S1100RS Series Spectrophotometer Operation Manual

United Products & Instruments, Inc.
Dayton, NJ USA
www.unicosci.com
info@unicosci.com
(732)274-1155

GENERAL INFORMATION

The spectrophotometer described in this manual is designed to be used by properly trained personnel in suitably equipped laboratory. For the correct and safe use of this spectrophotometer it is essential that laboratory personnel follow generally accepted safe procedures in addition to the safety precautions called for in this manual.

Some of the chemicals may be corrosive, flammable, radioactive, toxic, and/or potentially infective. Care should be taken to follow the normal laboratory procedures for handling chemicals and samples. Please carefully read the Safety, Electrical, Warning, Performance and Radio Interference instructions below.

SAFETY

This spectrophotometer has been designed and tested in accordance with EN 61326-1: 1997 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use standard (EMC Requirements). The spectrophotometer has been tested and supplied in a safe condition.

Read the following before installing and using the instrument and its accessories.

ELECTRICAL

The power plug shall be inserted in a socket provided with a protective grounded contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

Any interruption of the protective conductor inside or outside the spectrophotometer or disconnection of the protective ground terminal may make the spectrophotometer unsafe to use. Whenever it is likely that the protection has been impaired, the spectrophotometer shall be made inoperative and be secured against any unintended operation.

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

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

PERFORMANCE

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

INTERFERENCE

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

INTRODUCTION

The UNICO® 1100/1100RS Spectrophotometers are single beam, general purpose instruments designed to meet the needs of the conventional laboratory. UNICO® 1100/1100RS are ideal for various applications in Clinical Chemistry, General Education and other fields.

Featuring a digital display of photometric result, easy operation, and wavelength range of 335 nm~1000 nm, UNICO® 1100/1100RS are ideal for measurements in the visible wavelength region of the electromagnetic spectrum.

WORKING PRINCIPLE

The spectrophotometer consists of five parts: 1) Light Source (Halogen Lamp) to supply the light; 2) A Monochromator to isolate the wavelength of interest and eliminate the unwanted second order radiation; 3) A Sample Compartment to accommodate the sample solution; 4) A Detector to receive and convert the transmitted light to an electrical signal; 5) A Digital Display to show absorbance or transmittance. Figure-1 illustrates the relationship between these parts.

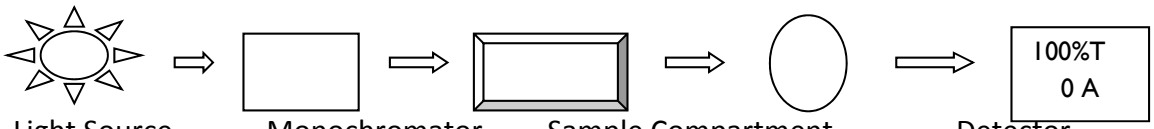


Figure-1 Block Diagram for the Spectrophotometer

In the spectrophotometer, light from the Halogen Lamp is focused on the entrance slit of the Monochromator where the collimating mirror directs the beam onto the grating. The grating disperses the light beam to produce the spectrum, a portion of which is focused on the exit slit of the Monochromator by a collimating mirror. From here the beam is passed to a Sample Compartment through one of the filters, which helps to eliminate unwanted second order radiation from the diffraction grating. Upon leaving the Sample Compartment, the beam is passed to the silicon photodiode Detector and causes the Detector to produce an electrical signal that is shown on the Digital Display window.

SPECIFICATIONS

	Model 1100	Model 1100RS
Wavelength Range	335~1000 nm	
Spectral Bandpass	20 nm	10 nm
Wavelength Accuracy	± 2 nm	
Wavelength Repeatability	± 1 nm	
Stray Radiant Energy	< 0.5 %T at 340 and 400 nm	
Photometric Range	0~125%T 0~2.0 Abs	0~125%T 0~2.0 Abs 0~1999C (0~1999 Factor)
Photometric Accuracy	± 2.0%T	± 1.0%T
Power Requirements	115/230 V ±10%, 60/50 Hz	
Dimensions	408W x 308D x 185H (mm)	
Net Weight	6kg (13lbs)	

