be hot.*
Remove the vials from the reactor and allow them to cool to 60 °C or less. Gently invert the vials several times to mix the contents while still warm. Allow the vials to cool to room temperature before measuring. Wipe the exteriors of the vials.
6. Load and run the CODH00 method.
7. Place the blank vial into the holder in the sample chamber and close the chamber door.
8. Press the **Measure Blank** function key to measure the blank.
9. Open the sample chamber door. Remove the blank vial from the holder.
10. Place the sample vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l oxygen.

Notes:

- Run samples and blanks with the same batch of vials. The blank is stable when stored in the dark and can be used for further measurements with vials of the same batch.
- Do not place the hot vials in the sample chamber. Cool the vials to room temperature for final measurements.
- Suspended solids in the vial lead to incorrect measurements. For this reason, it is important to place the vials carefully in the sample chamber. The precipitate at the bottom of the sample should be not suspended.
- Clean the outside of the vials with a towel. Fingerprints or other marks must be removed.
- Samples can be measured when the chloride content does not exceed 1000 mg/l.
- In exceptional cases, compounds contained in the water cannot be oxidized adequately, so results may be lower than reference methods.
- For samples under 100 mg/l it is recommended to repeat the test using the COD low range test (CODL00).

CODHP0 COD High Range Digestion Tube Test

Dichromate Digestion Method

0 – 15000 mg/l O₂ (High Range)

1. Open one 16 mm COD reaction vial and add 0.2 ml of deionized water (this is the blank vial).
2. Open a second 16 mm COD reaction vial and add 0.2 ml of sample (this is the sample vial).
3. Close the vials tightly with the caps and gently invert the vials several times to mix the contents. **CAUTION:** *The vials will become hot during mixing.*
4. Heat the vials for 120 minutes in the preheated reactor at a temperature of 150 °C.
5. **CAUTION:** *The vials will be hot.*
Remove the vials from the reactor and allow them to cool to 60 °C or less. Gently invert the vials several times to mix the contents while still warm. Allow the vials to cool to room temperature before measuring. Wipe the exteriors of the vials.
6. Load and run the CODHP0 method.
7. Place the blank vial into the holder in the sample chamber and close the chamber door.
8. Press the **Measure Blank** function key to measure the blank.
9. Open the sample chamber door. Remove the blank vial from the holder.
10. Place the sample vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l oxygen.

Notes:

- Run samples and blanks with the same batch of vials. The blank is stable when stored in the dark and can be used for further measurements with vials of the same batch.
- Do not place the hot vials in the sample chamber. Cool the vials to room temperature for final measurements.
- Suspended solids in the vial lead to incorrect measurements. For this reason, it is important to place the vials carefully in the sample chamber. The precipitate at the bottom of the sample should be not suspended.
- Clean the outside of the vials with a towel. Finger prints or other marks must be removed.
- Samples can be measured when the chloride content does not exceed 1000 mg/l.
- In exceptional cases, compounds contained in the water cannot be oxidized adequately, so results may be lower than reference methods.
- For samples under 1000 mg/l it is recommended to repeat the test using the COD mid range test (CODH00) or for samples under 100 mg/l it is recommended to repeat the test using the COD low range test (CODL00).

AC2029 Copper (Free & Total) Tablet Test

Biquinoline Method

0.05 – 5 mg/l Cu

1. Load and run the AC202924 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Copper No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Sample** function key to display the result in mg/l free copper.
10. Open the sample chamber door and remove the vial from the holder.
11. Add one Copper No.2 Tablet straight from the foil into the same vial. Crush the tablet with a clean stir rod.
12. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
13. Place the vial into the holder in the sample chamber and close the chamber door.
14. Press the **Measure Sample** function key to display the result in mg/l total copper.

Notes:

- Alternatively, the AC202950 method can be used with 50mm rectangular vials. All blank and sample volumes must remain the same as those specified in these instructions, so samples may need to be prepared in separate containers and then transferred into the selected vial.

AC4P29 Copper (Free) Powder Pack Test

Bicinchoninate Method

0.05 – 5 mg/l Cu

1. Load and run the AC4P29 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add the contents of one Cu 1 F10 Powder Pack straight from the foil into the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Wait for a reaction period of 2 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l free copper.

Notes:

- For determination of total copper, a digestion is required.
- Extremely acid water samples (pH 2 or less) must be adjusted between pH 4 and pH 6 before the reagent is added (with 8 mol/l potassium hydroxide solution, KOH).
- Accuracy is not affected by undissolved powder.
- Interferences:

Cyanide (CN ⁻)	Cyanide prevents full color development. Add 0.2 ml formaldehyde to 10 ml water sample and wait for a reaction time of 4 minutes (cyanide is masked). After this perform test as described. Multiply the result by 1.02 to correct the sample dilution by formaldehyde.
Silver (Ag ⁺)	If turbidity remains and turns black, silver interference is likely. Add 10 drops of saturated potassium chloride solution to 75 ml of water sample. Filtrate through a fine filter. Use 10 ml of the filtered water sample to perform test.

AC2098 Cyanuric Acid Tablet Test

Melamine Method

0 – 160 mg/l CyA

1. Load and run the AC2098 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Cyanuric Acid Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved (see notes below). Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Sample** function key to display the result in mg/l cyanuric acid.

Notes:

- If cyanuric acid is present, a cloudy solution will occur. Small single particles are not necessarily caused by cyanuric acid.
- Dissolve the tablet completely (swirl the vial for approximately 1 minute). Undissolved particles of the tablet can cause results that are too high.
- Exceeding the measurement range: samples with concentration above 90 mg/l must be diluted with water free of cyanuric acid. 10 ml of the diluted sample should be tested as described above and the displayed results calculated using the dilution factor.

AC2009 Fluoride SPADNS Liquid Test

SPADNS Method

0.05 – 2 mg/l F

1. Load and run the AC2009 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with exactly 10 ml of deionized water. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add exactly 2 ml SPADNS Solution to the vial. **CAUTION:** *The vial will be filled to the top.*
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Rgnt Blank** function key to measure the reagent blank.
10. Open the sample chamber door and remove the vial from the holder.
11. Empty the vial, thoroughly rinse the vial and cap several times and then fill the vial with exactly 10 ml of sample.
12. Add exactly 2 ml SPADNS Solution to the vial. **CAUTION:** *The vial will be filled to the top.*
13. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
14. Place the vial into the holder in the sample chamber and close the chamber door.
15. Press the **Measure Sample** function key to display the result in mg/l fluoride.

Notes:

- Reverse color methods use a reagent that, when prepared with samples, decreases in color as the concentration of the species being measured in the samples increases. Reverse color methods require the use of both a blank and a reagent blank. The blank is a clear solution (deionized water) with zero absorbance. The reagent blank is a mixture of the reagent and deionized water and provides a zero concentration point with the darkest color (highest absorbance). The color of samples prepared with the reagent will decrease as the concentration increases for this method.
- The same batch of SPADNS reagent solution must be used for testing (reagent blank and sample measurement) and one point calibration procedures. The one point calibration process needs to be performed for each new batch of SPADNS reagent solution (see Standard Methods 20th ed., 1998, APHA, AWWA, WEF 4500 F⁻ D, 4.a).

- During testing (blank, reagent blank and sample measurement) and one point calibration procedures the same vial should be used, as different vials may exhibit minor tolerances.
- The calibration solution and water samples should have the same temperature (± 1 °C).
- As the test result is highly dependent on exact sample and reagent volumes, the sample and reagent volumes should always be measured using a 10 ml or 2 ml volumetric pipette (class A).
- The accuracy of the test methods decreases above a level of 1.2 mg/l fluoride. Although the results are sufficiently accurate for most applications, more exact results can be achieved using a 1:1 dilution of the sample prior to use and subsequent multiplication of the result by 2.
- SPADNS reagent solution contains arsenite. Chlorine concentrations up to 5 mg/l do not interfere.
- Seawater and wastewater samples must be distilled.

AC3032T Hardness (Total) Tablet Test

Metallphthalein Method

2 – 50 mg/l CaCO_3 (Low Range) or 20 – 500 mg/l CaCO_3 (High Range)

For Low Range Total Hardness Measurements:

1. Load and run the AC3032TL method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Hardcheck P Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Wait for a reaction period of 5 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l total hardness.

For High Range Total Hardness Measurements:

1. Load and run the AC3032TH method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 1 ml of sample and 9 ml of deionized water. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Hardcheck P Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Wait for a reaction period of 5 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l total hardness.

Notes:

- Strong alkaline or acidic water samples must be adjusted between pH 4 and pH 10 before the tablet is added (use 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide).

AC2030 Hydrazine Powder Test

Dimethylamino-benzaldehyde Method

0.05 – 0.5 mg/l N_2H_4

1. Load and run the AC2030 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one gram (1 g) Hydrazine Powder to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Wait for a reaction period of 10 minutes.
9. The slight turbidity that occurs when the reagent is added must be removed by filtration
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l hydrazine.

Notes:

- If the water sample is cloudy, you must filter it before performing the blank measurement.
- The temperature of the water sample should not exceed 21 °C.
- Using the hydrazine spoon: 1 g is equivalent to one level spoon.
- Qualitative folded filter papers for medium precipitates are recommended.
- In order to check whether the reagent has aged (if it has been stored for a lengthy period), perform the test as described above using tap water. If the result is above the detection limit of 0.05 mg/l, you should only use the reagent with reservations, as there may be a major deviation in results.

AC2078 Iron (II & III) Tablet Test

PPST Method

0.02 – 1 mg/l Fe

1. Load and run the AC207824 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Iron LR Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Wait for a reaction period of 5 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l iron.

Notes:

- Alternatively, the AC207850 method can be used with 50mm rectangular vials. All blank and sample volumes must remain the same as those specified in these instructions, so samples may need to be prepared in separate containers and then transferred into the selected vial.
- This method determines the total dissolved iron as Fe^{2+} and Fe^{3+} .
- For the determination of total dissolved and undissolved iron (soluble and insoluble iron), digestion is required. An example is described here:
 - i. Add 1 ml of concentrated sulfuric acid to 100 ml water sample. Heat and boil for 10 minutes or until all particles are dissolved. After cooling down, the sample is set to a pH value of 3 to 6 by using ammonia solution. Refill with deionized water to the previous volume of 100 ml and mix well. 10 ml of this pre-treated solution is used for analysis (perform as described by the selected test method).
 - ii. Water that has been treated with organic compounds like corrosion inhibitors must be oxidized as necessary to break down the iron. Therefore add 1 ml concentrated sulfuric acid and 1 ml concentrated nitric acid to 100 ml water sample and boil to approximately half volume. After cooling down, proceed as described above.

AC4P78 Iron (Ferro) Powder Pack Test

1,10-Phenanthroline Method

0.02 – 3 mg/l Fe

1. Load and run the AC4P78 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add the contents of one Ferro F10 Powder Pack straight from the foil into the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Wait for a reaction period of 3 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l iron.

Notes:

- The reagent reacts with all soluble iron and most insoluble forms of iron in the water sample.
- Iron oxide requires prior digestion: use mild, vigorous or Digesdahl digestion. An example of digestion with acid is described here:
 - i. Add 1 ml of concentrated sulfuric acid to 100 ml water sample. Heat and boil for 10 minutes or until all particles are dissolved. After cooling down, the sample is set to a pH value of 3 to 6 by using ammonia solution. Refill with deionized water to the previous volume of 100 ml and mix well. 10 ml of this pre-treated solution is used for analysis (perform as described by the selected test method).
 - ii. Water that has been treated with organic compounds like corrosion inhibitors must be oxidized as necessary to break down the iron. Therefore add 1 ml concentrated sulfuric acid and 1 ml concentrated nitric acid to 100 ml water sample and boil to approximately half volume. After cooling down, proceed as described above.
- Very strong alkaline or acidic samples must be adjusted to a pH value between 3 and 5 before analysis.
- Accuracy is not affected by undissolved powder.
- Water samples containing visible rust should be allowed to react for at least 5 minutes.

AC4P79 Iron (Total) Powder Pack Test

TPTZ Method

0.02 – 1.8 mg/l Fe

1. Load and run the AC4P79 method.
2. Use two clean AQUAfast 24mm round vials, Cat. No. AC2V24.
3. Pour 10 ml of deionized water into the first vial (this is the blank vial).
4. Pour 10 ml of sample into the second vial (this is the sample vial).
5. Add the contents of one Iron TPTZ F10 Powder Pack straight from the foil into each vial. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
6. Wait for a reaction period of 3 minutes.
7. Place the blank vial into the holder in the sample chamber and close the chamber door.
8. Press the **Measure Blank** function key to measure the blank.
9. Open the sample chamber door. Remove the blank vial from the holder.
10. Place the sample vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l iron.

Notes:

- For determination of total iron, digestion is required. TPTZ reagent recovers most insoluble iron oxides without digestion.
- Rinse all glassware with 1:1 hydrochloric acid solution first and then rinse with deionized water to remove iron deposits that can cause slightly high results.
- Strong alkaline or acidic water samples must be adjusted between pH 3 and pH 8 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Interferences: When interferences occur, color development is inhibited or a precipitate is formed. The values below refer to a standard with an iron concentration of 0.5 mg/l. The following substances do not interfere when present up to the levels given:

Substance	No Interference To
Cadmium	4.0 mg/l
Chromium ⁽³⁺⁾	0.25 mg/l
Chromium ⁽⁶⁺⁾	1.2 mg/l
Cobalt	0.05 mg/l
Copper	0.6 mg/l
Cyanide	2.8 mg/l

Substance	No Interference To
Manganese	50 mg/l
Mercury	0.4 mg/l
Molybdenum	4.0 mg/l
Nickel	1.0 mg/l
Nitrite Ion	0.8 mg/l

AC2055 Manganese Tablet Test

Formaldehyde Method

0.2 – 4 mg/l Mn

1. Load and run the AC2055 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Manganese LR 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Add one Manganese LR 2 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 5 minutes.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l manganese.

AC4P54 Manganese Low Range Powder Pack & Liquid Test

PAN Method

0.01 – 0.7 mg/l Mn

1. Load and run the AC4P54 method.
2. Use two clean AQUAfast 24mm round vials, Cat. No. AC2V24.
3. Pour 10 ml of deionized water into the first vial (this is the blank vial).
4. Pour 10 ml of sample into the second vial (this is the sample vial).
5. Add the contents of one Ascorbic Acid Powder Pack straight from the foil into each vial. Close the vials tightly with the caps and swirl or invert several times to mix the contents.
6. Add 15 drops of Alkaline Cyanide Reagent Solution to each vial. Add drops of the same size by holding the bottle vertically and squeezing slowly. Close the vials tightly with the caps and swirl or invert several times to mix the contents.
7. Add 21 drops of PAN Indicator Solution to each vial. Add drops of the same size by holding the bottle vertically and squeezing slowly. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
8. Wait for a reaction period of 2 minutes.
9. Place the blank vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Blank** function key to measure the blank.
11. Open the sample chamber door. Remove the blank vial from the holder.
12. Place the sample vial into the holder in the sample chamber and close the chamber door.
13. Press the **Measure Sample** function key to display the result in mg/l manganese.

Notes:

- Rinse all glassware with 1:1 nitric acid solution first and then rinse with deionized water.
- Water samples that contain more than 300 mg/l CaCO₃ hardness: after adding the ascorbic acid powder pack, add 10 drops of Rochelle salt solution.
- After addition of the alkaline cyanide reagent solution, a cloudy or turbid solution may form in some water samples. The turbidity should disappear after the PAN indicator solution is added.
- Water samples containing more than 5 mg/l iron should be allowed to react for at least 10 minutes.

AC4P55 Manganese High Range Powder Pack Test

Periodate Oxidation Method

0.1 – 18 mg/l Mn (High Range)

1. Load and run the AC4P55 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add the contents of one Manganese Citrate Buffer Powder Pack straight from the foil into the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents.
8. Add the contents of one Sodium Periodate Powder Pack straight from the foil into the vial.
9. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
10. Wait for a reaction period of 2 minutes.
11. Place the vial into the holder in the sample chamber and close the chamber door.
12. Press the **Measure Sample** function key to display the result in mg/l manganese.

Notes:

- This test is applicable for the determination of soluble manganese in water and wastewater.
- Highly buffered water samples or extreme pH values may exceed the buffering capacity of the reagents and requires sample pre-treatment. If samples were acidified for storing, adjust the pH between 4 and 5 with 5 mol/l (5 N) sodium hydroxide before test. Do not exceed pH 5, as manganese may precipitate.
- Interferences:

Interfering Substance	Interference Level
Calcium	Greater than 700 mg/l
Chloride	Greater than 70,000 mg/l
Iron	Greater than 5 mg/l
Magnesium	Greater than 100,000 mg/l

AC4P42 Molybdate Powder Pack Test

Mercaptoacetic Acid Method

0.5 – 66 mg/l MoO_4 (Equivalent to 0.3 – 40 mg/l Mo)

1. Load and run the AC4P42 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add the contents of one Molybdenum HR 1 F10 Powder Pack straight from the foil into the vial. Close the vial tightly with the cap and swirl or invert several times to mix the contents.
7. Add the contents of one Molybdenum HR 2 F10 Powder Pack straight from the foil into the same vial. Close the vial tightly with the cap and swirl or invert several times to mix the contents.
8. Add the contents of one Molybdenum HR 3 F10 Powder Pack straight from the foil into the same vial. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
9. Wait for a reaction period of 5 minutes.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l molybdate.

Notes:

- Filter turbid water samples using filter paper and funnel before analysis.
- Highly buffered water samples or extreme pH values should be adjusted to a pH of nearly 7 with 1 mol/l nitric acid or 1 mol/l sodium hydroxide.
- Concentrations above 10 mg/l Cu causes too high test values if the reaction time of 5 minutes is increased – so it is very important to perform the test procedure as described.
- Substances which may interfere when present in concentrations at:

Aluminum	50 mg/l
Chromium	1000 mg/l
Iron	50 mg/l
Nickel	50 mg/l
Nitrite	All Levels

ACR007 Nitrate Reaction Tube Test

Chromotropic Acid Method

1 – 30 mg/l N (Nitrate as Nitrogen)

1. Load and run the ACR007 method.
2. Open one 16 mm reaction vial (Reagent A) and add 1 ml of deionized water (this is the blank vial).
3. Open a second 16 mm reaction vial (Reagent A) and add 1 ml of sample (this is the sample vial).
4. Add the contents of one Nitrate Chromotropic Powder Pack straight from the foil into each vial.
5. Close the vials tightly with the caps and invert gently about 10 times to mix contents. Some solids may not dissolve. Wipe the exteriors of the vials.
6. Wait for a reaction period of 5 minutes.
7. Place the blank vial into the holder in the sample chamber and close the chamber door.
8. Press the **Measure Blank** function key to measure the blank.
9. Open the sample chamber door. Remove the blank vial from the holder.
10. Place the sample vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l nitrate as N.

Notes:

- Some solids may not dissolve.
- Conversion: $\text{mg/l NO}_3 = \text{mg/l N} \times 4.43$

AC2046 Nitrite Tablet Test

N-(1-Naphthyl)-ethylenediamine Method

0.01 – 0.5 mg/l N (Nitrite as Nitrogen)

1. Load and run the AC2046 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Nitrite LR Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Wait for a reaction period of 10 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l nitrite as N.

Notes:

- The following ions can produce interferences since under the reaction conditions they cause precipitation: antimony (III), iron (III), lead, mercury (I), silver, chloroplatinate, metavanadate and bismuth. Copper (II) ions may cause lower test results as they accelerate the decomposition of the diazonium salt. It is unlikely in practice that these interfering ions will occur in such high concentrations that they cause significant reading errors.
- Conversion: $\text{mg/l NO}_2 = \text{mg/l N} \times 3.29$

AC4P46 Nitrite Powder Pack Test

Diazotization (Azo) Method

0.01 – 0.3 mg/l N (Nitrite as Nitrogen)

1. Load and run the AC4P46 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add the contents of one Nitri 3 Powder Pack straight from the foil into the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Wait for a reaction period of 20 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l nitrite as N.

Notes:

- Interferences:
 - Strong oxidizing and reducing substances interfere.
 - Cupric and ferrous ions cause low results.
 - Antimonous, auric, bismuth, chloroplatinate, ferric, lead, mercurous, metavanadate and silver ions interfere by causing precipitation.
 - In samples with very high concentrations of nitrate (> 100 mg/l N) a small amount of nitrite will be found. Such high levels of nitrate appear to undergo a slight amount of reduction to nitrite, either spontaneously or during the reaction time of the test.

ACD004 Nitrogen (Total) Low Range Digestion Tube Test

Persulfate Digestion Method

0.5 – 25 mg/l N (Nitrite as Nitrogen)

1. Open two TN Hydroxide LR Digestion Vials and add the contents of one TN Persulfate Reagent Power Pack straight from the foil into each vial. Use a funnel to add the reagent. Wipe off any persulfate reagent that may get on the lid or tube threads.
2. Add 2 ml of deionized water to the first digestion vial (this is the blank vial).
3. Add 2 ml of sample to the second digestion vial (this is the sample vial).
4. Close the vials tightly with the caps and shake the vials for at least 30 seconds to mix the contents. The reagent may not dissolve completely.
5. Heat the digestion vials for 30 minutes in the preheated reactor at a temperature of 100 °C.
6. **CAUTION:** *The vials will be hot.* Remove the digestion vials from the reactor and allow them to cool to room temperature.
7. Open the cooled digestion vials and add the contents of one TN Reagent A Power Pack straight from the foil into each vial. Use a funnel to add the reagent.
8. Close the vials tightly with the caps and shake the vials for at least 15 seconds to mix contents.
9. Wait for a reaction period of 3 minutes.
10. Open the digestion vials and add the contents of one TN Reagent B Power Pack straight from the foil into each vial. Use a funnel to add the reagent.
11. Close the vials tightly with the caps and shake the vials for at least 15 seconds to mix contents. The reagent will not completely dissolve.
12. Wait for a reaction period of 2 minutes.
13. Open two TN Acid LR/HR (Reagent C) Vials and add 2 ml of the digested, treated blank to the first vial (this is the blank vial).
14. Add 2 ml of the digested, treated sample to the second vial (this is the sample vial).
15. Close the vials tightly with the caps and gently invert the vials at least 10 times to mix contents. Hold the vial in a vertical position with the cap pointing up. Turn the vial upside-down. Wait for all of the solution to flow down to the cap. Return the vial to the upright position. Wait for all the solution to flow to the bottom of the vial. This process is one inversion; 10 inversions equal about 30 seconds. Wipe the exteriors of the vials.
CAUTION: *The vials will become warm during mixing.*
16. Wait for a reaction period of 5 minutes.
17. Load and run the ACD004 method.
18. Place the blank vial into the holder in the sample chamber and close the chamber door.

19. Press the **Measure Blank** function key to measure the blank.
20. Open the sample chamber door. Remove the blank vial from the holder.
21. Place the sample vial into the holder in the sample chamber and close the chamber door.
22. Press the **Measure Sample** function key to display the result in mg/l nitrogen.

Notes:

- Appropriate safety precautions and a good lab technique should be used during the whole procedure.
- Volumes for samples and blank should always be measured using 2 ml volumetric pipettes (class A).
- One blank is sufficient for each set of samples. After taking the blank measurement, it is possible to measure several samples.
- It is very important to remove the vials from the reactor after exactly 30 minutes.
- Large quantities of nitrogen free, organic compounds that are included in some water samples may reduce the effectiveness of the digestion by reacting with the persulfate reagent. Samples that are well known to contain large quantities of organic compounds must be diluted and digestion and measurement must be repeated for checking the effectiveness of the digestion.
- Application: for water, wastewater and seawater.
- Interfering substances that resulted in a concentration change of 10%: Bromide more than 60 mg/l and chloride more than 1000 mg/l produce positive interferences.

ACD007 Nitrogen (Total) High Range Digestion Tube Test

Persulfate Digestion Method

5 – 150 mg/l N (Nitrite as Nitrogen)

1. Open two TN Hydroxide HR Digestion Vials and add the contents of one TN Persulfate Reagent Power Pack straight from the foil into each vial. Use a funnel to add the reagent. Wipe off any persulfate reagent that may get on the lid or tube threads.
2. Add 0.5 ml of deionized water to the first digestion vial (this is the blank vial).
3. Add 0.5 ml of sample to the second digestion vial (this is the sample vial).
4. Close the vials tightly with the caps and shake the vials for at least 30 seconds to mix contents. The reagent may not dissolve completely.
5. Heat the digestion vials for 30 minutes in the preheated reactor at a temperature of 100 °C.
6. **CAUTION:** *The vials will be hot.* Remove the digestion vials from the reactor and allow them to cool to room temperature.
7. Open the cooled digestion vials and add the contents of one TN Reagent A Power Pack straight from the foil into each vial. Use a funnel to add the reagent.
8. Close the vials tightly with the caps and shake the vials for at least 15 seconds to mix contents.
9. Wait for a reaction period of 3 minutes.
10. Open the digestion vials and add the contents of one TN Reagent B Power Pack straight from the foil into each vial. Use a funnel to add the reagent.
11. Close the vials tightly with the caps and shake the vials for at least 15 seconds to mix contents. The reagent will not completely dissolve.
12. Wait for a reaction period of 2 minutes.
13. Open two TN Acid LR/HR (Reagent C) Vials and add 2 ml of the digested, treated blank to the first vial (this is the blank vial).
14. Add 2 ml of the digested, treated sample to the second vial (this is the sample vial).
15. Close the vials tightly with the caps and gently invert the vials at least 10 times to mix contents. Hold the vial in a vertical position with the cap pointing up. Turn the vial upside-down. Wait for all of the solution to flow down to the cap. Return the vial to the upright position. Wait for all the solution to flow to the bottom of the vial. This process is one inversion; 10 inversions equal about 30 seconds. Wipe the exteriors of the vials.
CAUTION: *The vials will become warm during mixing.*
16. Wait for a reaction period of 5 minutes.
17. Load and run the ACD007 method.
18. Place the blank vial into the holder in the sample chamber and close the chamber door.

19. Press the **Measure Blank** function key to measure the blank.
20. Open the sample chamber door. Remove the blank vial from the holder.
21. Place the sample vial into the holder in the sample chamber and close the chamber door.
22. Press the **Measure Sample** function key to display the result in mg/l nitrogen.

Notes:

- Appropriate safety precautions and a good lab technique should be used during the whole procedure.
- Volumes for samples and blank should always be measured using 2 ml volumetric pipettes (class A).
- One blank is sufficient for each set of samples. After taking the blank measurement, it is possible to measure several samples.
- It is very important to remove the vials from the reactor after exactly 30 minutes.
- Large quantities of nitrogen free, organic compounds that are included in some water samples may reduce the effectiveness of the digestion by reacting with the persulfate reagent. Samples that are well known to contain large quantities of organic compounds must be diluted and digestion and measurement must be repeated for checking the effectiveness of the digestion.
- Application: for water, wastewater and seawater.
- Interfering substances that resulted in a concentration change of 10%: Bromide more than 60 mg/l and chloride more than 1000 mg/l produce positive interferences.

AC3048 Ozone Tablet Test

DPD Method

0.02 – 2 mg/l O₃

Ozone Measurement in Absence of Chlorine

1. Load and run the AC3048 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet and one DPD No. 3 Tablet straight from the foil to the vial. Crush the tablets with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Wait for a reaction period of 2 minutes.
12. Press the **Measure Sample** function key to display the result in mg/L ozone.

Ozone Measurement in Presence of Chlorine

1. Load and run the AC3048 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet and one DPD No. 3 Tablet straight from the foil to the vial. Crush the tablets with a clean stir rod.
8. Fill a second clean AQUAfast 24mm round vial with 10 ml of sample. Add one Glycine Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod. Close the vial tightly with the cap and swirl several times until the tablet is dissolved.

9. Transfer the contents of the vial with glycine solution into the vial containing the DPD No. 1 and DPD No. 3 tablets.
10. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
11. Place the vial into the holder in the sample chamber. Close the sample chamber door.
12. Wait for a reaction period of 2 minutes.
13. Press the **Measure Sample** function key to display the result in mg/L ozone.

Notes:

- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of ozone may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
Preparation: Put all applicable glassware into a sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- Preparing the sample: When preparing the sample, the loss of ozone, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagent tablet therefore contains a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the tablet is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 6 mg/l ozone can lead to results showing 0 mg/l. In this case, the water sample must be diluted with water free of ozone. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Oxidizing agents such as bromine and chlorine interfere as they react in the same way as ozone.

AC2001 pH Tablet Test

Phenol Red Method

6.5 – 8.4 pH

1. Load and run the AC2001 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Phenol Red Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Sample** function key to display the result in pH units.

Notes:

- Water samples with low values of alkalinity-m (below 35 mg/l CaCO_3) may give wrong pH readings.
- pH values below 6.5 and above 8.4 can produce results inside the measuring range. A plausibility test (pH meter) is recommended.
- The accuracy of the colorimetric determination of pH values depends on various boundary conditions (buffer capacity of the sample, salt contents, etc.).
- Salt error: Correction of test results (average values) for samples with salt contents of:

Indicator	Salt Content		
Phenol Red	1 molar – 0.21	2 molar – 0.26	3 molar – 0.29

- The values of Parson and Douglas (1926) are based on the use of Clark and Lubs buffers.
1 Mol NaCl = 58.4 g/l = 5.8 %

AC3001 pH Liquid Test

Phenol Red Method

6.5 – 8.4 pH

1. Load and run the AC3001 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add six drops of Phenol Red Solution to the vial. Add drops of the same size by holding the bottle vertically and squeezing slowly.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Sample** function key to display the result in pH units.

Notes:

- When testing chlorinated water, the residual chlorine contents can influence the color reaction of the liquid reagent. This can be avoided (without interfering with the pH measurement) by adding a small crystal of sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5 \text{H}_2\text{O}$) to the sample before adding the phenol red solution. Phenol red tablets already contain thiosulfate.
- Due to differing drop sizes results can show a discrepancy in accuracy by comparison with tablets. This can be minimized by using a pipette (0.18 ml phenol red solution is equivalent to 6 drops).
- After use, replace the bottle cap securely.
- Store the phenol red solution in a cool, dry place ideally at between 6 °C and 10 °C.

AC2095-WA Phosphate (Ortho) Low Range Tablet Test

Phosphomolybdic Acid/Ascorbic Acid

0.05 – 4 mg/l PO₄

1. Load and run the AC2095 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Phosphate No. 1 LR Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Add one Phosphate No. 2 LR Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 10 minutes.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l ortho-phosphate.

Notes:

- Only ortho-phosphate ions react.
- The tablets must be added in the correct sequence.
- The test sample should have a pH value between 6 and 7.
- Interferences: Higher concentrations of Cu, Ni, Cr (III), V (V) and W (VI) interfere due to their color. Silicates do not interfere (masked by citric acid in the tablets).
- Ortho-phosphate ions react with the reagent to form an intense blue color.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with acid and persulfate. The amount of organically combined phosphates can be calculated:
mg/l phosphate (organic) = mg/l phosphate (total) - mg/l phosphate (acid hydrolysable)
- Phosphate, ortho = Phosphorus, reactive

AC2096 Phosphate (Ortho) High Range Tablet Test

Vanado-Molybdate Method

1 – 80 mg/l PO₄

1. Load and run the AC2096 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Phosphate HR P1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Add one Phosphate HR P2 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 10 minutes.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l ortho-phosphate.

Notes:

- For samples under 5 mg/l PO₄, it is recommended to analyze the sample using the AC2095 phosphate (ortho) low range tablet test method.
- Only ortho-phosphate ions react.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with acid and persulfate. The amount of organically combined phosphates can be calculated:
mg/l phosphate (organic) = mg/l phosphate (total) - mg/l phosphate (acid hydrolysable)
- The ortho-phosphate ions react with the vanadate-molybdate reagent under acid conditions to form a yellow colored product.
- Phosphate, ortho = Phosphorus, reactive

AC4P95 Phosphate (Ortho) Powder Pack Test

Phosphomolybdenum/Ascorbic Acid

0.06 – 2.5 mg/l PO₄

1. Load and run the AC4P95 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add the contents of one Phosphate Rgt. F10 Powder Pack straight from the foil into the vial.
7. Close the vial tightly with the cap and swirl or invert several times for 10-15 seconds to mix contents. The powder will not dissolve completely. Wipe the exterior of the vial.
8. Wait for a reaction period of 2 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l ortho-phosphate.

Notes:

- Ortho-phosphate ions react with the reagent to form an intense blue color.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with acid and persulfate. The amount of organically combined phosphates can be calculated: mg/l phosphate (organic) = mg/l phosphate (total) - mg/l phosphate (acid hydrolysable)
- Application: for water, wastewater and seawater.
- Highly buffered samples or samples with extreme pH values should be adjusted between pH 2 and pH 10 before analysis with 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide.
- Phosphate, ortho = Phosphorus, reactive
- Interferences: Large amounts of turbidity may cause inconsistent results.

Interference	Interference Level
Aluminum	greater than 200 mg/l
Arsenate	at any level
Chromium	greater than 100 mg/l
Copper	greater than 10 mg/l
Iron	greater than 100 mg/l

Interference	Interference Level
Nickel	greater than 300 mg/l
Silica (Silicium dioxide)	greater than 50 mg/l
Silicate	greater than 10 mg/l
Sulfide	at any level
Zinc	greater than 80 mg/l

ACR095 Phosphate (Ortho) Reaction Tube Test

Phosphomolybdenum/Ascorbic Acid Method

0.06 – 5 mg/l PO₄

1. Load and run the ACR095 method.
2. Open one 16 mm PO4-P Dilution Tube and add 5 ml of sample. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door. Remove the vial from the holder.
6. Add the contents of one Phosphate Rgt. F10 Power Pack straight from the foil into the vial. Use a funnel to add the reagent.
7. Close the vial tightly with the cap and swirl the vial for 10-15 seconds to mix contents. The reagent will not completely dissolve. Wipe the exterior of the vial.
8. Wait for a reaction period of 2 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l ortho-phosphate.

Notes:

- Ortho-phosphate ions react with the reagent to form an intense blue color.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with acid and persulfate. The amount of organically combined phosphates can be calculated: mg/l phosphate (organic) = mg/l phosphate (total) - mg/l phosphate (acid hydrolysable)
- Application: for water, wastewater and seawater.
- Highly buffered samples or samples with extreme pH values should be adjusted between pH 2 and pH 10 before analysis with 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide.
- Phosphate, ortho = Phosphorus, reactive
- Interferences: Large amounts of turbidity may cause inconsistent results.

Interference	Interference Level
Aluminum	greater than 200 mg/l
Arsenate	at any level
Chromium	greater than 100 mg/l
Copper	greater than 10 mg/l
Iron	greater than 100 mg/l

Interference	Interference Level
Nickel	greater than 300 mg/l
Silica (Silicium dioxide)	greater than 50 mg/l
Silicate	greater than 10 mg/l
Sulfide	at any level
Zinc	greater than 80 mg/l

ACD095 Phosphate (Total) Digestion Tube Test

Persulfate Digestion/Ascorbic Acid Method

0.02 – 1.1 mg/l P (Phosphate as Phosphorous)

1. Open one 16 mm PO4-P Acid Reagent Digestion Tube and add 5 ml of sample.
2. Add the contents of one Potassium Persulfate F10 Power Pack straight from the foil into the vial. Use a funnel to add the reagent.
3. Close the vial tightly with the cap and invert the vial several times to mix the contents.
4. Heat the vial for 30 minutes in the preheated reactor at a temperature of 100 °C.
5. **CAUTION:** *The vial will be hot.* Remove the vial from the reactor and allow it to cool to room temperature.
6. Open the cooled digestion vial and add 2 ml of 1.54 N Sodium Hydroxide Solution to the vial.
7. Close the vial tightly with the cap and gently invert the vial several times to mix the contents. Wipe the exterior of the vial.
8. Load and run the ACD095 method.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Blank** function key to measure the blank.
11. Open the sample chamber door. Remove the vial from the holder.
12. Add the contents of one Phosphate Rgt. F10 Power Pack straight from the foil into the vial. Use a funnel to add the reagent.
13. Close the vial tightly with the cap and swirl the vial for 10-15 seconds to mix the contents. The reagent will not completely dissolve. Wipe the exterior of the vial.
14. Wait for a reaction period of 2 minutes.
15. Place the vial into the holder in the sample chamber and close the chamber door.
16. Press the **Measure Sample** function key to display the result in mg/l total phosphate as phosphorus (P).

Notes:

- Appropriate safety precautions and good lab technique should be used during the whole procedure.
- Ortho-phosphate ions react with the reagent to form an intense blue color.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with

acid and persulfate. The amount of organically combined phosphates can be calculated:
 $\text{mg/l phosphate (organic)} = \text{mg/l phosphate (total)} - \text{mg/l phosphate (acid hydrolysable)}$

- Application: for water, wastewater and seawater.
- Highly buffered samples or samples with extreme pH values should be adjusted between pH 2 and pH 10 before analysis with 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide.
- Phosphate, ortho = Phosphorus, reactive
- Interferences: Large amounts of turbidity may cause inconsistent results.

Interfering Substance	Interference Level
Aluminum	greater than 200 mg/l
Arsenate	at any level
Chromium	greater than 100 mg/l
Copper	greater than 10 mg/l
Iron	greater than 100 mg/l
Nickel	greater than 300 mg/l
Silica (Silicium dioxide)	greater than 50 mg/l
Silicate	greater than 10 mg/l
Sulfide	at any level
Zinc	greater than 80 mg/l

- Conversions: $\text{mg/l PO}_4 = \text{mg/l P} \times 3.07$
 $\text{mg/l P}_2\text{O}_5 = \text{mg/l P} \times 2.29$

ACD095AH Phosphate (Acid Hydrolysable) Digestion Tube Test

Acid Digestion/Ascorbic Acid Method

0.02 – 1.6 mg/l P (Phosphate as Phosphorous)

1. Open one 16 mm PO4-P Acid Reagent Digestion Tube and add 5 ml of sample.
2. Close the vial tightly with the cap and gently invert the vial several times to mix the contents.
3. Heat the vial for 30 minutes in the preheated reactor at a temperature of 100 °C.
4. **CAUTION:** *The vial will be hot.* Remove the vial from the reactor and allow it to cool to room temperature.
5. Open the cooled digestion vial and add 2 ml of 1.00 N Sodium Hydroxide Solution to the vial.
6. Close the vial tightly with the cap and gently invert the vial several times to mix the contents. Wipe the exterior of the vial.
7. Load and run the ACD095AH method.
8. Place the vial into the holder in the sample chamber and close the chamber door.
9. Press the **Measure Blank** function key to measure the blank.
10. Open the sample chamber door. Remove the vial from the holder.
11. Add the contents of one Phosphate Rgt. F10 Power Pack straight from the foil into the vial. Use a funnel to add the reagent.
12. Close the vial tightly with the cap and swirl the vial for 10-15 seconds to mix contents. The reagent will not completely dissolve. Wipe the exterior of the vial.
13. Wait for a reaction period of 2 minutes.
14. Place the vial into the holder in the sample chamber and close the chamber door.
15. Press the **Measure Sample** function key to display the result in mg/l acid hydrolysable phosphate as phosphorus (P).

Notes:

- Appropriate safety precautions and good lab technique should be used during the whole procedure.
- Ortho-phosphate ions react with the reagent to form an intense blue color.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with

acid and persulfate. The amount of organically combined phosphates can be calculated:
 $\text{mg/l phosphate (organic)} = \text{mg/l phosphate (total)} - \text{mg/l phosphate (acid hydrolysable)}$

- Application: for water, wastewater and seawater.
- Highly buffered samples or samples with extreme pH values should be adjusted between pH 2 and pH 10 before analysis with 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide.
- Phosphate, ortho = Phosphorus, reactive
- Interferences: Large amounts of turbidity may cause inconsistent results.

Interfering Substance	Interference Level
Aluminum	greater than 200 mg/l
Arsenate	at any level
Chromium	greater than 100 mg/l
Copper	greater than 10 mg/l
Iron	greater than 100 mg/l
Nickel	greater than 300 mg/l
Silica (Silicium dioxide)	greater than 50 mg/l
Silicate	greater than 10 mg/l
Sulfide	at any level
Zinc	greater than 80 mg/l

- Conversions: $\text{mg/l PO}_4 = \text{mg/l P} \times 3.07$
 $\text{mg/l P}_2\text{O}_5 = \text{mg/l P} \times 2.29$

AC2060 Silica Tablet Test

Silicomolybdate Method

0.05 – 4 mg/l SiO_2

1. Load and run the AC2060 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Silica No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved.
8. Wait for a reaction period of 5 minutes.
9. Add one Silica No. 2 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
10. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
11. Wait for a reaction period of 1 minute.
12. Place the vial into the holder in the sample chamber and close the chamber door.
13. Press the **Measure Sample** function key to display the result in mg/l silica.

Notes:

- The tablets must be added in the correct sequence.

AC2061 Silica with Phosphate Removal Tablet Test

Silicomolybdate Method with Phosphate Removal

0.05 – 4 mg/l SiO₂

1. Load and run the AC2061 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Silica No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved.
8. Wait for a reaction period of 5 minutes.
9. Add one Silica PR Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
10. Add one Silica No. 2 Tablet straight from the foil into the same vial. Crush the tablet with a clean stir rod.
11. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
12. Wait for a reaction period of 1 minute.
13. Place the vial into the holder in the sample chamber and close the chamber door.
14. Press the **Measure Sample** function key to display the result in mg/l silica.

Notes:

- The tablets must be added in the correct sequence.
- Phosphate ions do not interfere under the given reaction conditions.
- If phosphate is known to be absent, the addition of the Silica PR Tablet may be omitted.

AC4P60 Silica Powder Pack Test

Silicomolybdate Method

1 – 90 mg/l SiO₂

1. Load and run the AC4P60 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Temperature of the sample should be 15 °C to 25 °C. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add the contents of one Silica HR Molybdate F10 Powder Pack straight from the foil into the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents.
8. Add the contents of one Silica HR Acid Rgt. F10 Powder Pack straight from the foil into the same vial. If silica or phosphate is present, a yellow color will develop.
9. Close the vial tightly with the cap and swirl or invert several times to mix the contents.
10. Wait for a reaction period of 10 minutes.
11. Add the contents of one Silica Citric Acid F10 Powder Pack straight from the foil into the same vial. In this step, any yellow color due to phosphate is removed.
12. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
13. Wait for a reaction period of 2 minutes.
14. Place the vial into the holder in the sample chamber and close the chamber door.
15. Press the **Measure Sample** function key to display the result in mg/l silica.

Notes:

- Occasionally water samples contain forms of silica which reacts very slowly with molybdate. The nature of these forms is not known.
- A pre-treatment with sodium hydrogen carbonate and then with sulfuric acid will make these forms reactive to molybdate (pre-treatment is given in "Standard Methods for the Examination of Water and Wastewater" under "Silica Digestion with Sodium Bicarbonate").

Substance	Interference
Iron	Large amounts interfere
Phosphate	Does not interfere at concentrations less than 50 mg/l PO ₄ At 60 mg/l PO ₄ the interference is approximately 2% At 75 mg/l PO ₄ the interference is approximately 11 %
Sulfide	Interferes at all levels

AC4P82 Sulfate Powder Pack Test

Barium Sulfate/Turbidity Method

5 – 100 mg/l SO₄

1. Load and run the AC4P82 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add the contents of one Sulpha 4/F10 Powder Pack straight from the foil into the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Wait for a reaction period of 5 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Sample** function key to display the result in mg/l sulfate.

Notes:

- If sulfate ions are present a cloudy solution will appear.

AC2016 Sulfide Tablet Test

DPD/Catalyst Method

0.04 – 0.5 mg/l S

1. Load and run the AC2016 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the holder.
6. Add one Sulfide No. 1 Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Add one Sulfide No. 2 Tablet straight from the foil into the same vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 10 minutes.
10. Place the vial into the holder in the sample chamber and close the chamber door.
11. Press the **Measure Sample** function key to display the result in mg/l sulfide.

Notes:

- The tablets must be added in the correct sequence.
- Chlorine and other oxidizing agents that react with DPD do not interfere with the test.
- To avoid loss of sulfide collect the sample carefully with a minimum of aeration. It is essential to test the sample immediately after collection.
- The sample temperature should be 20 °C. A different temperature can lead to higher or lower results.

AC2065 Zinc Tablet Test

Zincon Method

0.02 – 1 mg/l Zn

1. Load and run the AC2065 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of deionized water. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber and close the chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Empty and dry the vial and then fill the vial with 10 ml of sample.
6. Add one Copper / Zinc LR Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Wait for a reaction period of 5 minutes.
9. Place the vial into the holder in the sample chamber and close the chamber door.
10. Press the **Measure Rgnt Blank** function key to measure the reagent blank.
11. Open the sample chamber door and remove the vial from the holder.
12. Add one EDTA Tablet straight from the foil into the vial. Crush the tablet with a clean stir rod.
13. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
14. Place the vial into the holder in the sample chamber and close the chamber door.
15. Press the **Measure Sample** function key to display the result in mg/l zinc.

Notes:

- Reverse color methods use a reagent that, when prepared with samples, decreases in color as the concentration of the species being measured in the samples increases. Reverse color methods require the use of both a blank and a reagent blank. The blank is a clear solution (deionized water) with zero absorbance. The reagent blank is a mixture of the reagent and sample (with no EDTA reagent) and provides a zero concentration point with the darkest color (highest absorbance). The color of samples prepared with the EDTA reagent will decrease as the concentration increases for this method.
- Measuring the reagent blank needs to be done with each sample analysis.
- The tablets must be added in the correct sequence.
- In the case of high levels of residual chlorine, perform the analysis with a dechlorinated water sample.

Color Measurement from Application Log #131

Color Measurement – Water Color

The color of our water is important not only for drinking purposes, but also for aquatic environments, and for home and industrial uses. Color in water can be caused by dissolved and suspended materials. In water and wastewater color measurement, there is a distinction between apparent color and true color¹. Apparent color is the color of the sample as received and includes color due to both the dissolved and suspended materials in the water. True color is the color in the sample after it has been filtered to remove suspended materials, such as algae and particulates which cause turbidity. True color is the result of only dissolved species in water – natural organic matter, minerals, or chemicals.

Techniques to Measure Color in Water

There are two main approaches to measuring water color:

- Visual methods – a water sample is visually compared to a series of colored standards.
- Spectrophotometric methods – the color is determined by measuring how much light is absorbed or transmitted through a sample at a single wavelength or at a number of certain wavelengths. The results are then compared with a known color standard or used in various algorithms, which are defined by the test method.

Many groups publish methods for measuring color. Examples of spectrophotometric methods are Platinum-Cobalt Color, Tristimulus Values, and ADMI methods². Specific method references for color in water include: APHA Standard Methods 2120; EPA 110.1; DIN ISO 7887 and SAC 436 nm; China MEP GB 11903; NCASI Technical Bulletin 253 or 803; and others.

Color Standards and Color Units

Platinum Cobalt Color Standard and Units

The most common color measurement of water and wastewater is Platinum-Cobalt (Pt-Co) color, also known as APHA color or Hazen color. These names are commonly used in different applications, but they are based on identical procedures. Measurement with the Pt-Co/PHA/Hazen standard is based on the Hazen color scale that was introduced in 1892 by chemist Allen Hazen. The color is a light yellow to brown color. The range is 0 to 500 Platinum Color Units (PCU). Intermediate standards are prepared from a platinum cobalt 500 ppm stock solution that is available commercially³ or can be prepared by user¹. A unit of color is the color produced by 1 mg/L platinum in the form of chloroplatinum ion. The color values measured by comparison with the platinum-cobalt standards can be expressed as PCU, Pt-Co, APHA, or Hazen units depending on the specific procedures. In the United States, the National Secondary Drinking Water Regulation for color is a maximum of 15 color units. The World Health Organization recommends that drinking water color does not to exceed 15 true color units.

Other Color Standards and Color Units

For samples where the color is different from Pt-Co standards, several different standards and color scales are used such as: ADMI Color (American Dye Manufacturer's Institute), Gardner Color, Saybolt, Rosin, EBC (European Brewery Convention), CIE System, etc.

Platinum Cobalt Color Methods

Two single-wavelength methods are commonly used in the United States to measure water and wastewater color with color characteristics similar to that of the Pt-Co standards:

- **Water/Wastewater at 455 nm:** This method utilizes a spectrophotometer to measure the absorbance of light as it passes through a sample at the 455 nm wavelength. This procedure is recommended for water from naturally occurring materials, i.e., vegetable residues such as leaves, barks, roots, humus and peat materials. If samples are turbid, they should be filtered prior to the analysis through 0.45 μm filter to determine the true color. To determine the apparent color, non-filtered samples are measured. Samples with a high color (>500 PCU) should be diluted until the color is within the range of the standard curve. Sample pH should not be adjusted as long as it is between 4 and 10.
- **Pulp Mill Wastewater at 465 nm:** This method utilizes a spectrophotometer to measure the absorbance of light as it passes through a sample at the 465 nm wavelength. This method is adapted from the NCASI Technical Bulletin 803 for pulp and paper effluent⁴ (which supersedes NCASI Technical Bulletin 253). The true color is determined in a sample with the pH adjusted to 7.6 \pm 0.05 pH and then passed through a 0.8 μm filter. The apparent color is determined in the original sample. Samples with high color should be diluted to fall within the range of the standard curve.

There are also multiple-wavelength methods, which are recommended for color measurement in waters and wastewaters having color characteristics different from, but not excluding, platinum-cobalt standards. Such a method is SM 2120D-2001, which is used to calculate Tristimulus Values and ultimately values for the dominant wavelength, hue, luminance, and purity of a sample². According to this method, the spectrophotometer examines a number of points (e.g. 10 or 30 points) in the range from 400 to 700 nm to determine the transmittance at each wavelength and uses the obtained values to calculate color by the published computation method. A modification of the Tristimulus Method that is used in water and waste water industry is based on the measurement of percent transmittance at three wavelengths (590, 540 and 438nm)⁵.

Range, Detection Limit, and Sample Cell Size

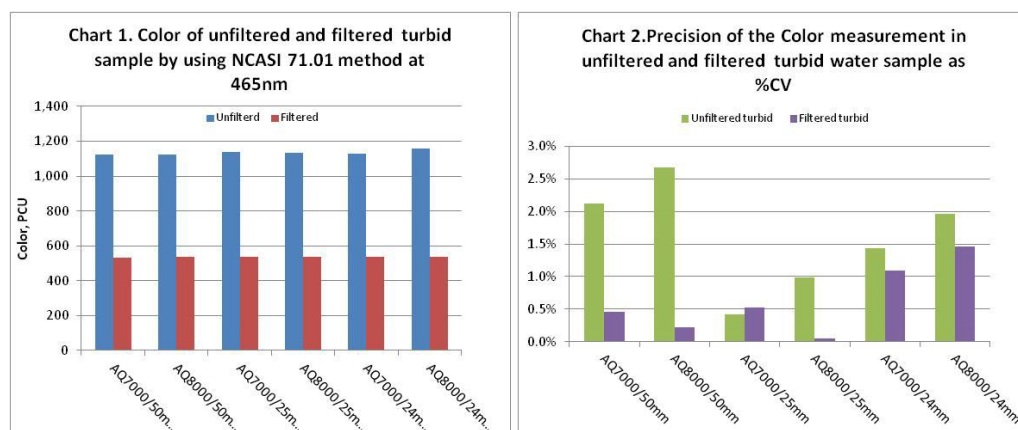
Accuracy, precision, and detection limits that can be obtained by a specific color measurement procedure depend on the quality of the instrument optics and the sample cell path length.

- Spectrophotometers allow for more accurate and precise results than colorimeters, but are more expensive. Lowest detection limits and better accuracy at low levels can be achieved on a spectrophotometer by choosing a sample cell with a longer cell path length.

- Colorimeters are useful for testing outside the laboratory and indicate relative color intensity. Color values determined on a colorimeter may differ from color values determined on a spectrophotometer, especially when the colorimeter wavelength does not match the wavelength used on the spectrophotometer.
- Sample cells for color testing are made of glass. Glass is suitable for testing in the visible wavelength range. A round glass 24 mm or 25 mm cell gives satisfactory results. For best accuracy and precision at color levels that are lower than 15 color units, a rectangular glass 50 mm cell is recommended. The 10 mm sample cell size is not recommended for color testing.

Turbidity Effect on Color Measurement

When measuring “true” color, turbidity must be removed, since it can cause light scattering and increase the color value. Turbidity may also affect the precision of the measurement. Chart 1 demonstrates that filtering reduces the color reading – the more turbid the sample, the more significant the effect. Chart 2 shows that the filtered sample generally shows better precision, especially for turbid samples.



Thermo Scientific Orion AquaMate Spectrophotometers for Color Measurement

The Thermo Scientific Orion AquaMate AQ8000 UV-Vis and AQ7000 Vis spectrophotometers have the required wavelengths to analyze for any color measurement – by preprogrammed methods, by a user-generated standard curve, or by multiple wavelengths, if desired. The following table describes some of the color methods which may be tested on the Orion AQ7000 and AQ8000 spectrophotometers.