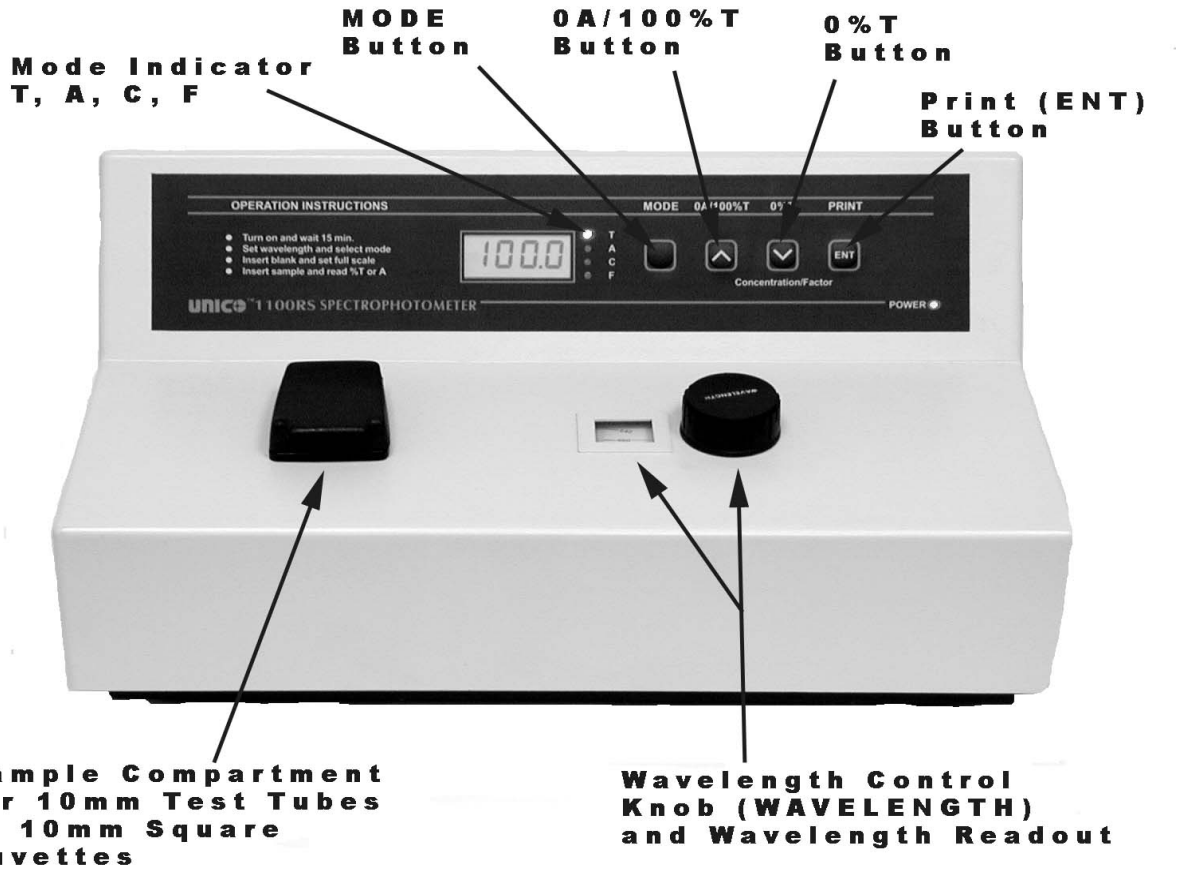
UNPACKING

Carefully unpack the contents and check the materials against the following packing list to ensure that you have received everything in good condition:

Spectrophotometer	1
Power Cord	1
Cuvette (round)	12
Square Cuvette Adapter	1
Dust Cover	1
Operation Manual	1

INSTALLATION

1. Place the instrument in a suitable location and keep it as far as possible from any strong magnetic or electrical fields or any electrical device that may generate high-frequency fields. Set the unit up in an area that is free of dust, corrosive gases and strong vibrations.
2. Turn on your UNICO® 1100/1100RS and allow it to warm up for 15 minutes



1100RS SPECTROPHOTOMETER OPERATION PANEL

MODE INDICATOR: Show the current measurement mode (T--%Transmittance, A--Absorbance, C--Concentration, and F--Factor) (refer to Figure-4).

MODE BUTTON: There are four modes. T mode is transmittance mode; A mode is absorbance

mode; C mode is to measure unknown sample concentration through a standard solution; F mode is to measure unknown value with a previously determined factor.

∧ (0A/100%T) BUTTON: Set spectrophotometer to 100%T or 0.000A when the reference solution is in the Sample Compartment.

∨ (0%T) BUTTON: in T mode and the Sample Compartment is empty, internal shutter blocks the beam. Press to set the Digital Display reading to 00.0%T.

ENT (PRINT) Button: in A and %T modes will send the displayed results to printer; in C mode, set the concentration value (refer to Concentration Mode in Additional Features of Model 1100RS section); in F mode, set the factor number and change to C mode (refer to Factor Mode in Additional Features of Model 1100RS section); If you want to print the test results at C mode, push the MODE button to the position when the LED light is off, then push the ENT button

SAMPLE COMPARTMENT: Accept 10 mm test tube or 10 mm square cuvette (the square cuvette adapter is required).