Color Method	Preprogrammed name or user defined	Sample Cell Size	Wavelength(s)	Scope of the method
Platinum–Cobalt Color Method: absorbance measured at one wavelength. Range: 0 -500 PCU	CLRPT50 CLRPT25 CLRPT24 User Method	50 mm 25 mm 24 mm 10-50 mm	455 nm	Water and wastewater samples of color similar to Pt-Co color standards
Adaptation of NCASI 253/803: absorbance measured at one wavelength. Range: 0 -500 PCU	CLRPTP50 CLRPTP25 CLRPTP24 User Method	50 mm 25 mm 24 mm 10-50 mm	465 nm	Color in pulp mill wastewaters
ISO 7887; GB 11903: Water Quality - Examination and Determination of Colour	User Method	50 mm	436 nm 525 nm 620 nm	Raw and potable water, industrial water of low color
Tristimulus Values Method: transmittance is measured at multiple wavelength in the 400 – 700 nm range	User Method	10 mm or 50 mm	Multiple wavelengths 400 to 700nm range	Water and wastewater samples of color different from, but not excluding, Pt-Co standards

Application Notes

Application notes for color testing are available through your local technical sales representative, our technical support service, our website and other Thermo Scientific web locations. These notes give detailed information on how to test for color on our Thermo Scientific Orion AquaMate spectrophotometers: AQ7000 visible range and AQ8000 UV/Vis range. Application Notes available at this time include:

- Log 133, Color of water and wastewater by Pt-Co method at 455 nm
- Log 134, Color of pulp mill wastewater by Pt-Co method at 465 nm (NCASI method)

References

1. Standard Methods for the Examination of Water and Wastewater, Method 2120B. www.standardmethods.org
2. Standard Methods for the Examination of Water and Wastewater, Method 2120. www.standardmethods.org
3. Available through Fisher Scientific at www.fishersci.com
4. NCASI, Technical Bulletin No. 253, Dec. 1971. See 40CFR Part 136, Table IB, footnote 18. www.ecfr.gov
5. EPA Color Method 110.1. <http://www.umass.edu/tei/mwwwp/acrobat/epa110.1.colors.spec.pdf>

UVA and UV254 Measurements from Application Log #137

UVA and UV254 Measurement of Water

This method utilizes a spectrophotometer to measure the absorbance of waters, such as drinking water and source water, at 254nm wavelength. These results may be correlated to organic carbon, color, and/or disinfection byproduct precursors. Results can also indicate the efficacy of treatment processes that remove organic carbon or results may be used with a corresponding total organic carbon (TOC) result to calculate the Specific UV Absorbance (SUVA) value for a water sample. See Reference 1 for details.

References

1. EPA Method 415.3 Rev 1.1. UV254 for SUVA. <http://www.epa.gov/microbes/ordmeth.htm>
2. Standard Methods 5910B, UV-Absorbing Organic Constituents. www.standardmethods.org
3. Orion AquaMate 8000 UV-Vis Instrument User Guide

Recommended Equipment

- Thermo Scientific Orion AquaMate AQ8000 spectrophotometer
- Filtration apparatus (e.g., Fisher XX1004707); 0.45- μ m filters, 47 mm (e.g., Fisher HNWP04700)
- Vacuum source-aspirator, air flow or water flow, hand-operated or low pressure electric vacuum pump
- UV disposable cuvettes 1 cm (Fisher 14-377-009) or quartz sample cells
- Carousel for 10 cm cell, if needed (Orion AQ100C)
- Orion pH meter and electrode

Solutions

1. Organic-free deionized water (DI).
2. Reagents for pH adjustment. Sodium hydroxide, 0.1N; Hydrochloric acid, 0.1N; Orion pH 4.01 and 7.00 Buffers (Orion 910104, Orion 910107).
3. Spectrophotometer Check Solution (SCS), optional: Organic Carbon, KHP in pH 7 phosphate buffer, see Reference 2 for preparation; or, Commercial SCS, PN 222-234700 (www.unifylabservices.com).

Sample Cell Storage and Cleaning

In order to obtain reproducible results, clean and store sample cells per instructions in the Orion AquaMate Instrument User Guide.

Instrument Setup

Turn on the spectrophotometer. Choose a suitable cell size and method for the organic carbon content expected in your samples. Refer to the following chart. Select the desired cell holder position (1 or 5 cm) by pressing the cell position key. For 10 cm, install the carousel with 10 cm holder. Access the USB memory stick using a computer. Copy the desired preprogrammed method from the Orion folder to the Thermo folder (see Note 1). Remove the USB memory stick from the computer and insert it into the USB port on the front of the AquaMate. Select the method and load it. Press the **Run Test** function to start the analysis. Refer to the following chart for choosing the method.

Sample Concentration	Organic Carbon > 0.5 mg/L	Organic Carbon >0.1 mg/L	Organic Carbon >0.05 mg/L
Quartz Cell Size (see Note 2)	1 cm (10 mm)	5 cm (50 mm)	10 cm (100 mm)
Method Name	UV254_1	UV254_5	UV254_10

Zero the Instrument: Spectrophotometer Check

1. Touching only the frosted sides of the cell, rinse a clean cell three times with DI water. Then fill with DI water. Use a lint-free wiper to remove water on the outside.
2. Open the sample compartment and insert the sample cell containing DI water (the blank) into the sample holder, with the clear sides facing front and back. If sample cell is not in the light path, press the correct sample position key. Close the lid, then press the Measure Blank key.
3. If required, test an SCS: Using the same cell, empty and fill with the prepared SCS, wipe dry, and insert into the sample holder. Close the lid, and press the Measure Sample key. Record the displayed result.
4. The reading for the SCS should be within the desired criteria, per your QA plan. See Results section for examples.

Sample Storage

Samples are not preserved. Analyze as soon as possible after collection. Samples may be stored for up to 48 hours at <6°C prior to analysis. See EPA Method 415.3 for SUVA storage.

Sample Preparation: pH adjust and/or sample filtration.

For non-SUVA: If the pH is not between 4 and 10, adjust pH per steps in "pH Adjustment of Sample" (p.2). Note: Do not adjust pH for a SUVA determination.

For UVA, UV254: Set up the filtration apparatus with a 0.45 µm filter. Wash the filter with 50 mL DI and discard the rinse water. Filter 50 mL of the sample. Test the filtrate.

Sample Measurement

Ensure the instrument has been zeroed properly. Touching only the frosted sides of the cell, rinse the clean cell with a portion of the filtered sample, then fill with the filtered sample. Wipe dry. Insert the sample cell into the holder, close the lid, and press the Measure Sample key. Record the displayed result. The results can be saved to the USB stick, if desired. If the reading is >0.900 absorbance, dilute and retest. Multiply the reading by the dilution factor. If the results are <0.010 absorbance, consider using a larger cell. Load the appropriate method, and rezero the instrument.

Quality Control (QC)

Run an SCS and duplicate samples with each batch, or run QC samples per your QA plan. For SUVA testing, follow requirements of EPA Method 415.3. See Reference 1.

pH Adjustment of Sample

1. Note: Do not adjust the pH of a sample which will be used for a SUVA calculation. Proceed to the filtration step.
2. Calibrate the pH probe in pH 4.01 and 7.00 buffers.
3. Warm the sample up to room temperature.
4. Shake the sample to insure homogeneity.
5. Measure 50 mL of the sample to a 100-mL beaker using a graduated cylinder.
6. Immerse the pH probe in the sample and record the initial pH.
7. Adjust the sample into the range of pH 4 to 10, by adding drop-wise 0.1N sodium hydroxide to raise the pH or by adding drop-wise 0.1N hydrochloric acid to lower the pH. Different strength acid or base can be used, if needed.
8. Note that the overall volume change should not be greater than 1% (0.5 mL). Discard and re-prepare with stronger acid or base if the volume changes more than 1%.
9. Record the adjusted pH. Proceed to the filtration step (p. 1).

Results of SCS Testing on the Orion AQ8000 Spectrophotometer

25.0 mg/L organic carbon (KHP)

Bias Method UV254_1	Expected (per SM 5910B)	Result (AQ8000)	Difference	Evaluation
Absorbance	0.358 cm^{-1}	0.360 cm^{-1}	0.002 cm^{-1} (0.6%)	Good
Organic Carbon Concentration	25.0 mg/L	24.9 mg/L	0.01 mg/L (0.4%)	Good

Bias: readings of a KHP organic carbon standard at 25.0 mg/L in phosphate buffer (prepared per SM 5910B) tested in a 1 cm cell demonstrate good accuracy:

- The average AQ8000 absorbance result is within 0.002 absorbance units of the average reading expected per SM 5910B; 0.6% difference from the expected absorbance.
- The average AQ8000 organic carbon concentration result (calculated per SM 5910B) is within 0.1 mg/L of the expected value; 0.4% difference (99.6% recovery) from the expected value of 25.0 mg/L organic carbon.

Precision Method UV254_1	# of Samples Tested	Maximum %RSD (per SM 5910B)	Result (AQ8000)	Evaluation
Absorbance	14	< 10.7% RSD	0.3% RSD	Good

Precision: readings of a KHP organic carbon standard at 25.0 mg/L in phosphate buffer (prepared per SM 5910B) tested in a 1 cm cell demonstrate good precision:

- The relative standard deviation (RSD) of 14 test results on the AQ8000 is 0.3% RSD, well within the maximum 10.7% limit expected per SM 5910B.

Notes

1. If the preprogrammed method is not on the memory stick, download the method file from the our Online Library at www.thermoscientific.com/waterlibrary, or call Technical Support.
2. Alternately, use disposable cuvettes formulated for UV measurements, available in the 1 cm (10 mm) cell path.

6

CHAPTER 6 Standard Curve Test Menu

Concentration Measurements using the Standard Curve Application (Custom Method)

The Standard Curve test technique is used to perform a quantitative analysis experiment using a multipoint calibration curve. A calibration curve is composed of standards of well-known concentration. A fit of this standard curve is used to measure the concentration of samples.

This test technique is ideal when using colorimetric reagents for which the test kit manufacturer does not specify a factor or equation for obtaining the concentration of the test kit. Always follow the reagent instructions provided by the test kit manufacturer when creating a custom method.

Note: If the manufacturer does not specify the wavelength for the test kit, the [Scanning](#) test technique should be used with a prepared standard to determine the wavelength parameter for the reagent before creating a standard curve.

Use Standard Curve Test Technique:

- To create a standard curve by setting parameters and measuring standards for the curve
- To view calibration curve data – select between graphical and tabular displays
- To edit a standard curve, including changing the number of standards, selecting a different curve fit or deleting points from the curve
- To measure samples using the standard curve and to view and save measurement data
- To recall existing standard curve methods

Setting the Parameters for a Standard Curve

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Standard Curve and press the **enter** key.

Test Types		11:07am 27Mar15	
Water Analysis			
Advanced A-T-C			
Standard Curve			
Absorbance Ratio			
Absorbance Difference			
Kinetics			
Scanning			
3-Point Net			
Multiwavelength			
Performance Verification			
Press ↑ or ↓ to select			
Smart		Stored	Basic
Start		Tests	ATC

3. Highlight and change the displayed test parameters, including Test Name, Wavelength, Curve Fit, Number of Standards, Units and Sample Positioner.

Standard Curve		9:54am 15Apr15	
BLANK			
Test Name			
Date Standards Measured			
Wavelength		546.0nm	
Ref. Wavelength Correction		Off	
Curve Fit		Linear	
Number of Standards		2	
Units		C	
Sample Positioner		Auto 6	
Number of Samples		1	
More parameters...			
Press ↑ or ↓ to select item to change.			
Run	Save	Stored	
Standards	Test	Tests	

- a. See the [Parameters](#) section for more information on the test parameter settings.
- b. See the [Sample Positioner Setting for the Vial Holder Carousel](#) section for detailed information on selecting the appropriate Sample Positioner setting.

Standard Curve		10:18am 15Apr15	
BLANK			
Test Name		CHLORINE_CURVE	
Date Standards Measured			
Wavelength		510.0nm	
Ref. Wavelength Correction		Off	
Curve Fit		Linear	
Number of Standards		3	
Units		mg/L	
Sample Positioner		Manual 6	
More parameters...			
Press ↑ or ↓ to select item to change.			
Run	Save	Stored	
Standards	Test	Tests	

Standard Curve		10:19am 15Apr15	
		BLANK	
ID# (0=OFF)		Off	
Low/High Limits		-9999/9999	
Statistics		Off	
Auto Print		Off	
Auto Save Data		Off	
More parameters...			
Press ↑ or ↓ to select item to change.			
Run	Save	Stored	
Standards	Test	Tests	

- Press the **Save Test** function key and follow the onscreen prompts to save the test.

Measuring Standards for a Standard Curve

Once the parameters have been set for the standard curve:

- Press the **Run Standards** function key.
- Prepare the blank and standards that will be used to create the standard curve.
- If Auto 6 or Auto 3 is selected for the Sample Positioner setting:
 - Place the blank and standards in the appropriate positions on the carousel.
 - For each standard, use the numeric keypad to enter the concentration of the standard and press the **enter** key to save the value.
 - Press the **Measure Standard** function key. Confirm that the blank and standards are in the appropriate positions on the carousel and press the **enter** key.

Standard Curve		10:52am 15Apr15	
Test Name: -----		BLANK	
Conc. mg/L	Abs 510.0nm		
0.120	-----		
0.350	-----		
<div style="border: 1px solid black; padding: 10px; text-align: center;"> Insert blank into position B Insert standards 1 - 2 into positions 2 & 4 Press ENTER to measure </div>			

- If Manual 6 or Single Cell Holder is selected for the Sample Positioner setting:
 - For each standard, use the numeric keypad to enter the concentration of the standard and press the **enter** key to save the value.

Standard Curve		10:34am 15Apr15	
Test Name: CHLORINE_CURVE		BLANK	
Conc. mg/L	Abs	510.0nm	
-----	-----	-----	
0.120	-----	-----	
0.350	-----	-----	

Entry: 0.55			
Enter a number (0.000 to 9999)			

- b. Place the blank in the B position on the vial holder carousel and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.

Standard Curve		10:37am 15Apr15	
Test Name: CHLORINE_CURVE		BLANK	
Conc. mg/L	Abs	510.0nm	
-----	-----	-----	
0.120	-----	-----	
0.350	-----	-----	
0.550	-----	-----	
Page 1, Standards 1 - 3			
Measure Blank	Save Test	Edit Standards	

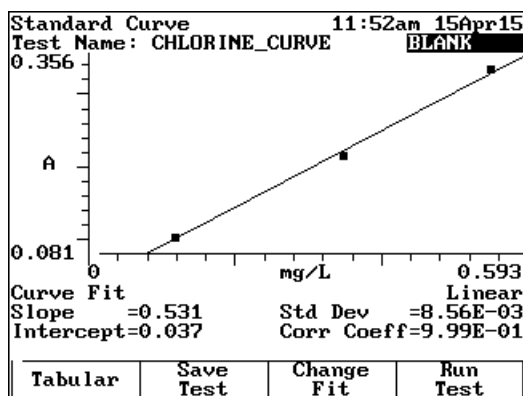
- c. Place the standard in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Standard** function key and press the **enter** key to measure the standard. Repeat for each standard.

Standard Curve		10:43am 15Apr15	
Test Name: CHLORINE_CURVE		BLANK	
Conc. mg/L	Abs	510.0nm	
-----	-----	-----	
0.120	0.104	-----	
0.350	0.216	-----	
0.550	-----	-----	
Page 1, Standards 1 - 2			
Measure Blank	Save Test	Edit Standards	Measure Standard

5. When all of the standards have been measured, the absorbance of each standard will be displayed with the slope, intercept and correlation coefficient of the standard curve.

Standard Curve		10:46am 15Apr15
Test Name: CHLORINE_CURVE		BLANK
Conc. mg/L	Abs 510.0nm	
0.120	0.104	
0.350	0.216	
0.550	0.333	
Curve Fit		
Slope =0.531	Std Dev =8.56E-03	Linear
Intercept=0.037	Corr Coeff=9.99E-01	
Page 1, Standards 1 - 3		
View	Save	Edit
Graph	Test	Standards
		Run
		Test

- a. Press the **View Graph** function key to display a graph of the standard curve data.



- b. To save the test with the standard curve, press the **Save Test** function key and follow the onscreen prompts.
- c. Press the **Edit Standards** function key to edit the standard curve.
- d. Press the **Run Test** function key to start measuring samples.

Measuring Samples using a Standard Curve

Once the standards have been measured for the standard curve:

1. Press the **Run Test** function key.
2. Prepare the blank and samples that will be measured.
3. If Auto 6 or Auto 3 is selected for the Sample Positioner setting:
 - a. Place the blank and samples in the appropriate positions on the vial holder carousel and press the **Measure Samples** function.
 - b. Confirm that the blank and samples are in the appropriate positions and press the **enter** key to begin taking measurements.

Standard Curve		1:43pm 15Apr15					
Test Name: CHLORINE_01		Cell # 4					
Abs	Result						
510.0nm	mg/L						

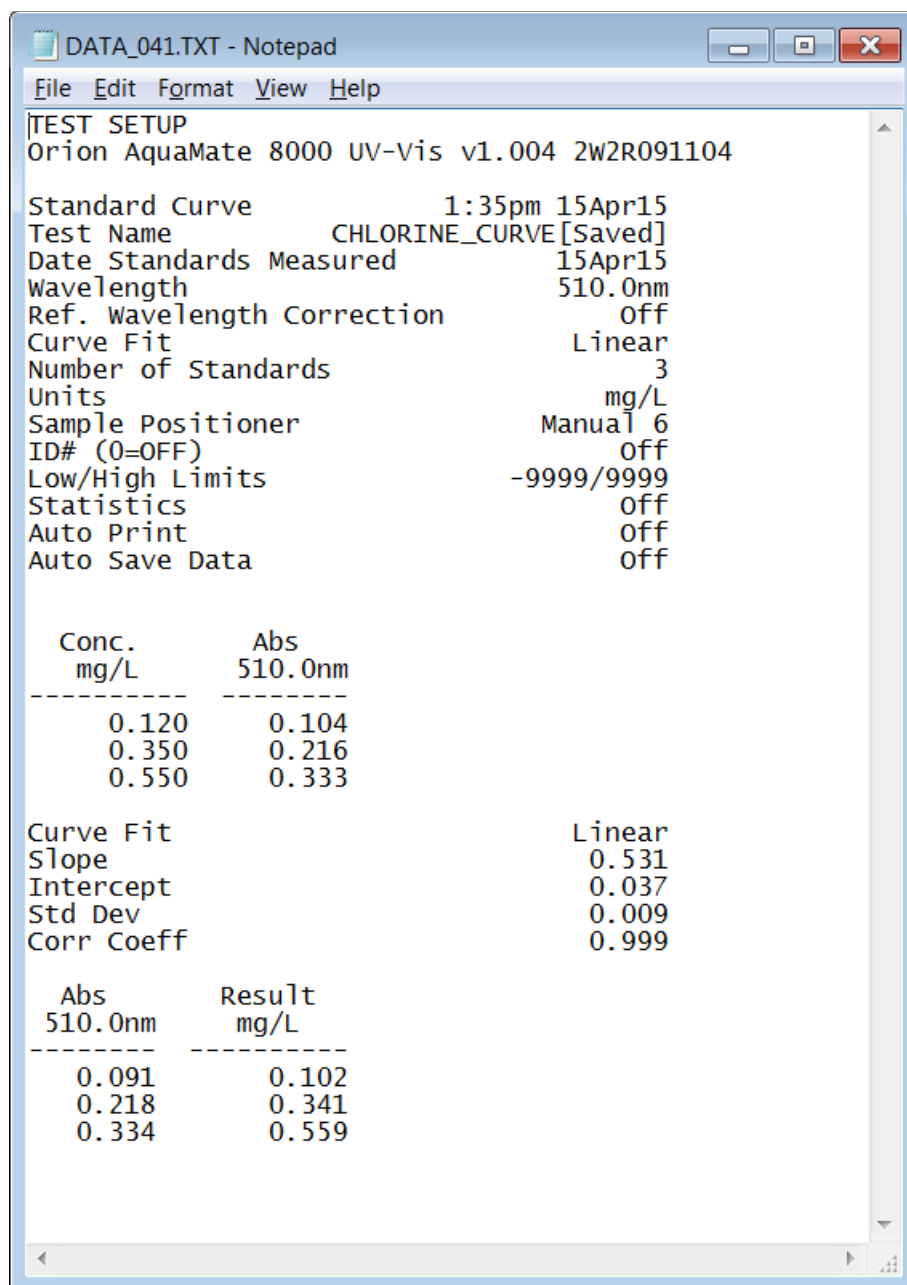
<div style="border: 1px solid black; padding: 10px; text-align: center;"> Insert blank into position B Insert samples 1 - 2 into positions 2 & 4 Press ENTER to measure </div>							
<table border="1" style="width: 100%;"> <tr> <td style="height: 20px;"></td> <td style="height: 20px;"></td> <td style="height: 20px;"></td> <td style="height: 20px;"></td> </tr> </table>							

4. If Manual 6 or Single Cell Holder is selected for the Sample Positioner setting:
 - a. Place the blank in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location.
 - b. Press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.
 - c. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Sample** function key to measure the sample. Repeat for each sample.

Standard Curve		1:29pm 15Apr15	
Test Name: CHLORINE_CURVE		BLANK	
Abs	Result		
510.0nm	mg/L		

0.091	0.102		
0.218	0.341		
0.334	0.559		
Page 1, Samples 1 - 3			
Measure Blank	Save Data	View Graph	Measure Sample

5. When all of the samples have been measured, press the **Save Data** function key and follow the onscreen prompts to save the sample measurements to the USB memory stick. Do not use more than eight characters when naming the saved data file. The data file will be saved as a .TXT file in the Thermo folder on the USB memory stick.



Editing a Standard Curve

You may edit the concentration of any standard on a standard curve. In addition, you may change the number of standards, delete points from the curve or reset the curve data.

1. With the standard curve displayed, press the **▲** or **▼** key to highlight the standard to be edited and press the **Edit Standards** function key.

Standard Curve		10:46am 15Apr15
Test Name: CHLORINE_CURVE		BLANK
Conc. mg/L	Abs 510.0nm	
0.120	0.104	
0.350	0.216	
0.550	0.333	
Curve Fit		
Slope =0.531	Std Dev =8.56E-03	Linear
Intercept=0.037	Corr Coeff=9.99E-01	
Page 1, Standards 1 - 3		
View Graph	Save Test	Edit Standards
		Run Test

2. Press the **▲** or **▼** key to highlight the desired editing function and press the **enter** key.

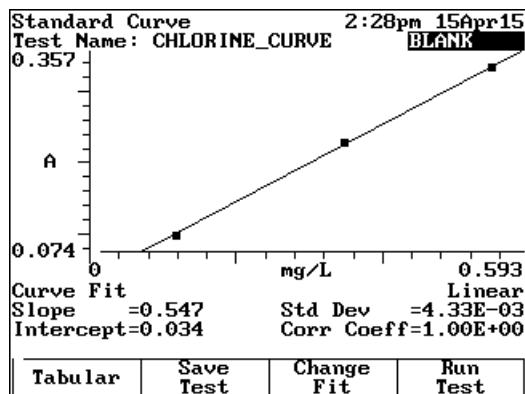
Standard Curve		2:06pm 15Apr15
Test Name: CHLORINE_CURVE		BLANK
Conc. mg/L	5	
0.120		
0.350		
0.550		
<div> Edit Concentration Add Standard Delete Standard Clear Measurements Reset Standards Press ↑ or ↓ to select Press ENTER </div>		
Curve Fit		
Slope =0.576	Std Dev =9.70E-03	Linear
Intercept=0.0146	Corr Coeff=9.98E-01	
Page 1, Standards 1 - 3		

- a. If Edit Concentration is selected, use the numeric keypad to enter the concentration of the highlighted standard and press the **enter** key.
- b. If Add Standard is selected, use the numeric keypad to enter the concentration of the new standard and press the **enter** key. Follow the steps in the [Measuring Standards for a Standard Curve](#) section to re-measure all of the standards.
- c. If Delete Standard is selected, the highlighted standard will be deleted.
- d. If Clear Measurements is selected, all absorbance measurements will be removed from the standard curve data.
- e. If Reset Standards is selected, all concentration and absorbance measurements will be removed from the standard curve data.

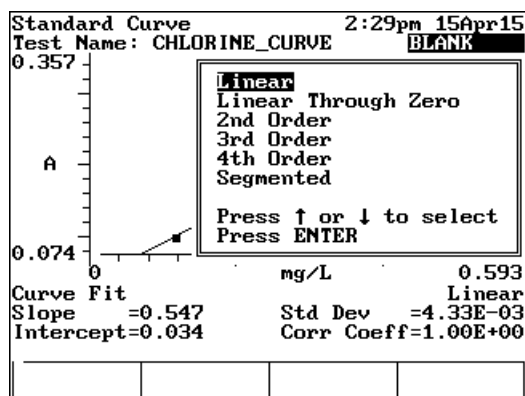
Selecting a Different Curve Fit for a Standard Curve

To change the curve fit for a standard curve, the standard curve must be displayed as a graph, not as a table.

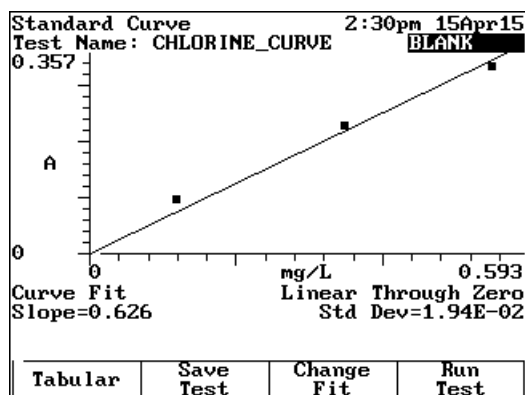
1. With the standard curve displayed as a graph, press the **Change Fit** function key.



2. Press the **▲** or **▼** key to highlight the desired curve fit and press the **enter** key.



3. The instrument will apply the selected curve fit to the data and display the new fit.



Recalling an Existing Standard Curve Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Standard Curve and press the **enter** key.

Test Types		11:07am 27Mar15	
Water Analysis			
Advanced A-%T-C			
Standard Curve			
Absorbance Ratio			
Absorbance Difference			
Kinetics			
Scanning			
3-Point Net			
Multiwavelength			
Performance Verification			
Press ↑ or ↓ to select			
Smart		Stored	Basic
Start		Tests	ATC

3. To recall an existing standard curve, press the **Stored Tests** function key.

Standard Curve		9:54am 15Apr15	
		BLANK	
Test Name -----			
Date Standards Measured -----			
Wavelength		546.0nm	
Ref. Wavelength Correction		Off	
Curve Fit		Linear	
Number of Standards		2	
Units		C	
Sample Positioner		Auto 6	
Number of Samples		1	
More parameters...			
Press ↑ or ↓ to select item to change.			
Run	Save	Stored	
Standards	Test	Tests	

4. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the desired test and press the **enter** key.

Utility Test Directory		2:25pm 15Apr15	
Standard Curve			
>CHLORINE_CURVE		15Apr15	
>CHLORINE_01		15Apr15	
Press ↑ or ↓ to select test.			
Unselect	Lock	Delete	Load
Test	Unlock	Test	Test

7

CHAPTER 7 Wavelength Scanning Test Menu

The Wavelength Scanning test technique lets you measure the absorption or percent transmission spectrum of a sample. You can use scans to determine peak wavelengths or to evaluate the quality of a material.

This test technique is useful when using colorimetric reagents for which the test kit manufacturer does not specify a wavelength parameter for the test kit. Always follow the reagent instructions provided by the test kit manufacturer when creating a custom method.

Note: If the manufacturer does not specify the factor or equation for obtaining the concentration of the test kit, the [Standard Curve](#) test technique should be used with prepared standards to determine the factor or equation for the reagent.

Use Scanning Test Technique:

- To scan samples by setting parameters, collecting a baseline scan and scanning a sample
- To view and manipulate scanning data, including rescaling graphical scan data, determining peak height using a 3-point net equation, calculating the area under a curve and labeling peaks and valleys
- To recall existing scanning methods

Setting the Parameters for a Scan

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight **Scanning** and press the **enter** key.

Test Types		3:53pm 15Apr15	
Water Analysis			
Advanced A-T-C			
Standard Curve			
Absorbance Ratio			
Absorbance Difference			
Kinetics			
Scanning			
3-Point Net			
Multiwavelength			
Performance Verification			
Press ↑ or ↓ to select			
Smart		Stored	Basic
Start		Tests	ATC

3. Highlight and change the displayed test parameters, including Test Name, Measurement Mode, Start Wavelength, Stop Wavelength, Sample Positioner, Scan Speed and Interval.
 - a. See the [Parameters](#) section for more information on the test parameter settings.
 - i. Use the [Baseline Expiration Setting](#) to set a baseline expiration time.
 - ii. If Auto Save Data is set On, enter a Data File Name before accessing the Run Test or Measure Samples functions.
 - b. See the [Sample Positioner Setting for the Vial Holder Carousel](#) section for detailed information on selecting the appropriate Sample Positioner setting.
 - i. Scan tests only measure one sample at a time, so Auto 6 and Auto 3 Sample Positioner settings are not fully functional.

Scanning		3:58pm 15Apr15	
BLANK			
Test Name			
SCAN_01			
Measurement Mode			
Absorbance			
Start Wavelength			
450.0nm			
Stop Wavelength			
550.0nm			
Sample Positioner			
Manual 6			
Scan Speed			
Fast			
Interval			
1.0nm			
ID# (0=OFF)			
1			
Auto Print			
On			
Auto Save Data			
Off			
Press ↑ or ↓ to select item to change.			
	Save	Stored	Run
	Test	Tests	Test

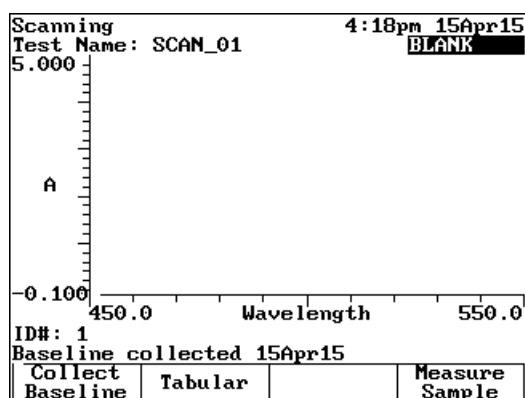
4. Press the **Save Test** function key and follow the onscreen prompts to save the test.

Collecting a Baseline Scan and Scanning a Sample

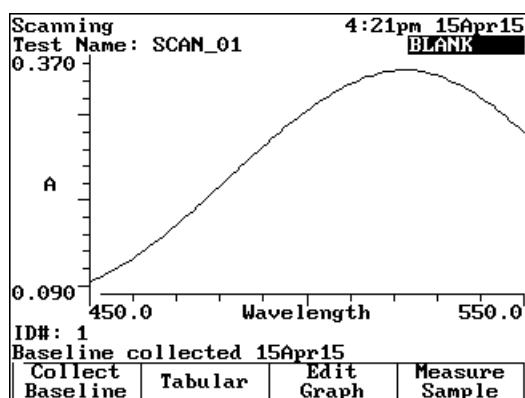
Note: If a 3-position or 6-position vial holder carousel is in use, the blank must be placed in the B position. The instrument always uses the B position to collect the baseline.

Once the parameters have been set for the scan:

1. Press the **Run Test** function key.
2. Prepare the blank and sample that will be scanned.
3. Place the blank in the B position on the vial holder carousel and press the **Collect Baseline** function key.
4. While the instrument is taking the baseline, a "Collecting baseline" message will be shown indicating the progress of the baseline scan. After the baseline is measured, the message will update to "Baseline Collected". Remove the blank from the sample compartment.



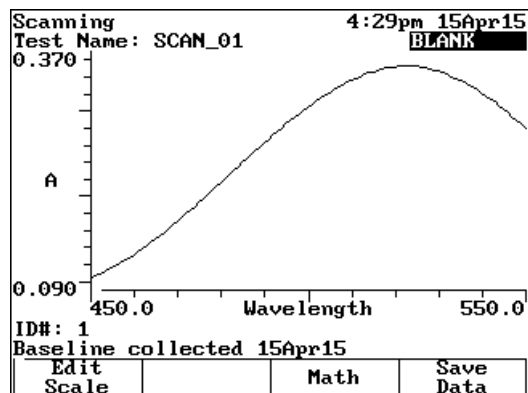
5. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location.
6. Press the **Measure Sample** function key.
7. When the scan is complete, a graph of the scanned measurement will be displayed. Press the **Tabular/Graph** function key to switch between tabular and graphical displays.



Scanning		4:24pm 15Apr15	
Test Name: SCAN_01		BLANK	
Wavelength	Abs		
450.0	0.105		
451.0	0.107		
452.0	0.109		
453.0	0.111		
454.0	0.114		
455.0	0.117		
456.0	0.119		
457.0	0.122		
458.0	0.126		
459.0	0.128		
ID#: 1			
Baseline collected 15Apr15			
Collect	Graph	Edit	Measure
Baseline		Data	Sample

Viewing and Manipulating Scanned Data

The Scanning test technique allows results to be viewed and manipulated in graphical or tabular form. When working with graphical scan data, press the **Edit Graph** function key before performing other functions on the data. Use the Edit Graph menu to rescale graphical scan data, determine peak height using a 3-point net equation, perform calculations on the scanned data and label peaks and valleys.



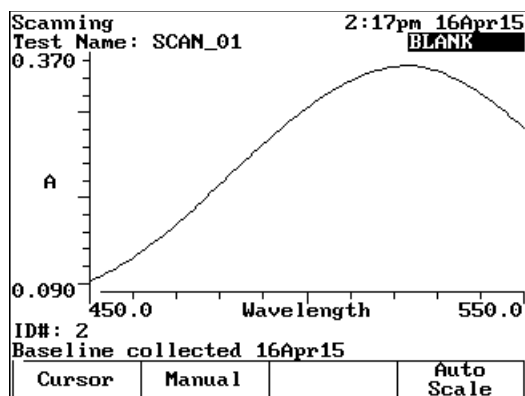
When working with tabular scan data, press the **Edit Data** function key before performing other functions on the data. Use the Edit Data menu to rescale tabular scan data.

Scanning		2:59pm 16Apr15
Test Name: SCAN_01		BLANK
Wavelength	A	<div> Select Data Save Data Press ↑ or ↓ to select Press ENTER </div>
450.0	0	
451.0	0	
452.0	0	
453.0	0	
454.0	0.112	
455.0	0.115	
456.0	0.117	
457.0	0.120	
458.0	0.123	
459.0	0.126	
ID#: 1		
Baseline collected 16Apr15		

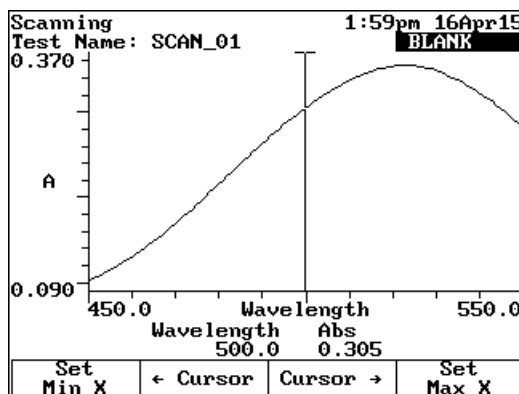
Rescaling Graphical Scan Data

Modify the scale of the scan data plot automatically or manually. When Auto Scale is selected, the instrument scales the X- and Y-axes so all of the data appears on the plot. When Manual is selected, manually select specific minimum and maximum values for the axes.

1. In the graphical display, press the **Edit Graph** function key.
2. Press the **Edit Scale** function key to modify the scale.
3. In the Edit Scale menu:



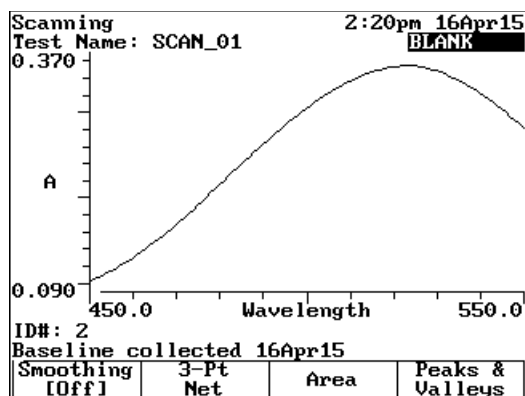
- Press the **Auto Scale** function key to automatically change the scale of the scanned data and display the new graph. The instrument adjusts the minimum and maximum values for the X- and Y-axes so all the data appears on the plot.
- Press the **Manual** function key to manually change the scale of the scanned data (values) and display the new graph. Press the **Min Y**, **Max Y**, **Min X** or **Max X** function key, use the numeric keypad to enter the new value and press the enter key to apply the new value. The instrument will redraw the graph using the entered minimum and maximum values.
- Press the **Cursor** function key to identify specific points along the X-axis. Press the **←Cursor** function key to move to the desired minimum wavelength value and press the **Set Min X** reset the minimum wavelength value and redraw the graph. Press the **Cursor→** function key to move to the desired maximum wavelength value and press the **Set Max X** reset the maximum wavelength value and redraw the graph.



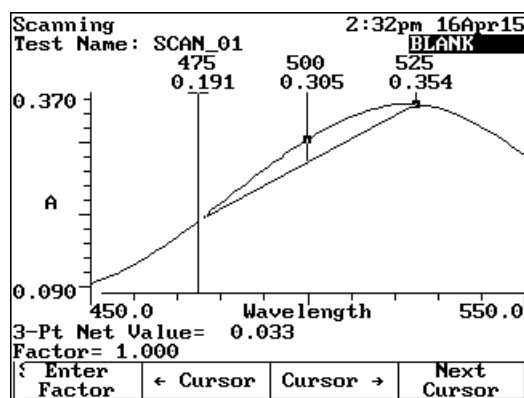
Performing Calculations on the Scan Data

Modify the scan data graph by performing calculations on the data.

- In the graphical display, press the **Edit Graph** function key.
- Press the **Math** function key to modify the graph by performing calculations on the data.
- In the Math menu:

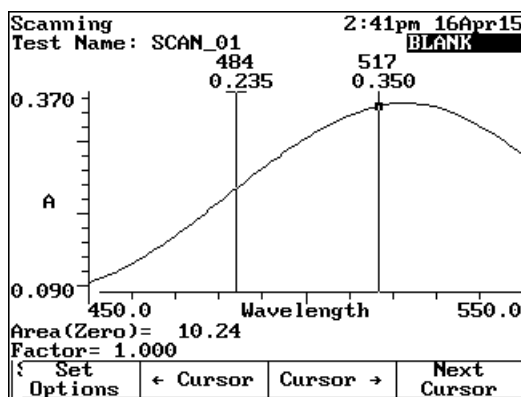


- a. Press the **Smoothing** function key to smooth the data if it shows sampling noise.
- b. Press the **3-Pt Net** function key to determine the peak height using a 3-point net equation. The 3-point net measurement screen shows the cursor options and three cursor lines (designated for the left, center and right wavelengths).
 - i. Press the **←Cursor** and **Cursor→** function keys to position the left cursor line at the desired wavelength value, press the **Next Cursor** function key and repeat for the center cursor line and right cursor line.
 - ii. Press the **Enter Factor** function key to access the set factor box, use the numeric keypad to enter the desired factor value and press the **enter** key.
 - iii. The instrument will calculate the value for the 3-point net absorbance for the selected wavelengths, multiplied by the selected factor.

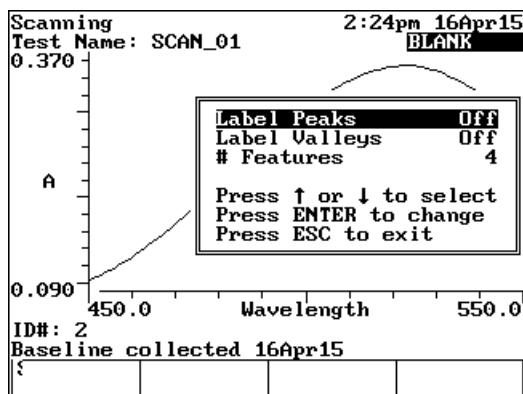


- c. Press the **Area** function key to calculate the area under the curve.
 - i. Press the **←Cursor** and **Cursor→** function keys to position the left cursor line at the desired wavelength value.
 - ii. Press the **Next Cursor** function key.
 - iii. Press the **←Cursor** and **Cursor→** function keys to position the right cursor line at the desired wavelength value.

- iv. Press the **Set Options** function key to access the set options window. Press the **▲** or **▼** key to highlight **Factor**, use the numeric keypad to enter the desired factor value and press the **enter** key. Press the **▲** or **▼** key to highlight **Calculation baseline** and press the **enter** key to toggle between the Zero and Tangent settings. Press the **esc** key once all settings are complete.
- v. The instrument will calculate the area under a curve value for the selected wavelengths, factor and calculation method.



- d. Press the **Peaks & Valleys** function key to label the valleys and peaks on the graph. Press the **▲** or **▼** key to highlight the type of labels to display and press the **enter** key. The instrument will label up to nine peaks or valleys on the scanned data graph.



Rescaling Tabular Scan Data

Modify the tabular scan data by performing calculations on the data.

1. In the tabular display, press the **Edit Data** function key.
2. Press the **▲** or **▼** key to highlight **Select Data** and press the enter key.

Scanning		2:59pm 16Apr15
Test Name: SCAN_01		BLANK
Wavelength	A	
450.0	0	Select Data
451.0	0	Save Data
452.0	0	Press ↑ or ↓ to select
453.0	0	Press ENTER
454.0	0.112	
455.0	0.115	
456.0	0.117	
457.0	0.120	
458.0	0.123	
459.0	0.126	
ID#: 1		
Baseline collected 16Apr15		

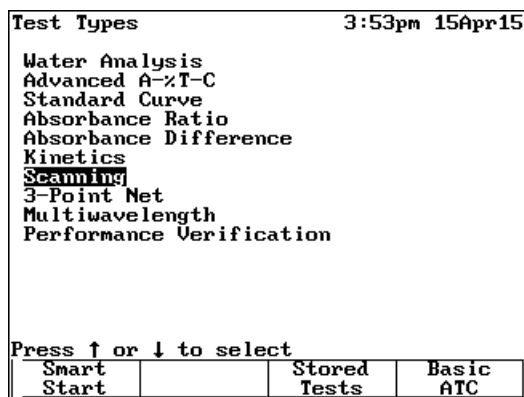
3. Select the scan data:
 - a. To use all the scan data, press the **Use all data** function key.
 - b. To select specific start and end wavelengths, press the **▲** or **▼** key to highlight the appropriate data point in the table for the starting wavelength, press the **Start nm** function key, press the **▲** or **▼** key to highlight the appropriate data point in the table for the ending wavelength and press the **End nm** function key.

Scanning		3:08pm 16Apr15
Test Name: SCAN_01		BLANK
Wavelength	Abs	
450.0	0.103	
451.0	0.105	
452.0	0.107	
453.0	0.109	
454.0	0.112	
455.0	0.115	
456.0	0.117	
457.0	0.120	
458.0	0.123	
459.0	0.126	
ID#: 1		
Baseline collected 16Apr15		
Use all data	Graph	Start nm
		End nm

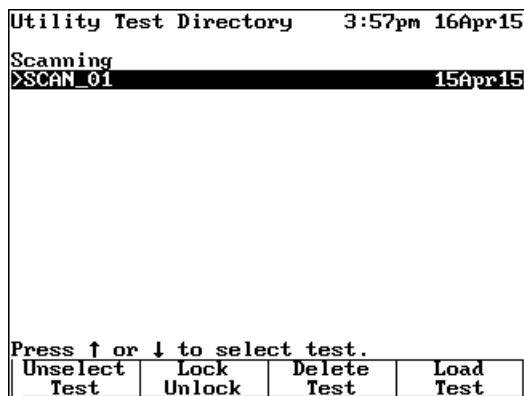
4. The instrument will highlight the selected data points. To display the graph using the highlighted data points, press the **Graph** function key.

Recalling an Existing Scanning Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Scanning and press the **enter** key.



3. To recall an existing scan method, press the **Stored Tests** function key.
4. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the desired test and press the **enter** key.



8

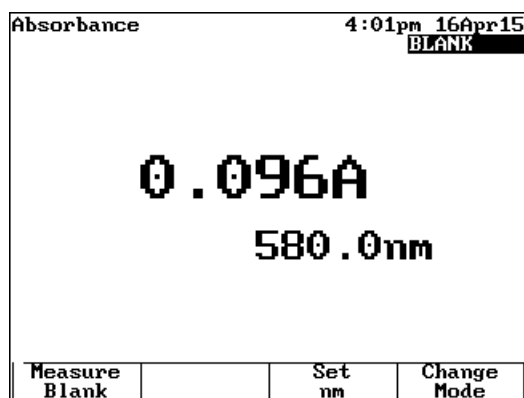
CHAPTER 8 Absorbance, % Transmittance and Concentration Measurements

Absorbance & % Transmittance Measurements

Using the Basic A-%T-C Test Method

Basic A-%T-C mode puts the instrument into an “instant measurement” mode. The user simply walks up to the instrument, inserts a sample and measures it. Depending on whether the mode is set to Absorbance (A), % Transmittance (%T), or Concentration, the measurement results appear, along with the type of measurement, date and time, wavelength and vial position.

In the main measurement mode, press the **Change Mode** function key to toggle between Absorbance, %Transmittance and Concentration.

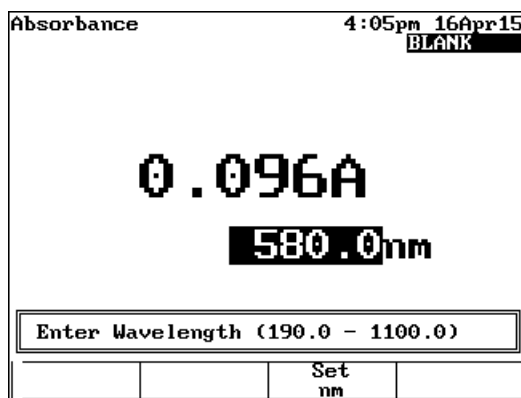


When Basic A-%T-C is set to Absorbance or % Transmittance, these capabilities are provided:

- Setting the Wavelength
- Measuring a Blank
- Measuring Samples

Setting the Wavelength

1. Press the **Set nm** function key to set the wavelength value.
2. Use the numeric keypad to enter the wavelength value for taking measurements.



3. Press the **Set nm** function key again to save the entered wavelength value.

Measuring a Blank

1. Place the blank in the vial holder carousel.

Note: If a 3-position or 6-position vial holder carousel is in use, the blank must be placed in the B position. The instrument always uses the B position to collect the blank measurement.

2. To enter an absorbance or transmittance value for the blank, use the numeric keypad to enter the desired value.
3. Press the **Measure Blank** function key.

Measuring Samples

1. Prepare the samples to be measured.
2. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location.
3. The absorbance (ABS) or percent transmittance (%T) measurement will be shown on the instrument display.

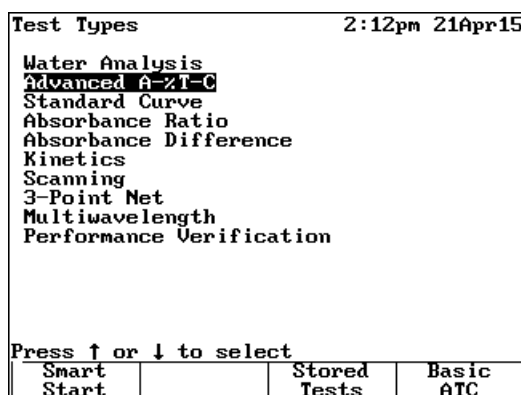
Using the Advanced A-%T-C Test Method

Use the Advanced A-%T-C application for absorbance or % transmittance measurements that include a measurement delay time, or for automating the measurement of multiple samples with a cell changer. This section covers:

- Selecting the measurement mode (Absorbance or %Transmittance)
- Setting Up Test Parameters
- Taking Measurements
- Recalling a Test

Setting the Parameters for Advanced A-%T-C Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Advanced A-%T-C and press the **enter** key.



3. Highlight and change the displayed test parameters, including Test Name, Measurement Mode, Wavelength and Sample Positioner.
 - a. Some parameters only appear when one of the concentration modes is selected, while others appear regardless of the selected measurement mode. See the [Parameters](#) section for more information on the test parameter settings.
 - b. Press the **▲** or **▼** key to highlight More parameters... and press the **enter** key to view additional parameters displayed on the second page.
4. Press the **Save Test** function key and follow the onscreen prompts to save the test.

Taking Measurements with the Advanced A-%T-C Method

Once the parameters have been set for the absorbance or % transmittance test:

1. Press the **Run Test** function key.
2. Prepare the blank and samples that will be measured.
3. If Auto 6 or Auto 3 is selected for the Sample Positioner setting:
 - a. Place the blank and samples in the appropriate positions on the carousel.
 - b. Confirm that the blank and samples are in the appropriate positions on the carousel and press the **enter** key.
 - c. Once the blank and samples have been measured, remove them from the carousel.
 - d. To measure additional samples, press the **Measure Sample** function key and repeat steps 3a through 3c.
4. If Manual 6 or Single Cell Holder is selected for the Sample Positioner setting:
 - a. Place the blank in the B position on the vial holder carousel and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.
 - b. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Sample** function key. Repeat for each sample.

Advanced A-%T-C		2:27pm 21Apr15	
Test Name: -----		BLANK	
Abs			
ID#	510.0nm		
1	0.066		
2	0.212		
3	0.310		
Page 1, Samples 1 - 3			
Measure Blank	Save Data		Measure Sample

5. When all of the samples have been measured, press the **Save Data** function key and follow the onscreen prompts to save the sample measurements to the USB memory stick.

Recalling an Existing Advanced A-%T-C Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Advanced A-%T-C and press the **enter** key.

Test Types		2:12pm 21Apr15	
Water Analysis			
Advanced A-%T-C			
Standard Curve			
Absorbance Ratio			
Absorbance Difference			
Kinetics			
Scanning			
3-Point Net			
Multiwavelength			
Performance Verification			
Press ↑ or ↓ to select			
Smart		Stored	Basic
Start		Tests	ATC

3. To recall an existing standard curve, press the **Stored Tests** function key.

Advanced A-%T-C		2:13pm 21Apr15	
		BLANK	
Test Name			
Measurement Mode		Absorbance	
Wavelength		546.0nm	
Ref. Wavelength Correction		Off	
Delay Time (min:sec)		0:00	
Sample Positioner		Auto 6	
Number of Samples		1	
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save	Stored	Run
	Test	Tests	Test

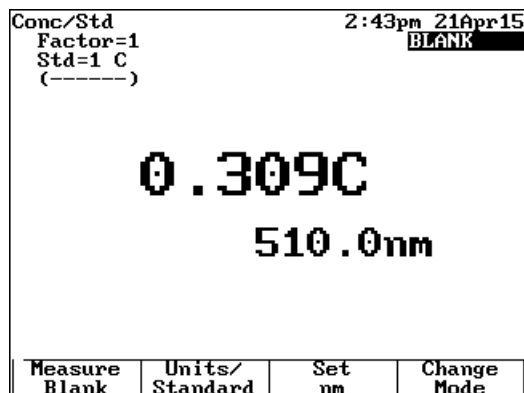
4. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the desired test and press the **enter** key.

Concentration Measurements

Using the Basic A-%T-C Test Method

Use the Basic A-%T-C mode to obtain basic concentration measurements. This basic concentration mode is useful for very simple comparisons that do not require a standard curve. You cannot save data in this application or factors used when a single standard is measured. For better accuracy and the ability to save and recall methods and data, use the [Standard Curve Test Technique](#).

Measuring concentration using the Basic A-%T-C mode is similar to measuring absorbance or % transmittance. The Basic A-%T-C mode measures concentration using either a standard (Conc/Std) or factor (Conc/Factor) to convert absorbance readings to concentration units. When using a standard, specify the concentration of the standard and measure its absorbance. When using a factor, specify the factor and concentration units. The steps for taking measurements in the two modes are similar, the only difference is if a standard is measured or a factor is entered.



In the main measurement mode, press the **Change Mode** function key to toggle between Absorbance, % Transmittance and Concentration. When the mode is set to Conc/Std or Conc/Factor, these capabilities are provided:

- Measuring a Blank
- Measuring a Standard or Entering a Factor
- Setting the Wavelength
- Measuring Samples

Using the Conc/Std Mode to Measure Concentration

In this mode, a standard sample of well known concentration is used to determine the concentration of samples. When the standard concentration is precisely known, the Abs / %T of the standard and the Abs / %T of the unknown sample are measured and the sample concentration is calculated. The measurement can be expressed mathematically as:

$$\frac{\text{Standard Concentration}}{\text{Abs / \%T of Standard}} = \frac{\text{Sample Concentration}}{\text{Abs / \%T of Unknown Sample}}$$

1. If necessary, press the **Change Mode** function key until Conc/Std is set as the mode.
2. If necessary, press the **Set nm** function key to set the wavelength value. Use the numeric keypad to enter the wavelength value for taking measurements. Press the **Set nm** function key again to save the entered wavelength value
3. Prepare the blank and standard that will be used to calculate sample concentration.
4. Place the blank in the B position and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.
5. Press the **Units/Standard** function key to set the units and measure the standard.
 - a. Press the **Enter Conc** function key, use the numeric keypad to enter the concentration of the standard and press the **enter** key.
 - b. Press the **Select Units** function key, press the **▲** or **▼** key to highlight the desired units and press the **enter** key.
 - c. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Standard** function key. The instrument will measure the absorbance of the standard and display the absorbance and calculated factor.

Conc : Measure Std		3:14pm 21Apr15	
		BLANK	
Standard Conc.	Units	Abs (510.0nm)	Factor (calculated)
0.55	ppm	0.306	1.797
Measure Blank		Enter Conc	Select Units
		Measure Standard	

6. Press the **esc** key to return to the main measurement mode.
7. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. The concentration measurement will be shown on the instrument display.