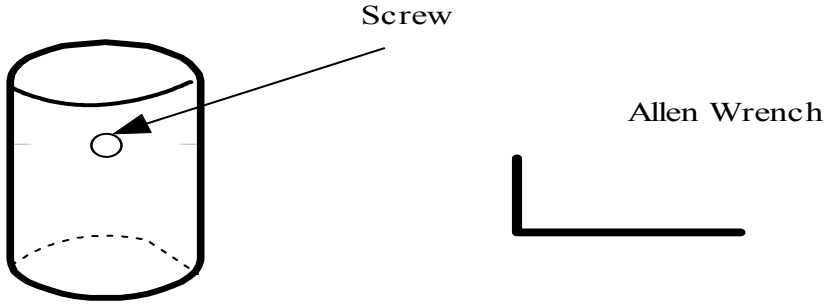
WAVELENGTH KNOB: Select desired wavelength in nanometers (nm).

WAVELENGTH READOUT Window: Display desired wavelength.

CHANGING SAMPLE HOLDERS

S-1100RS comes standard with the S-1100-102 Sample Holder. UNICO offers three additional holders as optional accessories, please refer to Table-2 “1100 and 1100RS Parts List” in 1100 and 1100RS Parts List of this manual.
To change the Cuvette Sample Holder:

- Open the lid of the Sample Holder, and locate the Sample Holder Locking Screw
- Use Allen Wrench (S-1100-521) to loosen the Screw counterclockwise
- Remove the Sample Holder you want to change, insert the one you want to install, align it properly, and fasten the Screw



BASIC OPERATION

OPERATION INSTRUCTIONS are printed on the front panel of your UNICO® 1100/1100RS.

Sample Preparation and Analysis

A. Spectrophotometer Warm-up

1. Turn on the spectrophotometer by turning on the Power Switch (IO). Allow 15 minutes for the instrument to warm up.
2. Select either the T (Transmittance Mode) or A (Absorbance Mode) by pressing the MODE button until the red light for T or A is on.
3. Select the desired wavelength by turning the WAVELENGTH control knob.

B. Sample Preparation

4. Make a blank reference solution by filling a clean square cuvette (or test tube) half full with distilled/de-ionized water or other specified solvent. Wipe the cuvette with tissue to remove the fingerprints or droplets of liquid.
5. Insert the blank square cuvette into the square cuvette adapter and place the adapter in the Sample Compartment (if using test tube, insert it directly into the Sample Compartment, aligning the guide mark (if present) with the guide mark at the front of the Sample Compartment). Close the lid.
6. Set 0.000A or 100%T with the 0A/100%T (Λ) button.

NOTE: This step fulfills the instruction on the front of the spectrophotometer

7. Remove the blank square cuvette or test tube. Set it aside in case that you may need to adjust the 0A/100%T using 0A/100%T (Λ) button later (i.e. change the wavelength).

C. Sample Analysis

8. Rinse a second square cuvette with a small amount of the sample solution to be tested. Fill the square cuvette half full and wipe clean the exterior of the cuvette.
9. Put the sample cuvette in the Sample Compartment. Close the lid.
10. Read the T or A from the Digital Display window. Remove the sample cuvette or test tube.
11. If you are to test the same sample at other wavelengths, repeat step 3 to 10 for each wavelength.
12. For each new sample you analyze, repeat step 2 to 11.

ADDITIONAL FEATURES OF MODEL 1100RS

1100RS offers two more features--Concentration Mode--C and Factor Mode--F though operating basically the same as the Model 1100.

CONCENTRATION MODE

C is used for determining the concentration of unknown samples.

NOTE: This method should only be used when the relationship between Absorbance and

Concentration is known to be linear. The concentration of the Standard solution used to calibrate the instrument should be higher than the most concentrated sample.

1. Select the desired wavelength by turning the wavelength control knob.
2. Using the MODE button, select A mode.
3. Insert the cuvette containing the blank solution.
4. Set 0.000A with the ∧ button.
5. Using the MODE button, select C mode.
6. Insert a cuvette containing a standard solution of known concentration in the Sample Compartment and set the Digital Display window to be the value of the standard by using the ∧ and ∨ buttons.
7. Press the ENT button.

NOTE: If the reading changes, the factor required is too high (i.e. >1999) to be displayed. In this case, divide the concentration by 10; re-select the C mode by successive presses on the MODE button, cycling through the F, T, and A modes, and follow step 2 above to set the concentration of the standard to the reduced value. Push the MODE button till the Mode Indicator light is off, then push ENT button; you can print the test result under C Mode.

8. With the standard concentration set, determine the concentration values of samples with unknown concentration by inserting the sample cuvette into the Sample Compartment and reading the value direct from the Digital Display.
9. To read the value of the multiplier used to convert Abs to Concentration, after measuring all the samples, change the mode to F and read the multiplier from the display. Keep a record of this value for future use.