Using the Conc/Factor Mode to Measure Concentration

In this mode a concentration factor is used to determine the concentration of samples. When the factor is entered, the Abs / %T of the sample is measured and the sample concentration is calculated from the entered factor. The measurement can be expressed mathematically as:

$$(\text{Abs} / \%T \text{ of Sample}) * \text{Factor} = \text{Concentration of Sample}$$

1. If necessary, press the **Change Mode** function key until Conc/Factor is set as the mode.
2. If necessary, press the **Set nm** function key to set the wavelength value. Use the numeric keypad to enter the wavelength value for taking measurements. Press the **Set nm** function key again to save the entered wavelength value
3. Press the **Units/Factor** function key to set the units and enter the factor.
 - a. Press the **Enter Factor** function key, use the numeric keypad to enter the value of the factor and press the enter key.
 - b. Press the **Select Units** function key, press the **▲** or **▼** key to highlight the desired units and press the enter key.

Conc with Factor		3:20pm 21Apr15	
		BLANK	
Factor	1.850		
Units	ppm		
Press ↑ or ↓ to select item to change.			
	Enter Factor	Select Units	

4. Press the **esc** key to return to the main measurement mode.
5. Prepare the blank, place it in the B position and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.
6. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. The concentration measurement will be shown on the instrument display.

Using the Advanced A-%T-C Test Method

Use the Advanced A-%T-C mode to obtain advanced concentration measurements. Methods, data and factors can be saved in this application. This advanced concentration mode is useful for very simple comparisons that do not require a standard curve. For better accuracy, use the [Standard Curve Test Technique](#).

The Advanced A-%T-C mode measures concentration using either a standard or factor to convert absorbance readings to concentration units. When using a standard, specify the concentration of the standard and measure its absorbance. When using a factor, specify the factor and concentration units. The steps for taking measurements in the two modes are similar, the only difference is if a standard is measured or a factor is entered.

Setting the Parameters for Advanced A-%T-C Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Advanced A-%T-C and press the **enter** key.

Test Types		2:12pm 21Apr15	
Water Analysis Advanced A-%T-C Standard Curve Absorbance Ratio Absorbance Difference Kinetics Scanning 3-Point Net Multiwavelength Performance Verification			
Press ↑ or ↓ to select			
Smart		Stored	Basic
Start		Tests	ATC

3. Press the **▲** or **▼** key to highlight Measurement Mode and press the **enter** key. Press the **▲** or **▼** key to highlight Conc/Std or Conc/Factor and press the **enter** key.

Advanced A-%T-C		12:58pm 8Jul15	
		BLANK	
Test Name	Absorbance		
Measurement Mo	% Transmittance		
Wavelength	Conc/Std		
Ref. Wavelength	Conc/Factor		
Delay Time (mi	Press ↑ or ↓ to select		
Sample Positio	Press ENTER		
More parameter			
Press ↑ or ↓ to select item to change.			

4. Highlight and change the displayed test parameters, including Test Name, Wavelength, Concentration of Standard, Factor, Units and Sample Positioner.

- a. Some parameters only appear when one of the concentration modes is selected, while others appear regardless of the selected measurement mode. See the [Parameters](#) section for more information on the test parameter settings.
- b. Press the ▲ or ▼ key to highlight **More parameters...** and press the **enter** key to view additional parameters displayed on the second page.

Advanced A-%T-C		12:59pm 8Jul15	
BLANK			
Test Name			
Measurement Mode		Conc/Std	
Wavelength		510.0nm	
Ref. Wavelength Correction		Off	
Delay Time (min:sec)		0:00	
Conc of Standard		Undefined	
Factor		Undefined	
Units		C	
Sample Positioner		Manual 6	
More parameters...			
Press ↑ or ↓ to select item to change.			
Run	Save	Stored	
Standard	Test	Tests	

Advanced A-%T-C		1:00pm 8Jul15	
BLANK			
ID# (0=OFF)			
Low/High Limits		-9999/9999	
Statistics		Off	
Auto Print		On	
Auto Save Data		Off	
More parameters...			
Press ↑ or ↓ to select item to change.			
Run	Save	Stored	
Standard	Test	Tests	

5. Press the **Save Test** function key and follow the onscreen prompts to save the test.

Measuring a Standard with Advanced A-%T-C Method

Once the parameters have been set for the concentration test and the measurement mode is set to Conc/Std:

1. Press the **Run Standard** function key.
2. Prepare the blank and standard that will be measured.
3. Use the numeric keypad to enter the concentration of the standard and press the **enter** key to save the value.
4. If Auto 6 or Auto 3 is selected for the Sample Positioner setting:
 - a. Place the blank and standard in the appropriate positions on the carousel.
 - b. Press the **Measure Standard** function key. Confirm that the blank and standard are in the appropriate positions on the carousel and press the **enter** key.

5. If Manual 6 or Single Cell Holder is selected for the Sample Positioner setting:
 - a. Place the blank in the B position on the vial holder carousel and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.
 - b. Place the standard in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Standard** function key and press the **enter** key to measure the standard.
6. When the standard has been measured, the concentration, absorbance and calculated factor will be displayed.

Advanced A-%T-C		1:11pm 8Jul15	
Test Name: -----		BLANK	
Conc.	Abs	Factor	
C	510.0nm	calculated	
0.500	0.342	1.462	
Page 1, Standard 1			
	Save	Edit	Run
	Test	Standard	Test

7. To save the test with the calculated factor, press the **Save Test** function key and follow the onscreen prompts.
8. Press the **Run Test** function key to start measuring samples.

Taking Measurements with Advanced A-%T-C Method

Once the parameters have been set for the concentration test:

1. Press the **Run Test** function key.
2. Prepare the blank and samples that will be measured.
3. If Auto 6 or Auto 3 is selected for the Sample Positioner setting:
 - a. Place the blank and samples in the appropriate positions on the carousel.
 - b. Confirm that the blank and samples are in the appropriate positions on the carousel and press the **enter** key.
 - c. Once the blank and samples have been measured, remove them from the carousel.
 - d. To measure additional samples, press the **Measure Sample** function key and repeat steps 3a through 3c.
4. If Manual 6 or Single Cell Holder is selected for the Sample Positioner setting:
 - a. Place the blank in the B position on the vial holder carousel and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.

- b. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Sample** function key. Repeat for each sample.
5. When all of the samples have been measured, press the **Save Data** function key and follow the onscreen prompts to save the sample measurements to the USB memory stick.

Recalling an Existing Advanced A-%T-C Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Advanced A-%T-C and press the **enter** key.

Test Types		2:12pm 21Apr15	
Water Analysis Advanced A-%T-C Standard Curve Absorbance Ratio Absorbance Difference Kinetics Scanning 3-Point Net Multiwavelength Performance Verification			
Press ↑ or ↓ to select			
Smart Start		Stored Tests	Basic ATC

3. To recall an existing standard curve, press the **Stored Tests** function key.

Advanced A-%T-C		2:13pm 21Apr15	
		BLANK	
Test Name			
Measurement Mode	Absorbance		
Wavelength	546.0nm		
Ref. Wavelength Correction	Off		
Delay Time (min:sec)	0:00		
Sample Positioner	Auto 6		
Number of Samples	1		
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save Test	Stored Tests	Run Test

4. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the desired test and press the **enter** key.

Multiwavelength

The Multiwavelength application obtains multiple fixed-wavelength measurements. It is a fast alternative to scanning if the wavelengths of interest are well known. This section covers:

- Setting Up Test Parameters and Adding Wavelengths and Factors
- Taking Measurements
- Recalling a Test

Setting the Parameters for Multiwavelength Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight **Multiwavelength** and press the **enter** key.

Test Types		1:16pm 8Jul15	
Water Analysis			
Advanced A-%T-C			
Standard Curve			
Absorbance Ratio			
Absorbance Difference			
Kinetics			
Scanning			
3-Point Net			
Multiwavelength			
Performance Verification			
Press ↑ or ↓ to select			
Smart		Stored	Basic
Start		Tests	ATC

3. Highlight and change the displayed test parameters, including Test Name, Measurement Mode and Sample Positioner.
 - a. Some parameters only appear when the concentration mode is selected, while others appear regardless of the selected measurement mode. See the [Parameters](#) section for more information on the test parameter settings.

Multiwavelength		1:18pm 8Jul15	
Cell # 1			
Test Name			
Measurement Mode		Absorbance	
Sample Positioner		Auto 6	
Number of Samples		1	
ID# (0=OFF)		1	
Auto Print		On	
Auto Save Data		Off	
Press ↑ or ↓ to select item to change.			
Set nms	Save	Stored	
	Test	Tests	

4. Press the **Set nms** function key to add the wavelengths and factors. Factors can only be added when the measurement mode is set to Conc/Factor.

- Press the **Add nm** function key, use the numeric keypad to enter the wavelength value and press the **enter** key.
- If the measurement mode is set to Conc/Factor, use the numeric keypad to enter the factor value and press the **enter** key.
- Repeat for each wavelength and factor.

Multiwavelength			1:29pm 8Jul15
Test Name: -----			Cell # 1
WL#	nm	Factor	
1	340.0	56.85	
2	532.0	630.0	
3	633.0	0.050	
4	-----	-----	
Page 1			
Press ↑ or ↓ to view data			
Edit	Add nm		Run Test

- Press the **Run Test** function key.

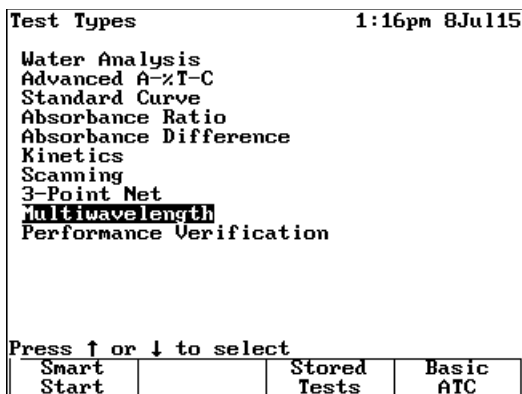
Taking Measurements with Multiwavelength Method

Once the parameters have been set for the multiwavelength test:

- Press the **Run Test** function key.
- Prepare the blank and samples that will be measured.
- If Auto 6 or Auto 3 is selected for the Sample Positioner setting:
 - Place the blank and samples in the appropriate positions on the carousel.
 - Confirm that the blank and samples are in the appropriate positions on the carousel and press the **enter** key.
 - Once the blank and samples have been measured, remove them from the carousel.
 - To measure additional samples, press the **Measure Sample** function key and repeat steps 3a through 3c.
- If Manual 6 or Single Cell Holder is selected for the Sample Positioner setting:
 - Place the blank in the B position on the vial holder carousel and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.
 - Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Sample** function key. Repeat for each sample.
- When all of the samples have been measured, press the **Save Data** function key and follow the onscreen prompts to save the sample measurements to the USB memory stick.

Recalling an Existing Multiwavelength Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Multiwavelength and press the **enter** key.



3. To recall an existing multiwavelength method, press the **Stored Tests** function key.
4. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the desired test and press the **enter** key.

Absorbance Ratio

The Absorbance Ratio application measures the absorption ratio of two different wavelengths. Reference wavelength correction is available to eliminate the effects of a sample matrix. Typically used in quality control applications, an absorbance ratio provides a convenient and quick diagnostic test for sample quality. This section covers:

- Setting Up Test Parameters
- Taking Measurements
- Recalling a Test

Setting the Parameters for Absorbance Ratio Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Absorbance Ratio and press the **enter** key.

Test Types		1:40pm 8Jul15	
Water Analysis			
Advanced A-%T-C			
Standard Curve			
Absorbance Ratio			
Absorbance Difference			
Kinetics			
Scanning			
3-Point Net			
Multiwavelength			
Performance Verification			
Press ↑ or ↓ to select			
Smart		Stored	Basic
Start		Tests	ATC

3. Highlight and change the displayed test parameters, including Test Name, Wavelength 1, Wavelength 2 and Sample Positioner. See the [Parameters](#) section for more information on the test parameter settings.

Absorbance Ratio		1:42pm 8Jul15	
		Cell # 1	
Test Name			
Wavelength 1		546.0nm	
Wavelength 2		546.0nm	
Ref. Wavelength Correction		Off	
Sample Positioner		Auto 6	
Number of Samples		1	
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save	Stored	Run
	Test	Tests	Test

4. Press the **Save Test** function key and follow the onscreen prompts to save the test.

Taking Measurements with Absorbance Ratio Method

Once the parameters have been set for the absorbance ratio test:

1. Press the **Run Test** function key.
2. Prepare the blank and samples that will be measured.
3. If Auto 6 or Auto 3 is selected for the Sample Positioner setting:
 - a. Place the blank and samples in the appropriate positions on the carousel.
 - b. Confirm that the blank and samples are in the appropriate positions on the carousel and press the **enter** key.
 - c. Once the blank and samples have been measured, remove them from the carousel.
 - d. To measure additional samples, press the **Measure Sample** function key and repeat steps 3a through 3c.
4. If Manual 6 or Single Cell Holder is selected for the Sample Positioner setting:
 - a. Place the blank in the B position on the vial holder carousel and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.
 - b. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Sample** function key. Repeat for each sample.
5. When all of the samples have been measured, press the **Save Data** function key and follow the onscreen prompts to save the sample measurements to the USB memory stick.

Recalling an Existing Absorbance Ratio Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Absorbance Ratio and press the **enter** key.
3. To recall an existing Absorbance Ratio method, press the **Stored Tests** function key.
4. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the desired test and press the **enter** key.

Absorbance Difference

The Absorbance Difference application measures the difference in absorption at two different wavelengths. Reference wavelength correction is available to eliminate the effects of a sample matrix. Typically used in quality control applications, an absorbance difference application provides a convenient and quick diagnostic test for sample quality. This section covers:

- Setting Up Test Parameters
- Taking Measurements
- Recalling a Test

Setting the Parameters for Absorbance Difference Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Absorbance Difference and press the **enter** key.

Test Types		2:05pm 8Jul15	
Water Analysis			
Advanced A-%T-C			
Standard Curve			
Absorbance Ratio			
Absorbance Difference			
Kinetics			
Scanning			
3-Point Net			
Multiwavelength			
Performance Verification			
Press ↑ or ↓ to select			
Smart		Stored	Basic
Start		Tests	ATC

3. Highlight and change the displayed test parameters, including Test Name, Wavelength 1, Wavelength 2, Factor 1, Factor 2, Units and Sample Positioner. See the [Parameters](#) section for more information on the test parameter settings.

Absorbance Difference		2:06pm 8Jul15	
BLANK			
Test Name			
Wavelength 1		546.0nm	
Wavelength 2		546.0nm	
Ref. Wavelength Correction		Off	
Factor 1		1.000	
Factor 2		1.000	
Units		ppm	
Sample Positioner		Auto 6	
Number of Samples		1	
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save	Stored	Run
	Test	Tests	Test

4. Press the **Save Test** function key and follow the onscreen prompts to save the test.

Taking Measurements with Absorbance Difference Method

Once the parameters have been set for the absorbance difference test:

1. Press the **Run Test** function key.
2. Prepare the blank and samples that will be measured.
3. If Auto 6 or Auto 3 is selected for the Sample Positioner setting:
 - a. Place the blank and samples in the appropriate positions on the carousel.
 - b. Confirm that the blank and samples are in the appropriate positions on the carousel and press the **enter** key.
 - c. Once the blank and samples have been measured, remove them from the carousel.
 - d. To measure additional samples, press the **Measure Sample** function key and repeat steps 3a through 3c.
4. If Manual 6 or Single Cell Holder is selected for the Sample Positioner setting:
 - a. Place the blank in the B position on the vial holder carousel and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.
 - b. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Sample** function key. Repeat for each sample.
5. When all of the samples have been measured, press the **Save Data** function key and follow the onscreen prompts to save the sample measurements to the USB memory stick.

Recalling an Existing Absorbance Difference Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Absorbance Difference and press the **enter** key.
3. To recall an existing Absorbance Difference method, press the **Stored Tests** function key.
4. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the desired test and press the **enter** key.

3-Point Net

The 3-Point Net application determines the height of a peak based on a sloping baseline drawn between two wavelengths on either side of the peak. This type of analysis is beneficial when the precise peak height is needed for a particular assay. A factor can be multiplied by the measured peak height to give the concentration of the measured analyte in the appropriate concentration units. This section covers:

- Setting Up Test Parameters
- Taking Measurements
- Recalling a Test

Setting the Parameters for 3-Point Net Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight **3-Point Net** and press the **enter** key.

Test Types		2:10pm 8Jul15	
Water Analysis			
Advanced A-%T-C			
Standard Curve			
Absorbance Ratio			
Absorbance Difference			
Kinetics			
Scanning			
3-Point Net			
Multiwavelength			
Performance Verification			
Press ↑ or ↓ to select			
Smart		Stored	Basic
Start		Tests	ATC

3. Highlight and change the displayed test parameters, including Test Name, Wavelength 1, Wavelength 2, Wavelength 3, Factor, Units and Sample Positioner. See the [Parameters](#) section for more information on the test parameter settings.

3-Point Net		2:10pm 8Jul15	
BLANK			
Test Name			
Wavelength 1		545.0nm	
Wavelength 2		546.0nm	
Wavelength 3		547.0nm	
Factor		1.000	
Units		C	
Sample Positioner		Auto	6
Number of Samples		1	
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save	Stored	Run
	Test	Tests	Test

4. Press the **Save Test** function key and follow the onscreen prompts to save the test.

Taking Measurements with 3-Point Net Method

Once the parameters have been set for the 3-point net test:

1. Press the **Run Test** function key.
2. Prepare the blank and samples that will be measured.
3. If Auto 6 or Auto 3 is selected for the Sample Positioner setting:
 - a. Place the blank and samples in the appropriate positions on the carousel.
 - b. Confirm that the blank and samples are in the appropriate positions on the carousel and press the **enter** key.
 - c. Once the blank and samples have been measured, remove them from the carousel.
 - d. To measure additional samples, press the **Measure Sample** function key and repeat steps 3a through 3c.
4. If Manual 6 or Single Cell Holder is selected for the Sample Positioner setting:
 - a. Place the blank in the B position on the vial holder carousel and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.
 - b. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Sample** function key. Repeat for each sample.
5. When all of the samples have been measured, press the **Save Data** function key and follow the onscreen prompts to save the sample measurements to the USB memory stick.

Recalling an Existing 3-Point Net Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight 3-Point Net and press the **enter** key.
3. To recall an existing 3-Point Net method, press the **Stored Tests** function key.
4. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the desired test and press the **enter** key.

Kinetics

The Kinetics application measures the change in the sample absorbance as a function of time. The local control software allows the determination of a linear rate over a particular region, which can be defined after the data acquisition. Frequently used in enzymatic kinetics, a factor can be multiplied by the slope of the linear rate fit to determine activity. This section covers:

- Setting Up Test Parameters
- Taking Measurements
- Recalling a Test
- Recalling and Recalculating Graphical Kinetics Results
- Rescaling and Recalculating Tabular Kinetics Results
- Modifying the scale of the plot

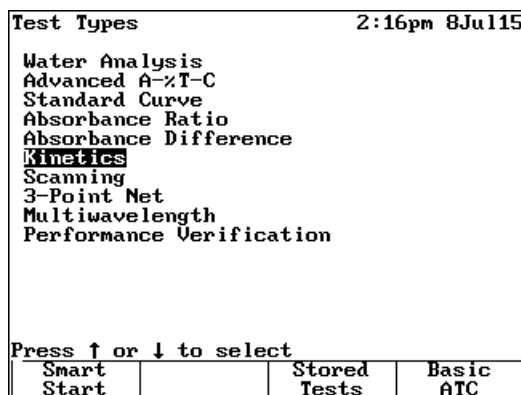
You can work with graphical or tabular data and perform the same functions with either. However, the location of the function keys depends on the display type.

Note: The Kinetics application can measure only one sample at a time.

Note: The Kinetics application collects up to 400 data points per run. When setting test parameters, select the interval time and total run time accordingly.

Setting the Parameters for Kinetics Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Kinetics and press the **enter** key.



3. Highlight and change the displayed test parameters, including Test Name, Measurement Mode, Wavelength, Interval Time, Total Run Time, Factor, Units, Linearity Value and Sample Positioner.
 - a. The Delay Time parameter is used to enter the time from test initiation to first measurement, allowing for sample equilibration.
 - b. The Interval Time parameter is used to enter the time between repeated readings.
 - c. The Measure Blank parameter is used to select the frequency of zeroing the instrument (as function key) as once or every reading.
 - d. See the [Parameters](#) section for more information on the test parameter settings.
 - e. Press the **▲** or **▼** key to highlight **More parameters...** and press the **enter** key to view additional parameters displayed on the second page.

Kinetics		2:16pm 8Jul15	
		BLANK	
Test Name			
Measurement Mode		Absorbance	
Wavelength		546.0nm	
Ref. Wavelength Correction		Off	
Delay Time (min:sec)		0:00	
Interval Time (min:sec)		0:01	
Total Run Time (hr:min:sec)		0:05:00	
Measure Blank		Once	
Display Result (Rate * Factor)		On	
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save	Stored	Run
	Test	Tests	Test

Kinetics		2:17pm 8Jul15	
		BLANK	
Factor	1.000		
Units	C		
Linearity Value	0.005		
Sample Positioner	Auto 6		
ID# (0=OFF)	1		
Low/High Limits	-9999/9999		
Auto Print	On		
Auto Save Data	Off		
More parameters...			
Press ↑ or ↓ to select item to change.			
	Save	Stored	Run
	Test	Tests	Test

4. Press the **Save Test** function key and follow the onscreen prompts to save the test.

Taking Measurements with Kinetics Method

Once the parameters have been set for the kinetics test:

1. Press the **Run Test** function key.
2. Prepare the blank and sample that will be measured.

3. If Auto 6 or Auto 3 is selected for the Sample Positioner setting:
 - a. Place the blank and sample in the appropriate positions on the carousel.
 - b. Confirm that the blank and sample are in the appropriate positions on the carousel and press the **enter** key.
 - c. Once the blank and sample have been measured, remove them from the carousel.
 - d. To measure additional samples, press the **Measure Sample** function key and repeat steps 3a through 3c.
4. If Manual 6 or Single Cell Holder is selected for the Sample Positioner setting:
 - a. Place the blank in the B position on the vial holder carousel and press the **Measure Blank** function key. Once the blank has been measured, remove it from the carousel.
 - b. Place the sample in the appropriate position on the vial holder carousel. If needed, use the Sample Positioner keypad to set the vial location. Press the **Measure Sample** function key.
5. After the measurement is complete, the kinetics data and rate will be shown. Press the **Tabular** or **Graph** function key to switch between tabular and graphical displays.
 - a. On the graphical display, press the **Edit Graph** function key and then press the **Cursor** function key to move the cursor line from one position to another on the plot. As the cursor moves, the rate and result values indicate the values for the point where the cursor is located.

Recalling an Existing Kinetics Method

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Kinetics and press the **enter** key.
3. To recall an existing Kinetics method, press the **Stored Tests** function key.
4. Press the **▲** or **▼** key to highlight Load internal test or Load test from USB drive and press the **enter** key.
5. Press the **▲** or **▼** key to highlight the desired test and press the **enter** key.

Recalling and Recalculating Graphical Kinetics Results

The Kinetics application allows the viewing and manipulation of results in graphical or tabular form. When the results are displayed, the range (start and stop time) can be modified and the instrument recalculates the reaction rate. When working with graphical kinetics results, press the **Edit Graph** function key before you can rescale and recalculate.

You can modify the scale of your kinetics data plot automatically or manually. When you select **Auto Scale**, the instrument automatically scales the X- and Y-axes so all the data appears on the plot. When you select **Manual Scale**, you select specific minimum and maximum values for the X- and Y-axes. Whenever you modify the scale, the instrument recalculates and displays the new reaction rate and result.

The edit screen allows you to use Auto Scale to change the scale, display the new graph and recalculate the results; use Manual Scale to change the scale, display the new graph and recalculate the results; and use the cursor to select new minimum or maximum values for the X-axis and recalculate the results.

To use Auto Scale

1. With kinetics data displayed on the Edit Graph screen, press the **Auto Scale** function key.
2. The instrument adjusts the minimum and maximum values for the X- and Y-axes so all the data appears on the plot. The instrument also recalculates the results, using all the data and displays them.

To use Manual Scale

1. With kinetics data displayed on the Edit Graph screen, press the **Manual Scale** function key to display the manual scale options.
2. Enter the appropriate minimum or maximum value for the X- or Y-axis and press Min Y, Max Y, Min X or Max X to accept it. The instrument redraws the plot using the entered minimum and maximum values and displays the recalculated rate and result.
3. Continue until you have entered all the values that you want to change.

To use the Cursor function

1. With kinetics data displayed on the Edit Graph screen, press the **Cursor** function key to display the cursor options.
2. Press the **←Cursor** or **Cursor→** function key to position the cursor line on the appropriate point on the graph. The data for the selected point will be displayed.
3. When the cursor line is in the correct position, press the **Set Min X** or **Set Max X** function key to accept the selected point.
4. The instrument will redraw the plot using the selected minimum and maximum values and display the recalculated rate and result.

Rescaling and Recalculating Tabular Kinetics Results

The Kinetics application allows the viewing and manipulation of results in graphical or tabular form. When the results are displayed, the range (start and stop time) can be modified and the instrument recalculates the reaction rate. When working with tabular kinetics results, press the **Edit Data** function key before you can rescale and recalculate.

After collecting kinetics data, you can use all the data for the rate calculation or select specific start and end times. When you modify the start and end times or select all the data, the instrument recalculates and displays the new reaction rate and result.

The edit screen allows you to use all the data to recalculate the results and select specific start and end times for the rate calculation and recalculate the results.

To use all the data to calculate the reaction rate

1. With tabular kinetics data displayed on the Edit Data screen, press the **Use All Data** function key.
2. The instrument will calculate and display the rate.

To select specific start and end times for the rate calculation

1. With tabular kinetics data displayed on the Edit Data screen, press the **▲** or **▼** key to highlight the appropriate data point in the table.
2. Press the **Start Time** or **End Time** function key to display the recalculated rate and result.

9

CHAPTER 9 Performance Verification

Performance Verification Tests

Thermo Scientific Orion AquaMate 8000 UV-Vis and AquaMate 7000 Vis spectrophotometers offer performance verification tests that assist with checking the performance of the instrument:

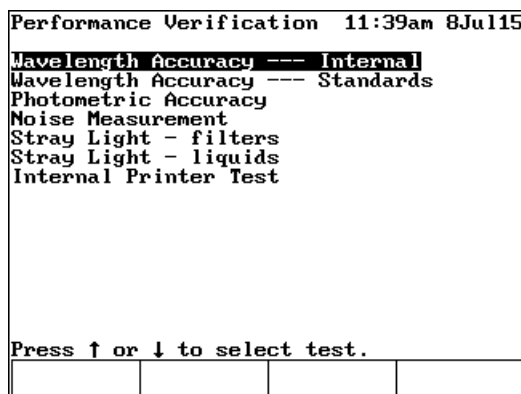
- Wavelength Accuracy – Internal
- Wavelength Accuracy – Standards
- Photometric Accuracy
- Noise Measurement
- Stray Light – filters
- Stray Light – liquids

Run the appropriate tests regularly and maintain a log of results to help document the reliability of the instrument and indicate potential performance issues.

Note: If a printer is connected, enabled and active, the instrument automatically prints test results. You can also press the **print** key to print another copy of the results.

Accessing the Performance Verification Tests

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Performance Verification and press the **enter** key.
3. Press the **▲** or **▼** key to highlight the desired test and press the **enter** key.



Troubleshooting Checklist

If a performance verification test fails, follow the suggestions below to diagnose common problems. If a test continues to fail after you have tried all these recommendations, follow the troubleshooting list for the test being run (included with the description of each test).

- Make sure to follow the instructions for the test properly.
- Make sure filters and standards are clean.
- Check that the sample compartment door is closed during the test.
- Check that the sample compartment is clear of obstructions.
- Make sure the vial holder carousel is installed properly. If the 6-position vial holder carousel is installed, run the test once with the sample compartment door open to verify that the carousel is moving smoothly.
- Check that no problems are indicated by the power-on diagnostics after you turn the instrument power OFF and then ON.
- Make sure the lamp is ON.
- Make sure the lamp compartment is clear of obstructions.

Warning: Do not open the lamp compartment unless the instrument power is OFF.

Warning: Do not turn the instrument power ON unless the lamp compartment is closed.

Wavelength Accuracy – Internal

This test locates the peaks of the internal xenon lamp (UV-Vis instruments) or internal didymium filter (Vis instruments) and displays the expected and measured wavelengths for the peaks.

- UV-Vis: A xenon lamp has strong, fundamental lines at 229 nm, 529 nm and 883 nm. These lines are an essential property of xenon and serve as a fundamental standard.
- Vis: Didymium glass has strong transmission peaks at 585nm and 807nm. These peaks are well characterized and suitable for use as wavelength standards.

When running the internal standard test, remember that:

- The wavelengths and tolerance values are preset and cannot be changed.
- The vial holder should be empty.

To run the Wavelength Accuracy – Internal test:

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Performance Verification and press the **enter** key.
3. Press the **▲** or **▼** key to highlight Wavelength Accuracy - Internal and press the **enter** key.
4. Press the **Start Test** function key.
5. Once the test is complete, the results will indicate pass or fail for each wavelength.

Performance Verification 11:52am 8Jul15			
Wavelength Accuracy --- Internal			
Expected	Tolerance	Measured	Result
nm	±nm	nm	
247.5	± 1	247.6	Pass
529.0	± 1	529.3	Pass
824.2	± 1	824.4	Pass
Make sure the Blank position is empty.			
Press Start Test			
			Start Test

If the test fails, follow these guidelines:

- Repeat the test twice to verify that the test is failing consistently.
- Contact technical support for more troubleshooting advice.

Wavelength Accuracy – Standards

This test measures the absorbance of a wavelength accuracy standard and compares the location of the peaks with precisely known values at up to five wavelengths. By default, wavelength accuracy tests are performed in absorbance mode; however, this test may also be performed in %T mode.

When running the external standard test, remember:

- Wavelength accuracy standards designed to measure the wavelength accuracy at the specified wavelengths are required.
- Use an empty vial holder as the blank.
- Measure the standards in the order they are listed on the test screen. The wavelength standard at only five wavelengths can be measured.

To run the Wavelength Accuracy – Standards test:

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Performance Verification and press the **enter** key.
3. Press the **▲** or **▼** key to highlight Wavelength Accuracy - Standards and press the **enter** key.
4. Enter the appropriate wavelength values and their tolerances.
 - a. Press the **Add nm** function key, use the numeric keypad to enter the wavelength value in the entry field and press the **enter** key.
 - b. Use the numeric keypad to enter the tolerance for the entered wavelength in the entry field and press the **enter** key.
 - c. Repeat for each standard.
5. Verify that the wavelengths and tolerances are set correctly.

Performance Verification 12:09pm 8Jul15			
Wavelength Accuracy --- Standards			
Measurement Mode: %Transmittance Peak			
Expected	Tolerance	Measured	Result
nm	±nm	nm	
399.0	± 2		
525.0	± 2		
Place Standard 1 in position 1			
Press ESC to save test			
Change Mode	Add nm	Delete nm	Start Test

6. Press the **Start Test** function key.

7. The results will indicate pass or fail for each wavelength.

If the test fails, follow these guidelines:

- Repeat the test twice to verify that the test is failing consistently.
- Make sure the target and tolerance values you entered for the calibrated wavelength are the same as the values on the calibration certificate for the standard.

Photometric Accuracy

This test measures the absorbance (or % T) of a set of standards and compares the results with specified tolerances. The wavelength absorbencies and tolerances are preset, but you should change them to the values on the calibration certificate included with your standards.

Note: You can display the tolerances for this test in either absorbance or %Transmittance.

When running the Photometric Accuracy test, remember:

- You need photometric accuracy standards calibrated to known absorbance values at specified wavelengths.
- Measure the standards in the order they are listed on the test screen.
- You can use one to five standards.

To run the Photometric Accuracy test:

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Performance Verification and press the **enter** key.
3. Press the **▲** or **▼** key to highlight Photometric Accuracy and press the **enter** key.

Performance Verification				12:16pm 8Jul15
Photometric Accuracy				
#	nm	Expected %T	Tol. ±%T	Meas. %T Result
1	590.0	50.000	± 1.200	
2	590.0	10.000	± 1.200	
Place Standards 1 - 2 in positions 1 - 2				
Change to Abs		Add Std	Delete Std	Start Test

4. To switch between absorbance and %Transmittance, press the **Change to %T** or **Change to Abs** function key until the appropriate mode is displayed.
5. You will need to set three values for each standard: the wavelength, the absorbance (or % Transmittance) and the tolerance value. To add a standard:
 - a. Press the **Add Std** function key, use the numeric keypad to enter the wavelength value in the entry field and press the **enter** key.
 - b. Use the numeric keypad to enter the absorbance or %T value for the entered wavelength in the entry field and press the **enter** key.

- c. Use the numeric keypad to enter the tolerance value for the entered wavelength in the entry field and press the **enter** key.
 - d. Repeat for each standard.
6. Verify that the wavelengths, absorbance or %T and tolerances are set correctly.
7. Press the **Start Test** function key.
8. The results will indicate pass or fail for each wavelength.

If the test fails, follow these guidelines:

- Repeat the test twice to verify that the test is failing consistently.
- Follow the guidelines provided with the standard reference materials.
- Contact technical support for more troubleshooting advice.

Noise Measurement

This test measures the amount of noise. The Vis instrument measures only at 340 nm. All test parameters are determined by instrument specifications and cannot be changed by the user. When running the noise test, remember:

- Perform the 0A measurement with the vial holder empty. Optionally you can perform the 2A measurement with a 2A filter.

To run the Noise Measurement test:

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Performance Verification and press the **enter** key.
3. Press the **▲** or **▼** key to highlight Noise Measurement and press the **enter** key.

Performance Verification 12:29pm 8Jul15			
Noise Measurement			
00A	Peak-to-Peak	Meas.	Result
	Tolerance		
230.0nm	≤0.002		
340.0nm	≤0.001		
02A	Peak-to-Peak	Meas.	Result
	Tolerance		
230.0nm	≤0.003		
340.0nm	≤0.002		
Make sure the Blank position is empty.			
Place 2A filter in Cell Position 1			
Press Start Test			
			Start Test

4. With the Blank position empty, insert the 2A filter in position #1. Ignore the test results at 2A if you do not have a filter installed in position #1.
5. Press the **Start Test** function key.
6. The results will indicate pass or fail for each wavelength.

If the test fails, follow these guidelines:

- Repeat the test twice to verify that the test is failing consistently.
- Make sure the instrument is warmed up for at least 30 minutes, with the standby mode feature turned off.
- Contact technical support for more troubleshooting advice.

Stray Light

This test measures the stray light at selected wavelengths and compares the measurements with expected values. The wavelengths and expected values are preset and cannot be changed. Running the stray light test takes about 30 seconds.

When running the stray light test, remember:

Stray light standards are required that are designed to measure stray light at 220 nm (UV-Vis only), 340 nm and 400 nm (i.e., must have .0.1 %T at the wavelength of interest).

For UV-Vis instruments:

- Position B should be empty.
- Use position 1 for the 220 nm stray light standard (SRE 220 or equivalent).
- Use position #2 for the 340 nm stray light standard (SRE 340 or equivalent).
- Use position #3 for the 400 nm stray light standard (SRE 400 or equivalent).

For Vis only instruments:

- Position B should be empty.
- Use position #1 for the 340 nm stray light standard (SRE 340 or equivalent).
- Use position #2 for the 400 nm stray light standard (SRE 400 or equivalent).

To run the Stray Light test:

1. Press the **test** key to access the Test Types menu.
2. Press the **▲** or **▼** key to highlight Performance Verification and press the **enter** key.
3. Press the **▲** or **▼** key to highlight Stray Light and press the **enter** key.
4. In the Stray Light screen, make sure the wavelengths and tolerances are set correctly.

Performance Verification 12:36pm 8Jul15			
Stray Light - filters			
Wavelength	Expected	Measured	Result
220.0nm	$\leq 0.1\%T$		
340.0nm	$\leq 0.1\%T$		
400.0nm	$\leq 0.1\%T$		
Place SRE filters in position 1 - 3. Press Start Test			
			Start Test

5. Press the **Start Test** function key.
6. The results will indicate pass or fail for each wavelength.

If the test fails, follow these guidelines:

- Repeat the test twice to verify that the test is failing consistently.
- Make sure all the filters being used are specifically designed to measure stray light at the specific wavelengths.
- Verify that the filters are placed in the correct positions.
- Contact technical support for more troubleshooting advice.

10

CHAPTER 10 Maintenance

The spectrophotometer is durable and reliable, so routine maintenance is minimal. This section explains:

- Routine Care
- Changing the Fuse
- Replacing the Tungsten Lamp (Orion AquaMate 7000 Vis instruments only)



Warning: Operating the instrument with the cover off exposes the operator to potentially dangerous voltages and ultraviolet (UV) radiation. Therefore, we recommend that only authorized service representatives perform procedures requiring removal of the instrument cover and replacement of electrical components. To protect both yourself and the instrument, be sure to contact an authorized service representative to perform any service procedure you do not feel comfortable performing.

Routine Care

Routine care for the spectrophotometer does not require a lot of time. To help minimize maintenance time and increase the life and performance of the instrument, please follow these guidelines:

- Always replace the dust cover when the instrument is not turned on to prevent dust from accumulating in and on the instrument.
- Do not use or store the instrument in a corrosive environment.
- Gently wipe the outside of the instrument, including the keypad, with a soft cloth to remove any dust or spills. Water, isopropyl alcohol and other common laboratory cleaning agents may be used if necessary.
- Always clean up spills as soon as they occur to prevent or minimize damage to the instrument. If concentrated acids or bases, or any hydrocarbon materials, are spilled on the instrument, clean up the affected area immediately.

Cleaning and Maintaining Vials and Cuvettes

Carefully check the condition of the vials, cuvettes and other cells used to measure samples. If they are chipped, cracked or scratched, it is important to discard the damaged vials and replace them with new ones.

Ensuring your vials are clean both inside and out is important to the quality of your results for two reasons: 1) contaminating material may absorb light resulting in falsely high absorbance readings; and 2) contaminants in the vial may react chemically with subsequent reagents or standards introduced into the vial.

Cleaning methods depend to some extent on the nature of the contaminating material. It is important to identify the residual material in the vial that needs to be removed. Refer to the following table for suggestions on cleaning methods, solvents and material.

Solvent	Examples	Suggested Cleaning Methods
Aqueous	Protein, Biologics, DNA	Warm water with detergent Dilute nitric acid (<10%) rinse Copious water rinse
Aqueous	Salt solutions	Dilute nitric acid (<10%) rinse Copious water rinse
Aqueous	Basic solutions	Warm water with detergent Dilute nitric acid (<10%) rinse Copious water rinse

Solvent	Examples	Suggested Cleaning Methods
Organic	Hydrocarbons, small molecules, oils	Rinse with organic solvent Warm water with detergent Dilute nitric acid (<10%) rinse Copious water rinse
Organic	Alcohol solutions	Rinse with similar alcohol, acetone, or other solvent Copious water rinse
Organic	Acidic solutions	Rinse with organic solvent Warm water with detergent Dilute nitric acid (<10%) rinse Copious water rinse
Organic	Hydrocarbons, small molecules, oils	Rinse with organic solvent Warm water with detergent Dilute nitric acid (<10%) rinse Copious water rinse

Important: Keeping the vial clean is very important for long vial life.

- Never store vials or cuvettes long term in a water or solvent bath between uses. If the solvent you are using dries, impurities in the water or solvent may be deposited on the inside of the vial or cuvette, causing permanent damage.
- Use only lens cleaning tissue/paper or fine soft cloth to wipe optical surfaces. Most paper products (such as facial tissues, paper towels, etc.) contain wood fibers that can damage the vial or cuvette material.
- At the end of the day, ensure that all vials or cuvettes are well cleaned and stored in a suitable container after drying.

Term	Definition
Dilute acid	Dilute nitric acid (<10%)
Acid	Hydrochloric (5M) acid or nitric acid (5M) (see the Note below)
Solvent rinse	Rinse with the solvent that was originally used to solvate your analyte
Copious water rinse	Use a pure water (deionized, distilled, RO) and rinse at least 10 times
Detergent	Use a neutral pH detergent (Triton X-100), if available, to dilute acid wash; water rinse to remove residue

Note: Do not use 5M nitric acid on an anti-reflection mirror coated vials or cuvettes.

Important: Using an ultrasonic cleaning bath for your vials or cuvettes is not recommended. Each bath generates a different frequency; therefore, if your bath operates at the resonant frequency of a vial or cuvette, the vial or cuvette will break. If a vial or cuvette was cleaned in an ultrasonic bath, the warranty may be void by the manufacturer.

Important: Do not dry cells in an oven.

Micro flow-cells can be kept clean by:

- Flushing well with a solvent after use.
- Aspirating dilute acid, base, non-filming detergent or bleach through the cell in short bursts.
- Storing with distilled water in the cell.

Cleaning the Windows of the Sample Compartment

Do not use acetone or abrasive materials to clean the windows of the sample compartment. Instead, use a non-abrasive laboratory cleaning solution (such as a commercial cell cleaning solution), distilled water or alcohol.

Use the liquid and a soft, lint-free cloth to clean the windows. Do not apply too much pressure or the surface of the windows may be damaged. Be sure to remove all fingerprints.

Changing the Fuse

The fuse is located in the power entry module located at the center of the back panel of the instrument.

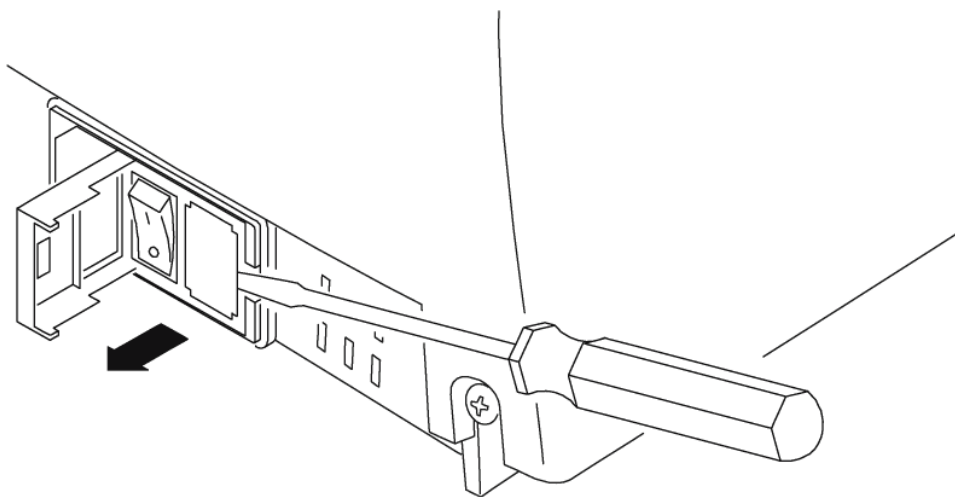
- 120 VAC, 2.5 A, Slo Blo
- 240 VAC, 1.25 A, Slo Blo (2 required)

Important: The instrument fuse must be replaced with the same type and rate.

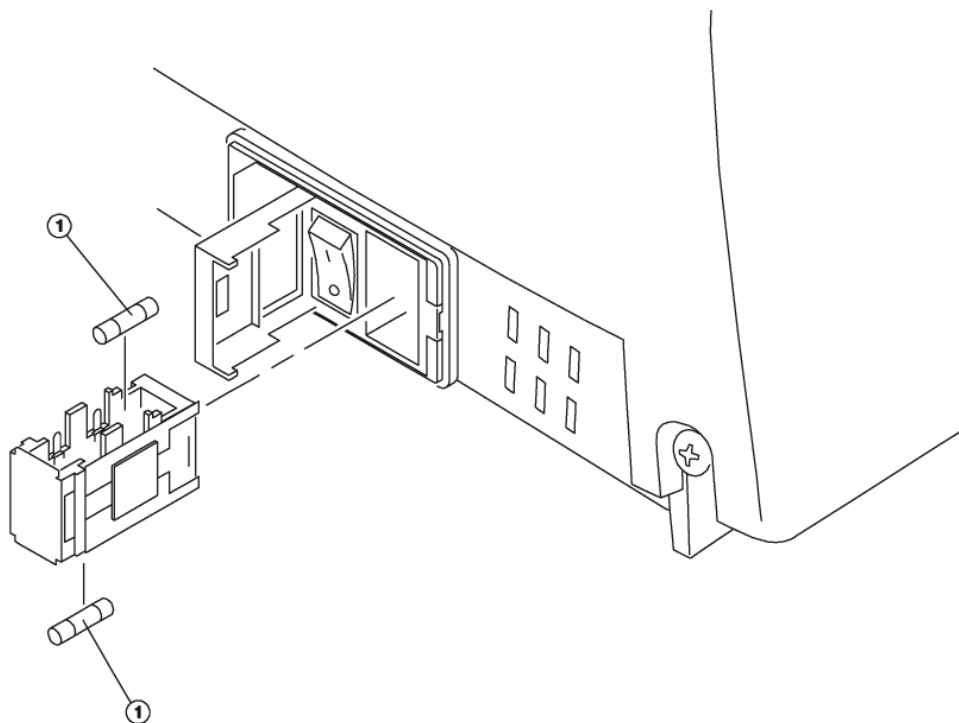
Important: If the fuse fails repeatedly, it may indicate a serious problem with the instrument. Contact technical support as soon as possible.

To change the fuse:

1. Turn off and unplug the instrument from the wall outlet or power strip.
2. Position the instrument so you can access the power entry module on the back of the instrument.
3. Remove the power cord.
4. Insert a flat-blade screwdriver into the notch on the fuse cover and pry off the cover.



5. Use a flat-blade screwdriver to remove the fuse holder.



6. Unsnap both fuses to remove them.
7. Insert the new fuses, pushing them in so they snap into place.
8. Replace the fuse cover.
9. Replace the power cord.
10. Plug the instrument back in to the wall outlet or power strip and turn on the power.

Note: If the fuse blows again, contact your distributor or technical support.

Replacing the Tungsten Lamp

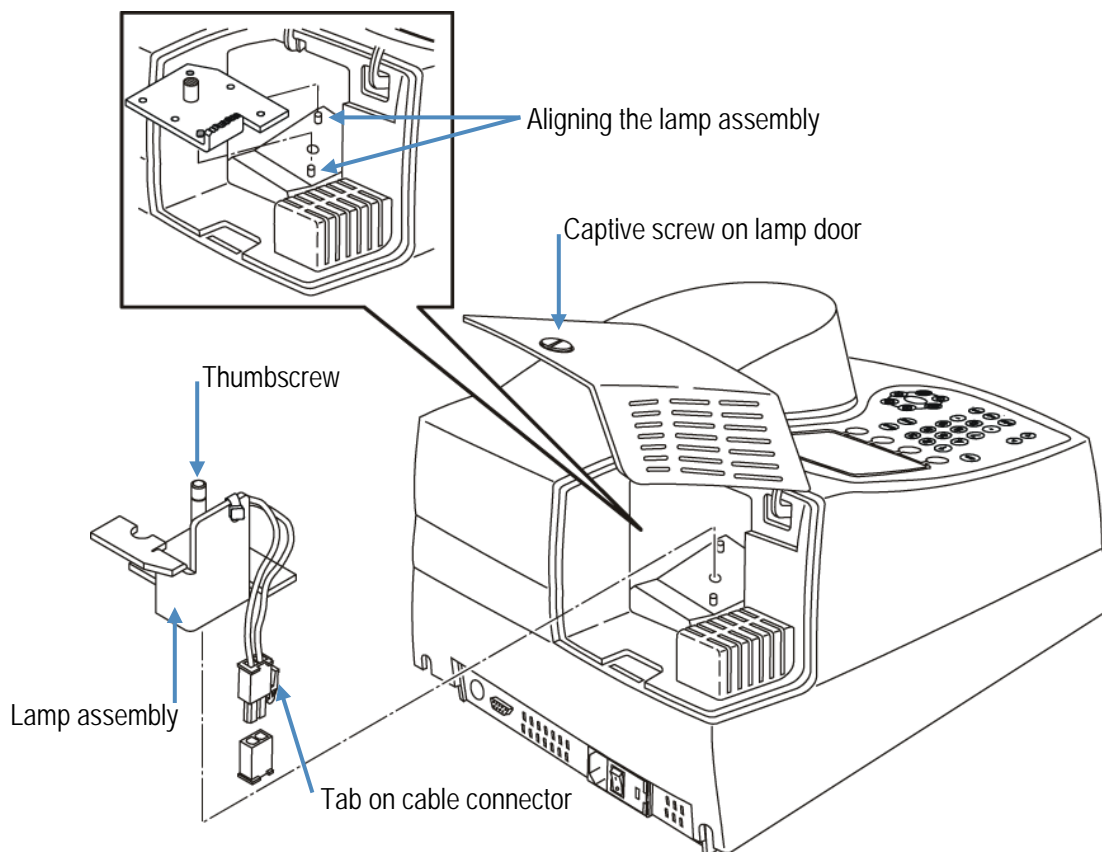
This procedure is for the Orion AquaMate 7000 Vis spectrophotometer.

Warning: This lamp gets very hot during operation. Before removing the lamp, turn off the instrument and allow the lamp to cool for 10 minutes.

Warning: Turn off and unplug the instrument before removing the cover of the lamp compartment.

To replace the tungsten lamp:

1. Turn off and unplug the instrument from the wall outlet or power strip.
2. Make sure the lamp has cooled for at least 10 minutes.
3. Loosen the captive screw on the lamp door by rotating it counterclockwise about $\frac{1}{4}$ turn.



4. Raise the lamp door.

5. Unscrew the thumbscrew while holding the lamp assembly in place.
6. Carefully pull the assembly out until you can reach the connector.
7. Release the tab and disconnect the cable.
8. Unpack the new lamp assembly.
9. Use a soft, lint-free cloth to wipe off any fingerprints on the lamp.
10. Connect the cable to the connector.
11. Position the new assembly as shown above, making sure to align the pins correctly.
12. Tighten the thumbscrew.
13. Close the lamp door.
14. Turn on the instrument and press the **utility** key.
15. Press the arrow keys to highlight Lamp Hours and press the **enter** key.
16. Press the **enter** key to reset the lamp hours to zero.

11

CHAPTER 11 **Customer Services**

Technical Support

For any questions or if you require assistance, contact our Technical Support Specialists:

- Email wai.techservbev@thermofisher.com
- Within the United States, call 1-800-225-1480
- Outside the United States, call +1-978-232-6000 or fax +1-978-232-6031

For additional product information, contact your local authorized dealer, Thermo Scientific Orion technical sales representative or contact us using the Water and Laboratory Products (WLP) information on the page back of this user manual.

Visit www.thermoscientific.com/water to view Thermo Scientific Orion products and download product literature, user manuals and manuals, software updates and additional application and technical resources.

For the most current warranty information, refer to the Thermo Scientific Orion warranty card included on the Thermo Scientific Orion AquaMate literature CD and available online at www.thermoscientific.com/water.

External Device Interfacing and Data Transfer

The following instructions describe how to interface an Orion AquaMate spectrophotometer with an external device, transfer the data and save the data as a Microsoft® Excel®, Word® or Notepad file. The operator must set the Orion AquaMate spectrophotometer settings to allow data to be sent to an external device, install the AquaMate USB driver on the computer, and install a computer program for a data collection program such as Realterm or HyperTerminal.

AquaMate Spectrophotometer Setup for Computer Interfacing

1. Power on the Orion AquaMate spectrophotometer.
2. Press the **utility** key to access the utility menu.
3. Press the **▲** or **▼** key to highlight the Printer option and press the **enter** key to open the printer menu.

```

Utility                               11:55am 23Jun14
Software Revision:                     1.004
Instrument Serial Number:              2W2R091104
Printer                               Off
Date/Time Setup                       11:55am 23Jun14
Standby                               30 min
Baseline Expiration (hr:min)          Off
Beeper                                On
Language                               English
% of lamp life used                    0.55%
Screen Contrast
Printout Contrast
Stored Tests Directory
USB Drive Files
Calculator
Press ↑ or ↓ to select parameter.

```

4. Press the **▲** or **▼** key to highlight the PC option and press the **enter** key to set the PC option to On.

```

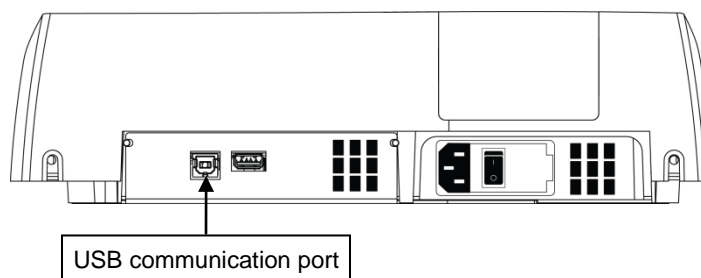
Utility                               11:56am 23Jun14
Software Revision:                     1.004
Instrument Serial Number:              2W2R091104
Printer                               Off
Date/Time Setu                        Internal Off
Standby                               PC On
Baseline Expir                        External Off
Beeper
Language
% of lamp life
Screen Contr
Printout Contr
Stored Tests Directory
USB Drive Files
Calculator
Press ↑ or ↓ to select parameter.

```

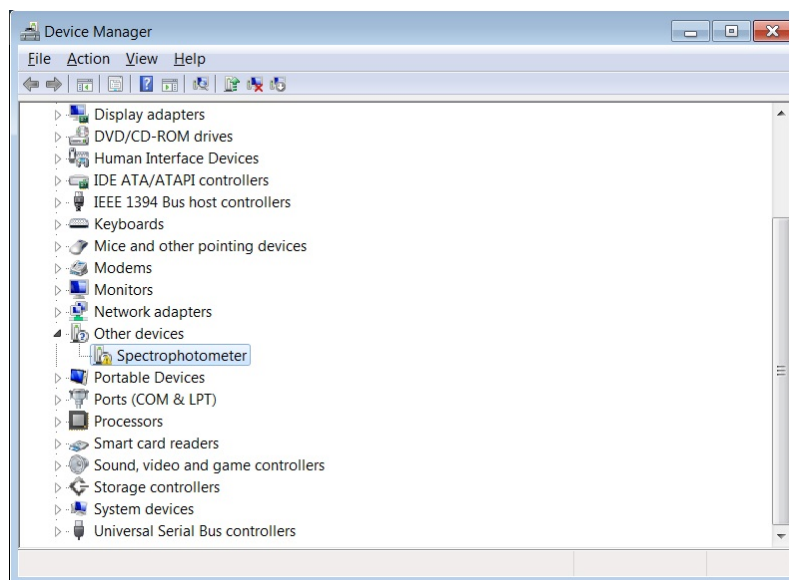
5. Press the **esc** key until the instrument returns to the main measurement screen.

USB Computer Cable Interfacing and USB Driver Installation

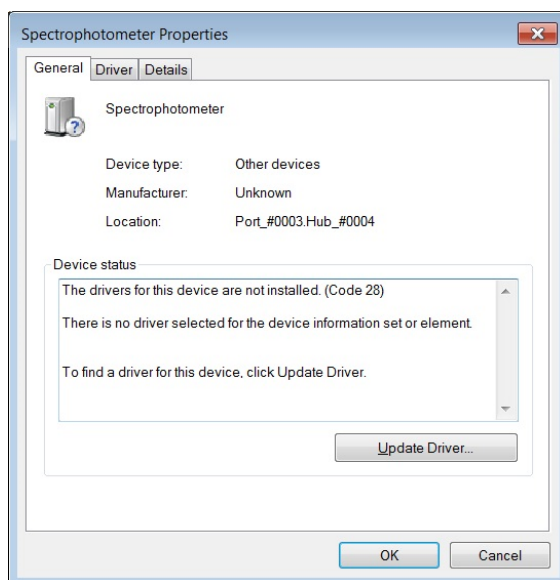
1. Connect the USB computer cable to the USB communication port on the back of the AquaMate spectrophotometer.



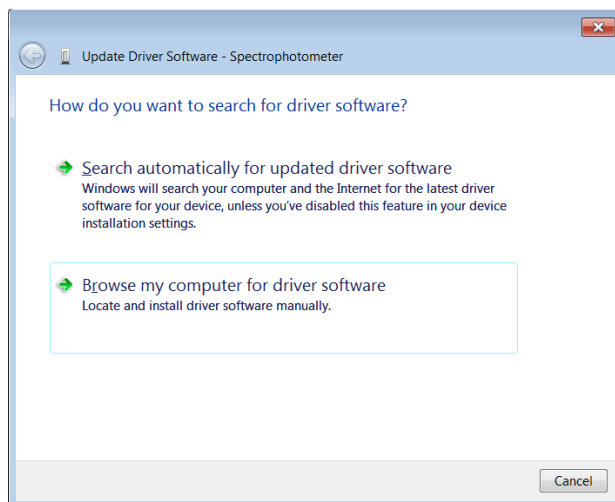
2. Insert the Orion AquaMate Documentation DVD into the computer CD/DVD drive.
3. Connect the USB computer cable to a USB port on the computer.
4. Open the computer Device Manager.
 - a. Click the Start icon.
 - b. Right-click the Computer button.
 - c. Click the Properties button.
 - d. Click the Device Manager button.
5. Double-click the Spectrophotometer button on the Device Manager window.



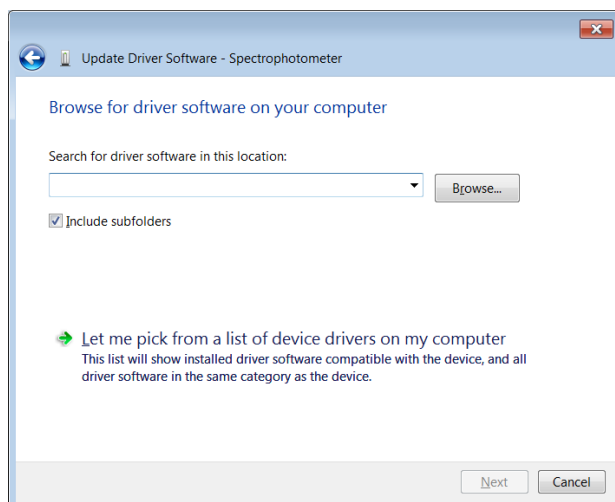
6. Click the Update Driver button on the Spectrophotometer Properties window.



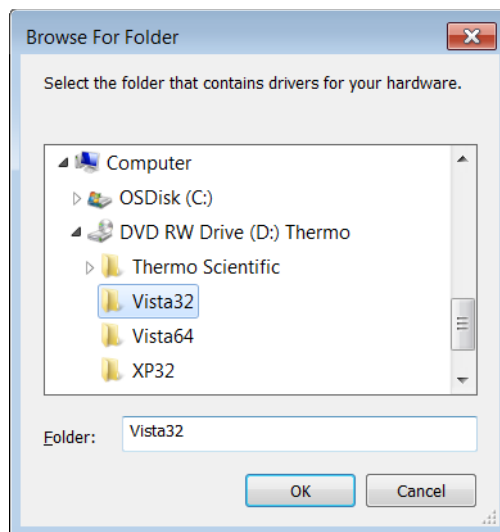
7. Click the Browse my computer for driver software button.



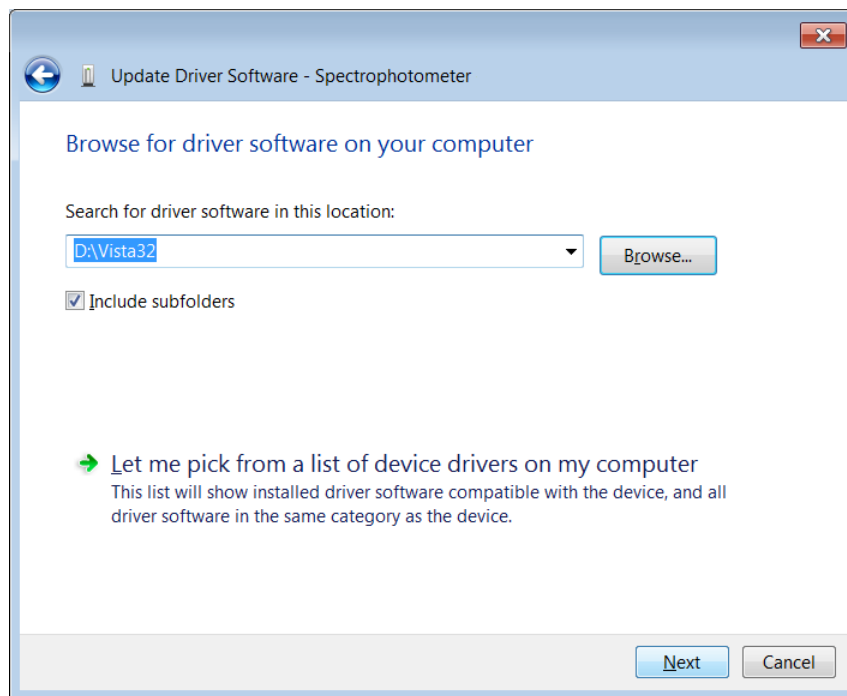
8. Click the Browse button.



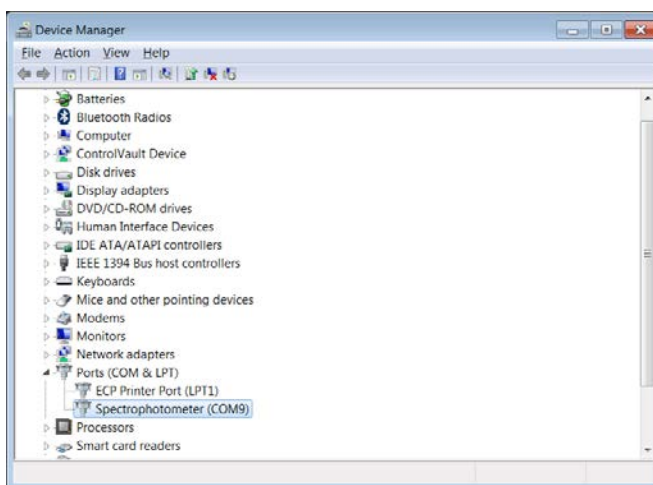
9. Select the appropriate USB driver folder from the Orion AquaMate Documentation DVD in the computer CD/DVD drive and click the OK button.
 - a. Select the Vista32 folder when using a computer with 32-bit Microsoft 7 or Vista operating system.
 - b. Select the Vista64 folder when using a computer with 64-bit Microsoft 7 or Vista operating system.
 - c. Select the XP32 folder when using a computer with Microsoft XP operating system.



10. Click the Next button.



11. Wait while the USB driver software is located and installed.
12. Approve any security messages by clicking the Install button.
13. Once the installation of the USB driver software is complete, click the Close button.
14. Record the COM port number of the Spectrophotometer USB connection in the Device Manager window.

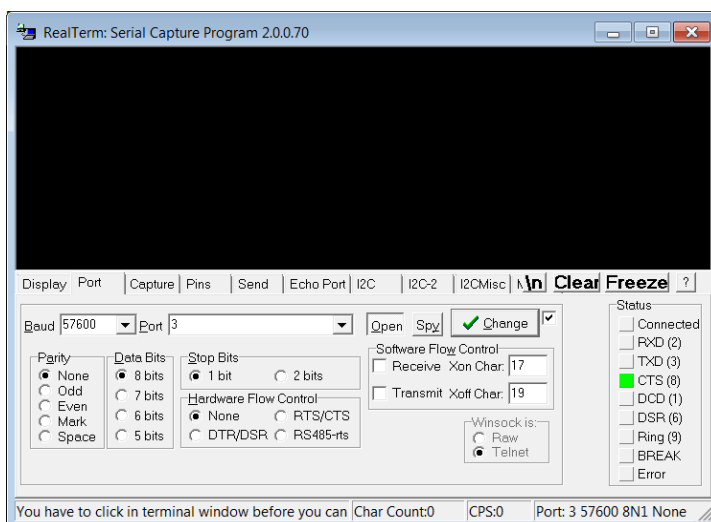


Example Data Collection Program

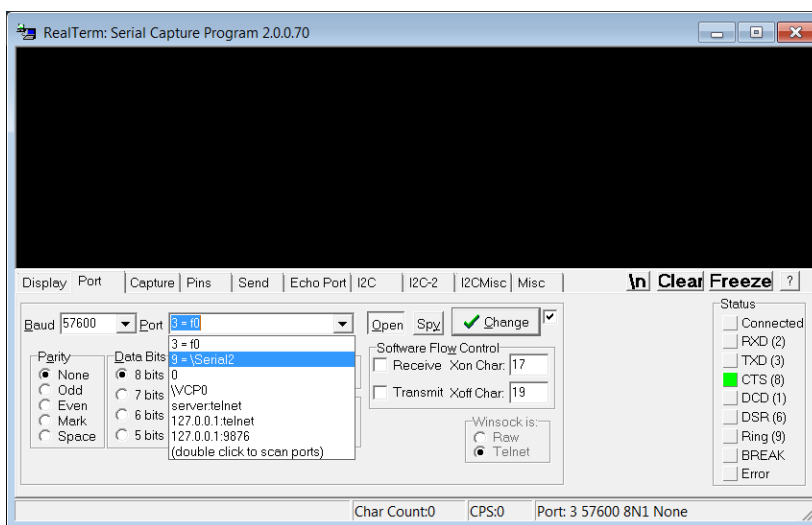
The AquaMate communication settings are as follows:

- Bits per second: 19200
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

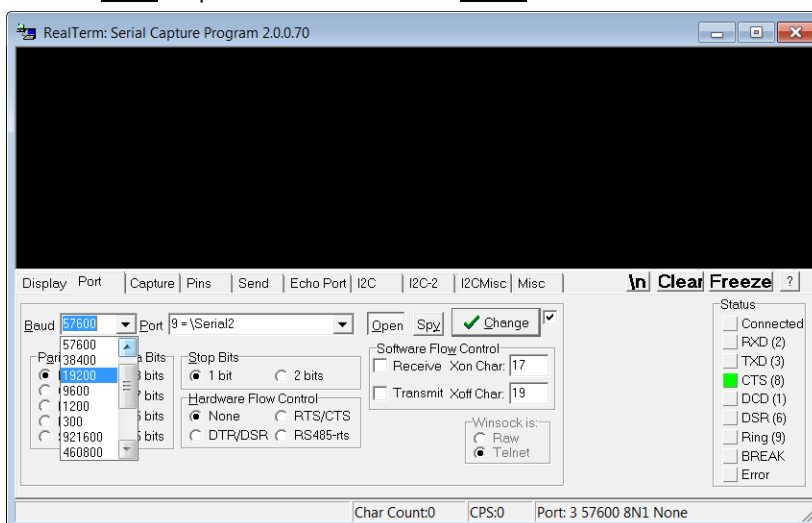
1. Select a computer program for data collection and make sure the program, including device drivers and plug-ins, is fully installed. Realterm data collection software can be downloaded from their website and is used in the following instructions as an example.
2. Open the data collection software program by clicking the Realterm icon on the computer desktop.
3. Click the Port tab on the RealTerm window. Confirm that the RealTerm communication settings match the appropriate AquaMate communication settings.



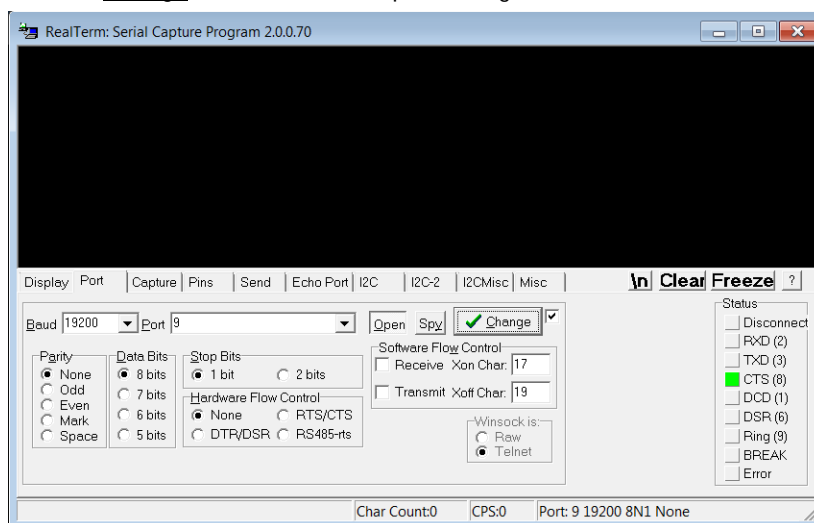
4. Click the Port dropdown menu and select the COM port number of the Spectrophotometer USB connection.



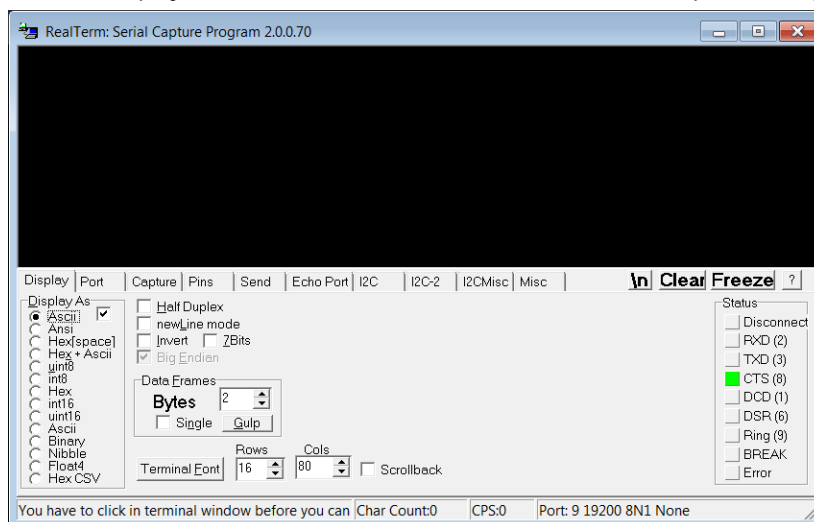
5. Click the Baud dropdown menu and select 19200.



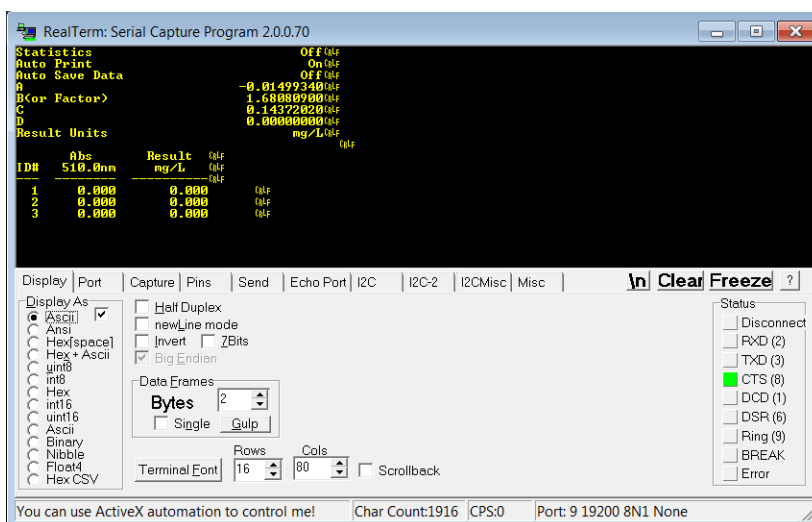
6. Click the Change button to save the port settings.



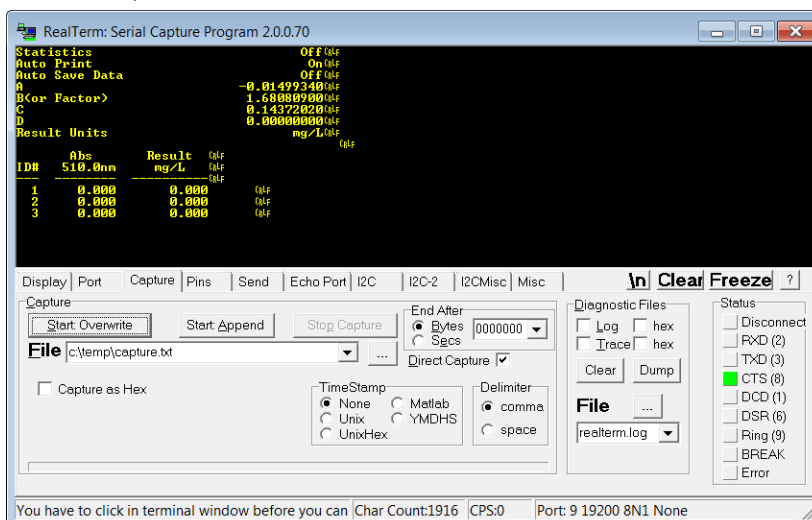
7. Click the Display tab on the RealTerm window. Select the Ascii option in Display As field.



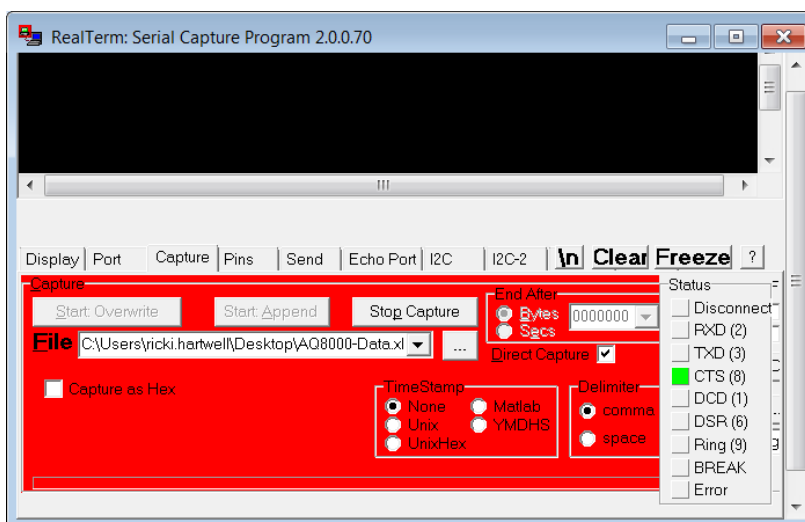
8. When data from the AquaMate spectrophotometer is ready to be sent to the computer, first test the connection between the spectrophotometer and data collection program.
9. Press the **print** key on the AquaMate spectrophotometer. The data from the AquaMate spectrophotometer should appear on the program display.



10. Once the connection has been validated, select the type, name and location of the file the data will be saved as.
11. Click the Capture tab on the RealTerm window.



12. Click the ... button next to the File field and set the file type, name and location. For example, use an Excel (.xls) file type, name the file *AQ8000-Data.xls* and save the file to the computer desktop.
13. Click the Start: Overwrite button on the Capture tab of the RealTerm window. The program is now ready to receive data from the AquaMate spectrophotometer and export the data to the selected file type, name and location.

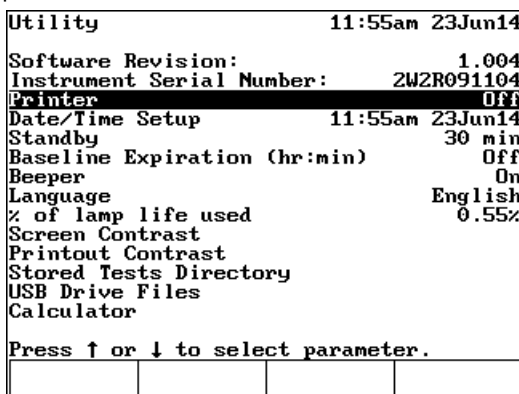


14. Press the **print** key on the AquaMate spectrophotometer to send the data from the instrument to the computer and data collection program.
15. Once all data has been sent from the instrument to the computer and data collection program, click the **Stop Capture** button on the Capture tab of the RealTerm window.
16. Open the data file, for example *AQ8000-Data.xls*, and format the data as needed.

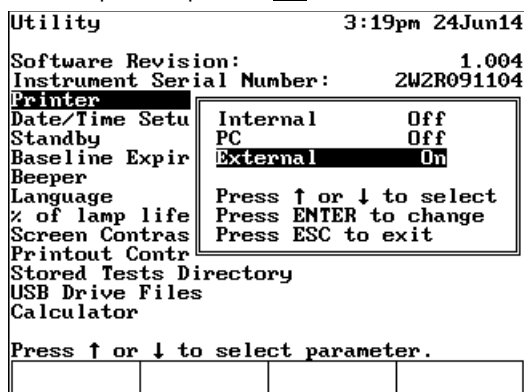
AquaMate Spectrophotometer Setup for Printer Interfacing

The AquaMate printer compatibility requirements are as follows:

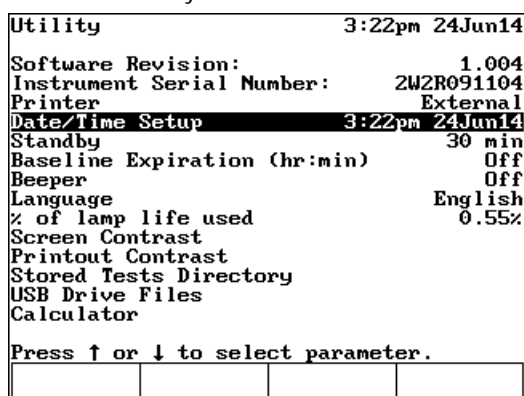
- Printer must be PCL5 or PCL6
 - Printer must be a printer only, not a multi-function printer
 - For this example, a PCL5 HP Laser Jet 1300 printer is used
 - HP 2055D and Office jet 6000 printers have been used in the past
1. Power on the Orion AquaMate spectrophotometer.
 2. Press the **utility** key to access the instrument utility menu.
 3. Press the **▲** or **▼** key to highlight the **Printer** option and press the **enter** key to open the printer menu.



- Press the ▲ or ▼ key to highlight the External option and press the *enter* key to set the External printer option to On.

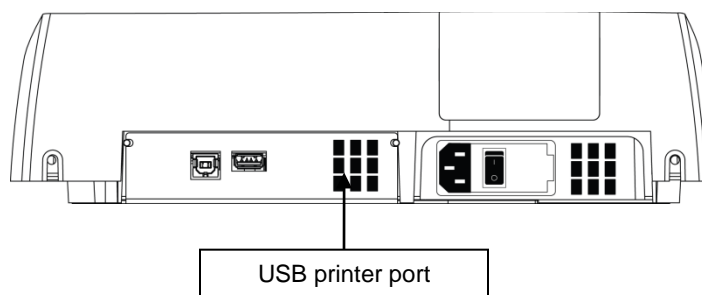


- Press the *esc* key until the instrument returns to the main measurement screen.



USB Printer Cable Interfacing and Printing Data

- Connect the USB cable to the USB printer port on the back of the AquaMate spectrophotometer.



- Connect the USB printer cable to the USB port on the printer.
- When data from the AquaMate spectrophotometer is ready to be sent to the printer, press the **print** key on the AquaMate spectrophotometer.

Instrument Specifications

Orion AquaMate 8000 UV-Vis Spectrophotometer Specifications	
Optical Design	Dual beam—internal reference detector
Spectral Bandwidth	1.8 nm
Light Source (Typical Lifetime)	Xenon flash lamp (5 years)
Detector	Dual silicon photodiodes
Wavelength Range	190 to 1100 nm
Wavelength Accuracy	±1.0 nm
Wavelength Repeatability	±0.5 nm
Wavelength Slew Speed	11,000 nm/min
Wavelength Scanning Speed	10 to 4,200 nm/min
Wavelength Data Interval	0.2, 0.5, 1.0, 2.0, 3.0, 5.0 nm
Photometric Measurement Modes	Absorbance, % transmittance, concentration
Photometric Range	-0.5 to 5.0 A ; -1.5 to 125 %T ; ±9999 C
Photometric Linearity	Up to 3.5 A at 260 nm
Photometric Accuracy	±0.005 A at 1.0 A, <0.00025 at 0.0 A
Photometric Noise	<0.00050 at 1.0 A, <0.00080 at 2.0 A RMS at 260 nm
Photometric Drift	<0.0005 A/hr
Photometric Stray Light	<0.08 %T at 220 nm and 340 nm, <0.1 %T at 340 nm and 400 nm, <1.0 %T at 198 nm
Display	Graphical with LCD backlight, 9.7 x 7.1 cm (3.8 x 2.8 in)
Keypad	Sealed membrane with tactile response keys
Connectivity	USB type A port for USB stick (front panel), USB type B port for computer (rear panel), USB type A port for printer (rear panel)
Dimensions	30 W x 40 D x 25 H cm (11.8 x 15.7 x 9.8 in)
Weight	8.6 kg (19 lb.)
Power Requirements	100 to 240 V ; 50 to 60 Hz

Orion AquaMate 7000 Vis Spectrophotometer Specifications	
Optical Design	Single beam
Spectral Bandwidth	5.0 nm
Light Source (Typical Lifetime)	Tungsten-halogen lamp (1000 hours)
Detector	Silicon photodiode
Wavelength Range	325 to 1100 nm
Wavelength Accuracy	±1.0 nm
Wavelength Repeatability	±0.5 nm
Wavelength Slew Speed	11,000 nm/min
Wavelength Scanning Speed	10 to 4,200 nm/min
Wavelength Data Interval	1.0, 2.0, 3.0, 5.0 nm
Photometric Measurement Modes	Absorbance, % transmittance, concentration
Photometric Range	-0.1 to 3.0 A ; -0.3 to 125 %T ; ±9999 C
Photometric Linearity	Up to 3.0 A at 340 nm
Photometric Accuracy	0.5 % or ±0.005 A, whichever is greater up to 2 A
Photometric Noise	<0.001 A at 0.0 A, <0.002 A at 2.0 A Peak-to peak at 340 nm
Photometric Drift	0.002 A/hr after warm-up
Photometric Stray Light	<0.08 %T at 220 nm and 340 nm, <0.1 %T at 340 nm and 400 nm, <1.0 %T at 198 nm
Display	Graphical with LCD backlight, 9.7 x 7.1 cm (3.8 x 2.8 in)
Keypad	Sealed membrane with tactile response keys
Connectivity	USB type A port for USB stick (front panel), USB type B port for computer (rear panel), USB type A port for printer (rear panel)
Dimensions	30 W x 40 D x 25 H cm (11.8 x 15.7 x 9.8 in)
Weight	8.6 kg (19 lb.)
Power Requirements	100 to 240 V ; 50 to 60 Hz

Note: We reserve the right to make product improvements and updates. Specifications are subject to change without notice.

Ordering Information

Cat. No.	Description
AQ8000	AquaMate 8000 UV-Vis spectrophotometer with methods on USB stick, 6-position turret, 3-position turret, 1-position turret, user documentation, dust cover, USB cable, and 110V / 220V / 240V power cords
AQ7000	AquaMate 7000 Vis Spectrophotometer with methods on USB stick, 3-position turret, user documentation, dust cover, USB cable, and 110V / 220V / 240V power cords
AQ006C	AquaMate 6-position vial holder turret for six 10 mm square vials
AQ003C	AquaMate 3-position vial holder turret for one adjustable 13-25 mm round vial, one adjustable 20-50 mm rectangular vial and one 10 mm square vial
AQ001C	AquaMate 1-position vial holder turret for one 10 mm square vial
AQ100C	AquaMate 1-position vial holder turret for one 100mm rectangular vial
AQ7LMP	AquaMate 7000 replacement Tungsten lamp in pre-aligned fixture
AQ0USB	AquaMate methods, USB memory stick
AQCHNV	AquaMate power cord, China, Australia, New Zealand plug
AQ240V	AquaMate power cord, 240 V UK, Singapore plug
AQ220V	AquaMate power cord, 220 V Euro plug
AQ110V	AquaMate power cord, 110 V US, Japan plug
AC2V24	24 mm round vials, 12 pack
AC2V16	16 mm round vials, 10 pack
COD165	Thermoreactor for digestion methods, 100 / 120 / 150 / 160 / 165°C temperature control
CODS01	1000 ppm COD standard, 475 mL
CODS10	10000 ppm COD standard, 475 mL
AC2002	Alkalinity-M, acid / indicator method, tablet reagent, 100 tests
AC3002P	Alkalinity-P, acid / indicator method, tablet reagent, 100 tests
AC2027	Aluminum, eriochrome cyanine R method, tablet reagent, 50 tests
AC4P27	Aluminum, eriochrome cyanine R method, powder reagent, 100 tests
AC2012	Ammonia as nitrogen, indophenol blue method, tablet reagent, 50 tests
AC4P12	Ammonia as nitrogen, salicylate method, powder reagent, 100 tests
ACR011	Ammonia as nitrogen, high range, salicylate method, 50 reaction tubes
ACR012	Ammonia as nitrogen, low range, salicylate method, 50 reaction tubes
AC2035	Bromine, DPD method, tablet reagent, 100 tests
AC2017	Chloride, silver nitrate / turbidity method, tablet reagent, 50 tests
AC2070	Chlorine, free & total, DPD method, tablet reagent, 50 tests each
AC2071	Chlorine, free, DPD method, tablet reagent, 100 tests
AC2072	Chlorine, total, DPD method, tablet reagent, 100 tests
AC3072	Chlorine, total, high range, KI / acid method, tablet reagent, 100 tests

Cat. No.	Description
AC4P71	Chlorine, free, DPD method, powder reagent, 100 tests
AC4P72	Chlorine, total, DPD method, powder reagent, 100 tests
AC2099	Chlorine dioxide, DPD method, tablet reagent, 100 tests
CODL00	COD, low range, dichromate reactor digestion method, 25 digestion tubes
CODH00	COD, mid range, dichromate reactor digestion method, 25 digestion tubes
CODHP0	COD, high range, dichromate reactor digestion method, 25 digestion tubes
AC2029	Copper, free & total, biquinoline method, tablet reagent, 50 tests
AC4P29	Copper, free, bicinchoninate method, powder reagent, 100 tests
AC2098	Cyanuric acid, melamine method, tablet reagent, 100 tests
AC2009	Fluoride, SPADNS method, liquid reagent, 50 tests
AC3032T	Hardness, total, metallphthalein method, tablet reagent, 100 tests
AC2030	Hydrazine, 4-(dimethyl-amino)-benzaldehyde method, powder reagent, 30 tests
AC2078	Iron, II & III, PPST method, tablet reagent, 100 tests
AC4P78	Iron, ferro, 1,10-phenanthroline method, powder reagent, 100 tests
AC4P79	Iron, total, TPTZ method, powder reagent, 100 tests
AC2055	Manganese, formaldoxime method, tablet reagent, 50 tests
AC4P54	Manganese, low range, PAN method, powder reagent, 100 tests
AC4P55	Manganese, high range, periodate oxidation method, powder reagent, 100 tests
AC4P42	Molybdate / molybdenum, mercaptoacetic acid method, powder reagent, 100 tests
ACR007	Nitrate as nitrogen, chromotropic acid method, 50 reaction tubes
AC2046	Nitrite as nitrogen, n-(1-naphthyl)-ethylenediamine method, tablet reagent, 100 tests
AC4P46	Nitrite as nitrogen, low range, diazotization (azo) method, powder reagent, 100 tests
ACD004	Nitrogen, total, low range, persulfate digestion method, 50 digestion tubes
ACD007	Nitrogen, total, high range, persulfate digestion method, 50 digestion tubes
AC3048	Ozone, DPD / glycine method, tablet reagent, 100 tests
AC2001	pH, phenol red method, tablet reagent, 100 tests
AC3001	pH, Phenol red method, liquid reagent, 30 tests
AC2095-WA	Phosphate, ortho, low range, phosphomolybdic acid / ascorbic acid, tablet reagent, 50 tests
AC2096	Phosphate, ortho, high range, vanadomolybdate method, tablet reagent, 50 tests
AC4P95	Phosphate, ortho, phosphomolybdenum / ascorbic acid method, powder reagent, 100 tests
ACD095	Phosphate as P, total, persulfate digestion / ascorbic acid method, 50 digestion tubes
ACD095AH	Phosphate as P, hydrolyzable, phosphomolybdenum / ascorbic acid, 50 digestion tubes
ACR095	Phosphate, ortho, phosphomolybdenum / ascorbic acid method, 50 reaction tubes
AC2060	Silica, silicomolybdate method, tablet reagent, 50 tests
AC2061	Silica, phosphate removal reagent, 100 tablets

Cat. No.	Description
AC4P60	Silica, high range, silicomolybdate method, powder reagent, 100 tests
AC4P82	Sulfate, barium sulfate-turbidity method, powder reagent, 100 tests
AC2016	Sulfide, DPD / catalyst method, tablet reagent, 50 tests
AC2065	Zinc, zincon method, tablet reagent, 50 tests

Visit www.thermoscientific.com/water for a complete listing of all available Thermo Scientific Orion meters, electrodes, solutions and accessories.



APPENDIX A General Instrument Information

Parameters

Parameter	Description
+ - x ÷	Enters math operators when in the calculator mode (Utility)
% of Lamp Life Used	Displays the estimated percentage of lamp life used, based on a typical Xenon lamp life of five years (Utility)
3-Pt Net	Calculates peak height from the tangential baseline in the graph (Scanning)
Absorbance	Enters the absorbance value
Accept Name	Accepts the displayed name entry (Test Name and Edit [Units])
Add Character	Adds a highlighted character to the name entry (Test Name and Edit [Units])
Add nm	Adds a wavelength and factor to the list in multi-wavelength tests and some performance verification tests
Area	Calculates area under the peak in the graph (Scanning)
AutoPrint	Turns the automatic printout on or off
Autoscale	Rescales the graph to the original ranges of X- and Y-axes (Kinetics, Scanning)
Baseline Expiration	Enters time when the baseline for scan tests needs to be collected again (Utility)
Beeper	Turns the audible signal for key presses on and off (Utility)
Calculation Baseline	Selects the zero baseline or the tangential baseline to calculate area under the peak in the graph (Scanning)
Calculator	Enables the calculator mode (Utility)
Cell Position #	Displays the vial or cuvette position placed in the light path (only with Auto 6 or Auto 3 sample positioner settings)

Parameter	Description
Change Mode Change to Abs Change to %T	Switches measurement modes (Basic A-%T-C and some Performance Verification tests)
Collect Baseline	Starts the collection of the baseline (Scanning)
Concentration	Sets the concentration value
Conc. of Standard	Displays the entered concentration value (Adv A-%T-C)
Cursor	Goes to cursor tracking mode to view data points in graph (Kinetics, Scanning)
←Cursor Cursor→	Moves the cursor right or left on the graph and displays the data of each point (Kinetics, Scanning)
Curve Fit	Selects the type of line fit calculation (Standard Curve)
Data File Name	Allows entry of a name for the data file when AutoSave is on
Date Standards Measured	Displays the date when standards were last measured (Standard Curve)
Date/Time Setup	Enters the current date and time settings for the instrument (Utility)
Delay Time	Enters the time from test initiation to first measurement; allows for sample equilibration (Adv A-%T-C and Kinetics)
Delete Character	Deletes the last character of name entry (Test Name and Edit [Units])
Delete File	Deletes a test or data file from the Stored Tests Directory (Utility)
Delete Name	Deletes the entire name to allow a new entry (Test Name and Edit [Units])
Delete nm	Removes a wavelength and factor from the list (Multiwavelength and Performance Verification)
Diluent Volume	Enters the volume of diluent added before measurement (Dilution Multiplier in some Bio Tests)
Dilution Multiplier	Displays the factor used to correct for sample dilution
Display Activity	Indicates whether results should include protein concentration
DNA ϵ (260)	Calculates the extinction coefficient
DNA Factor	Enter the factor to calculate DNA concentration (DNA Bio Tests)
Edit	Changes a wavelength or factor in the list (Multiwavelength and Performance Verification)
Edit Curve	Manipulates the graph (Kinetics)
Edit Data	Selects a portion of data in a table for recalculation of result (Kinetics, Scanning)
Edit Graph	Manipulates the graph (Scanning)
Edit Scale	Changes the graph axis scales and view individual data points (Scanning)
Factor	Enters a factor to convert a datum to a result Abs x Factor 1 = Concentration Result Abs/min x Factor 2 = Kinetics Result Can be entered or calculated from concentration and absorbance in Adv A-%T-C
Factor 1	Enters a factor to convert a datum to a result Abs(WL1) x Factor = Result (Abs Ratio, Abs Difference, Multiwavelength)
Factor 2	Enters a factor to convert a datum to a result Abs(WL2) x Factor = Result (Abs Ratio, Abs Diff, Multiwavelength)

Parameter	Description																												
Factor 3-31	Enters a factor to convert a datum to a result Abs (WL3-31) x Factor = Result (Multiwavelength)																												
Graph	Displays the graph of collected data (Kinetics, Scanning)																												
ID #	Enters the numeric identifier for measurement; auto increments during the test until turned off (set to 0)																												
Instrument Serial Number	Displays the serial number of the instrument (Utility)																												
Intercept	Enters where the line crosses the Y-axis (Abs where concentration = 0)																												
Interval	Enters the wavelength range between data points (Scanning)																												
Interval Time	Enters the time between repeated readings (Kinetics)																												
Linearity Value	Enters a linearity value (Kinetics) To help determine the linearity of the reaction during the measurement, the instrument offers a linearity parameter. This is the difference between the changes in absorbance of two measurements as shown in the following example: <table><tr><td>Time</td><td>Abs</td><td>?A</td><td>Linearity</td></tr><tr><td>1</td><td>.1</td><td>---</td><td>---</td></tr><tr><td>2</td><td>.2</td><td>.1</td><td>---</td></tr><tr><td>3</td><td>.29</td><td>.09</td><td>P</td></tr><tr><td>4</td><td>.38</td><td>.09</td><td>P</td></tr><tr><td>5</td><td>.46</td><td>.08</td><td>P</td></tr><tr><td>6</td><td>.52</td><td>.06</td><td>F</td></tr></table> Linearity is the ?A between ?A calculations; P=Pass and F=Fail	Time	Abs	?A	Linearity	1	.1	---	---	2	.2	.1	---	3	.29	.09	P	4	.38	.09	P	5	.46	.08	P	6	.52	.06	F
Time	Abs	?A	Linearity																										
1	.1	---	---																										
2	.2	.1	---																										
3	.29	.09	P																										
4	.38	.09	P																										
5	.46	.08	P																										
6	.52	.06	F																										
Load Test	Loads the highlighted test from the Stored Tests Directory into active memory and sets the instrument to the test parameters (Utility)																												
Lock/Unlock	Used to protect stored tests from accidental deletion or alteration; asks for a password to allow the user to lock or unlock the file (Utility)																												
Low/High Limits	Enters the lowest and highest acceptable results, outside of which the result is flagged as "Low" or "High" (Adv A-%T-C, Std Curve, Abs Ratio, Abs Diff, Kinetics, 3-Pt Net, some Bio Tests)																												
Math	Accesses manipulation functions of the graph (Scanning)																												
Measure Blank (as function key)	Initiates measurement of the blank																												
Measure Blank (as test parameter)	Selects the frequency of zeroing the instrument as Once or Every Reading (Kinetics)																												
Measurement Mode	Selects the type of photometric data reported for a measurement (Abs, %T, Conc) in A-%T-C, Kinetics, Scanning, Multiwavelength																												
Measure Samples	Initiates measurement of samples																												
Max, X	Enters a maximum X-value to manually rescale the graph (Kinetics, Scanning)																												
Max, Y	Enters a maximum Y-value to manually rescale the graph (Kinetics, Scanning)																												
Min, X	Enters a minimum X-value to manually rescale the graph (Kinetics, Scanning)																												
Min, Y	Enters a minimum Y-value to manually rescale the graph (Kinetics, Scanning)																												
Next Cursor	Selects a cursor point in functions using more than one cursor setting: Scan-Area and Scan-3-Pt Net calculations in the graph (Scanning)																												
Number of Matched Cuvettes	Enters the number of vials or cuvettes that will be run in the Correction Program (maximum of 5)																												

Parameter	Description
Number of Samples	Enters the number of samples to be measured in the test (Not available in Kinetics or Scanning)
Number of Standards	Enters the number of standards to be measured for the standard curve
Printer	Selects the output mode as RS-232 or Parallel (Utility)
Protein Factor	Enters the factor to calculate protein concentration (DNA Bio tests)
Ref. Wavelength	Enters a reference wavelength value; for each reported measurement, measures the analytical wavelength and reference wavelength Reported measurement = Abs @ Analytical WL – Abs @ Reference WL
Ref. Wavelength Correction	Turns reference wavelength correction on or off
Run Standard	Goes to the standards entry screen
Run Test	Goes to the data collection screen
Sample Positioner	Selects the type of Sample Positioner: 1 Cell = no movement; zeros and measures sample in same position Manual 6 = vial holder carousel moved by sample positioner keypad; always zeros on position B, then returns to set position to start measurement Auto 3 = vial holder carousel automatically moved to B, 2, 4 (always zeros on position B, then goes to position 2 to start measurement) Auto 6 = vial holder carousel automatically moved to B, 1, 2, 3, 4, 5 (always zeros on position B, then goes to position 1 to start measurement)
Sample Volume	Enters the total volume of sample (under Dilution Multiplier in some Bio Tests)
Save Test	Saves all parameters of the current test in internal memory for later recall
Scan Speed	Selects the speed (nm/min) for a scan as Slow, Medium or Fast (Scanning)
Screen Contrast	Improves visibility of the display by changing the contrast between the background and text (Utility)
Select Test	Tags the highlighted test name with ">" to include the test in the SmartStart menu (Utility Stored Tests Directory)
Set Max. X Set Min. X	Sets the cursor position in the graph as the minimum X and the maximum X values for recalculating rate (Kinetics)
Set nms	Use to enter and edit the wavelength and factor values
Set Options	Selects the factor entry or the baseline to calculate area under the peak in the graph (Scanning)
Setup Correction	Initiates the procedure to collect the data necessary to correct for absorbance differences between vials or cuvettes
Slope	Enters abs/concentration value (Standard Curve)
Smoothing	Turns data smoothing on and off (Scanning)
Software Revision	Displays the version of firmware in the instrument (Utility)
SRE Tolerance	Acceptable minimum stray light
Standard Concentrations	Enters the concentration of standards used to generate the standard curve for the test
Standby	Selects the time since the last keystroke or instrument activity; powers down the unit to save lamp life (Utility)
Start Wavelength	Enters the beginning wavelength for a scan (Scanning)

Parameter	Description
Statistics	Turns statistics on or off; calculates the average and standard deviation of results when set on; statistics registers are cleared when set off, when instrument is turned off, when test parameters are changed and when test is saved or resaved (all test types except Kinetics, Scanning, Multiwavelength)
Std Concentration	Enters the concentration of the analyte in the standard solution
Stop Wavelength	Enters the ending wavelength for a scan (Scanning)
Stored Tests Directory	Displays the list of tests stored in the instrument (Utility)
Tabular	Displays the list of collected data (Kinetics, Scanning)
Test Name	Operator enters an alphanumeric name (maximum of 16 characters) for the test; the name will be included on the data printout and, if the test is saved, will be displayed in the Utility Test Directory screen (available in all tests)
Total Run Time	Enters the time from the run initiation to the end of the test; equals Delay Time + Interval Times + Measurement Times (Kinetics)
Units	Selects or creates units labels for results (all stored tests except Abs Ratio, Scanning, Cell Growth)
Unselect Test	Removes the ">" tag of the highlighted test name to remove the test from the SmartStart menu (Utility Stored Tests Directory)
Wavelength	Enters values for the analytical wavelengths

Concentration Units

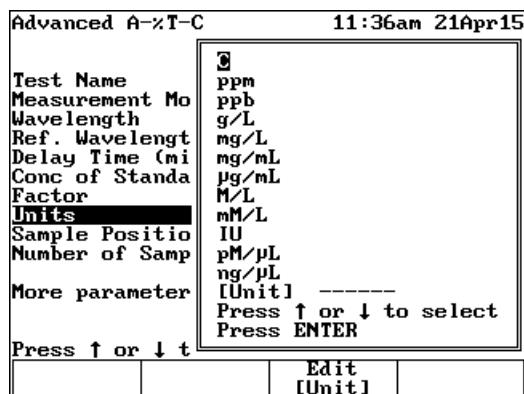
This section covers how to specify concentration units and create custom units.

To Specifying Concentration Units:

Concentration and kinetics tests include a parameter for units, which labels the results. The units parameter offers a list of common concentration units and each test method uses this list:

- C (concentration)
- ppm
- ppb
- g/L
- mg/L
- µg/L
- M/L
- mM/L
- IU
- pM/µL
- ng/µL

1. In the test method, press the ▲ or ▼ key to highlight Units and press the **enter** key.
2. Press the ▲ or ▼ key to highlight the desired concentration units and press the **enter** key.



To Create Custom Units:

In addition to the common concentration units, you can create a custom concentration unit and add it to the list. This custom concentration unit can be changed when desired. Only one custom concentration unit is available in the list at any given time.

1. In the test method, press the ▲ or ▼ key to highlight Units and press the **enter** key.
2. With the list of units shown, press the **Edit [Units]** function key.
3. Use the name entry screen to delete an existing custom unit, delete a character in the name of a unit, add a character to the name of a unit or accept the name of a unit.

- a. To enter a new custom unit, press the ▲ or ▼ key to highlight a character, press the **Add Character** function key and repeat until the desired name is shown. Press the **Accept Name** function key to save the entered name.

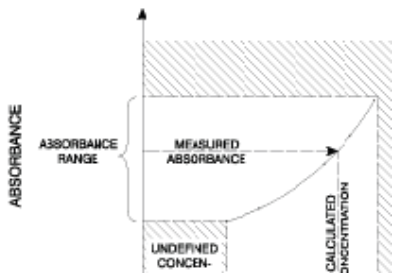

Edit [Unit]		11:49am 21Apr15	
ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789 abcdefghijklmnopqrstuvwxyz_*/p()#			
Unit = ppt			
Press ↑ or ↓ to select character.			
Delete Name	Delete Character	Add Character	Accept Name

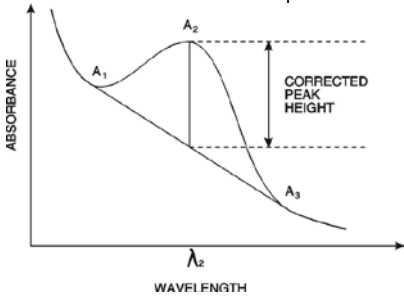
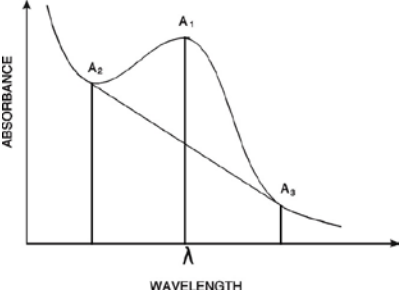
4. Press the ▲ or ▼ key to highlight the custom concentration unit and press the enter key.

Advanced A-ZT-C		11:49am 21Apr15	
Test Name	C		
Measurement Mo	ppm		
Wavelength	ppb		
Ref. Wavelength	g/L		
Delay Time (mi	mg/L		
Conc of Standa	mg/mL		
Factor	µg/mL		
Units	M/L		
Sample Positio	mM/L		
Number of Samp	IU		
More parameter	pM/µL		
	ng/µL		
	[Unit] ppt		
	Press ↑ or ↓ to select		
	Press ENTER		
Press ↑ or ↓ to			
		Edit [Unit]	

Calculations for Software

Calculation	Calculation Equation
Standard Curves	
Partial Sums	$SX = \sum x_i$ $SY = \sum y_i$ $SXX = \sum x_i^2$ $SYY = \sum y_i^2$ $SXY = \sum x_i y_i$ $SQX = \sum (x_i - \bar{x})^2 = N * SXX * SX^2$ $SQY = \sum (y_i - \bar{y})^2 = N * SYY * SY^2$ $SSXY = \sum (x_i - \bar{x})^2 (y_i - \bar{y})^2 = N * SXY - SX * SY$ <p>Where: x_i = Concentration of i^{th} standard y_i = Absorbance of i^{th} standard N = Number of standards</p>
Linear Regression (general case)	$A = A(c)$ <p>Where: A = absorbance c = concentration</p> <p>$A(c)$ is defined by an equation of the form: $A(c) = a_4 c^4 + a_3 c^3 + a_2 c^2 + a_1 c + a_0$</p> <p>Where: a_0 = Y-axis intercept $a_1 \dots a_4$ = coefficients</p> <p>(Coefficients are computed using the least squares method)</p>
Linear regression through zero	$A = a_1 * (c)$ <p>Where: A = absorbance c = concentration a_1 = slope</p> <p>The slope is calculated as: $a_1 = SXY/SXX$</p> <p>This model requires:</p> <ul style="list-style-type: none"> • Slope is not equal to zero or infinity • At least one standard data point with concentration > 0 • The absorbance of the 0 concentration blank = 0A

Calculation	Calculation Equation
Segmented model	<p>The segmented model requires:</p> <ul style="list-style-type: none"> • Data for at least two standard data points with different concentration and absorbance • Slopes of all segments must be ascending (positive) or descending (negative)
Validity of standard curves	<p> $A(c_1) > A(c_2)$ for all $c_1 > c_2$ or $A(c_1) < A(c_2)$ for all $c_1 > c_2$ </p> <p>Where: A = absorbance c_1, c_2 = concentration</p> <p>Graph of Valid Nonlinear Standard Curve:</p> 
	<p>If this is not the case, there will be more than one solution within the specified domain and the message "Curve cannot be used to determine sample concentrations – it may produce ambiguous results" will appear when the curve is viewed.</p> <p>Graph of Invalid Nonlinear Standard Curve:</p> 

Calculation	Calculation Equation
Statistics (Linear regression general case)	$\sigma = \sqrt{\frac{\sum (y_i - \bar{y})^2}{N - n - 1}}$ <p>Where: N = Degree of polynomial $r = \frac{ SSXY }{\sqrt{SQX * SQY}}$</p> <p>The calculation for the correlation coefficient applies only to first order linear regression curves (first degree polynomials)</p>
Linear regression through zero model	$\sigma = \sqrt{\frac{SYY - (a_1 * SXY)}{N - 1}}$
Absorbance Ratio	$\frac{Abs\lambda_1}{Abs\lambda_2} \quad \text{or} \quad \frac{Abs\lambda_1 - Abs_{ref}}{Abs\lambda_2 - Abs_{ref}}$
Absorbance Difference	<p>Result = $Abs\lambda_1 * factor_1 - Abs\lambda_2 * factor_2$ or Result = $(Abs\lambda_1 - Abs\lambda_{ref}) * factor_1 - (Abs\lambda_2 - Abs\lambda_{ref}) * factor_2$</p>
3-Point Net	<p>Baseline correction absorbance =</p> $A_2 - \left(A_3 + \left([A_1 - A_2] * \frac{\lambda_3 - \lambda_2}{\lambda_3 - \lambda_1} \right) \right)$ <p>3-Point Net Absorbance Sample Curve:</p> 
3-Point Net (ASTM E16904)	<p>Baseline correction absorbance =</p> $A_2 - \left(A_3 + \left([A_2 - A_3] * \frac{\lambda_3 - \lambda_1}{\lambda_3 - \lambda_2} \right) \right)$ 

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