Operational Note: if the MODE is changed to read F or A, the Concentration C reading is “frozen, re-start at step 1.

FACTOR MODE

This is a special mode for measuring concentration values of unknown samples using a previously determined factor to convert absorbance readings to concentration.

1. After setting the wavelength, and setting zero Abs on the blank solution, using the MODE button, select F mode.
2. Insert a cuvette containing a sample.
3. Using the ∧and ∨ buttons, set the Digital Display window to the desired value of the multiplier.
4. Press the ENT button. The spectrophotometer switches to the C mode.

Operational Note: If the Concentration of the sample is too high to be displayed, the instrument will not switch to C mode when the ENT button is pressed. Dilute the sample and multiply the concentration reading by the dilution factor to obtain the original sample concentration. If dilution is impossible or causes other problems, you may divide the factor value by “10” or “100” and follow step 1 to 4 to enter the “new” factor value. You need to calculate the sample concentration by multiplying readout with the multiple “10” or “100”.

5. Read the concentration value of the sample direct from the Digital Display.
6. Insert a cuvette containing the next sample and read the result. Repeat until all samples have been measured.

Operational Note: If the MODE is changed to A or T and the concentration reading is “frozen”, re-start at step 1.

MAINTENANCE

Lamp Replacement

Turn off and unplug the instrument. Carefully turn the instrument upside down, making sure no cuvette or chemicals are in the Sample Holder.

Remove the grill plate on bottom of the instrument by removing the fixing screw.

Unplug the lamp from the white connector. Insert the new lamp; pushing it in as far as it will go.

Replacement lamp Item Number: S-1100-505 (6V 10W G4 type)

CAUTION: DO NOT HANDLE THE LAMP WITH BARE FINGERS. USE TISSUE OR CLOTH WHEN HANDLING LAMP.

3. Turn on the instrument. Set the wavelength at 340 nm, insert a test tube or an empty cuvette with cuvette adapter, and blank the instrument. If the energy is low, adjust the lamp by "pulling" or "pushing" it so that the light beam is focused on the entrance slot of the monochromator. Since the lamp socket is pre-aligned, there will be minimum, if any, adjustment required.
4. Re-install the grill plate.

Wavelength Calibration Check

Normally the UNICO® 1100 Series spectrophotometer retains its wavelength calibration indefinitely. However if the instrument receives a severe shock or is abused, use the following methods to check wavelength calibration.

In the filter method, the didymium filter has two distinct absorbance peaks at 529 nm and 807 nm. The Holmium filter has a distinct peak at 361 nm. When the instrument is calibrated properly you will find minimum Transmittance (maximum Absorbance) at the range ± 2 nm from these peaks. Note that the specific Transmittance values are not important as you are only looking for the wavelength where the minimum Transmittance (maximum Absorbance) occurs.

Note: If you calibration filter has a certified peak/valley curve attached, please use the peaks on the curve to verify the instrument.

Holmium Oxide Filter Method

1. Turn instrument on and allow it to warm up for 15 minutes.
2. Select the A mode.
3. Set the wavelength to 350 nm.
4. Make sure the cuvette adapter is empty and place it in the Sample Compartment. Close the lid.
5. Set zero Absorbance by pressing the 0A/100%T (∧) button. Wait a few seconds when the display flashes. The reading should be 0.000A. If not, repeat step 5.
6. Remove the Cuvette Holder and insert the Holmium filter into it. Place it in the Sample Compartment again and close the lid.
7. Record the Absorbance reading on the Digital Display window.
8. Advance the wavelength setting by 1 nm and repeat step 4 to 7.
9. Repeat step 8 until the wavelength setting reaches 370 nm.
10. Look for the maximum absorbance reading obtained, and this should be found within 359~363

nm. The wavelength accuracy of the 1100/1100RS is ± 2 nm.

DIDYMIUM FILTER METHOD

1. Set the Wavelength to 800 nm.
2. Make sure the cuvette adapter is empty and place it in the Sample Compartment. Close the lid.
3. Set zero Abs by pressing the 0A/100%T (∧) button. Wait a few seconds when the display flashes. The reading should then be 0.000A. If not, repeat step 3.
4. Remove the Cuvette Holder and insert the Didymium filter into it. Place it in the Sample Compartment and close the lid.
5. Record the Absorbance reading on the Digital Display window.
6. Advance the wavelength setting by 1 nm and repeat step 2 to 5.
7. Repeat step 6 until the wavelength setting reaches 815 nm.
8. Look for the maximum absorbance reading obtained, it should be within 805~809 nm. The wavelength accuracy of the 1100/1100RS is ± 2 nm.
9. If a "middle" wavelength check is desired, set the wavelength to 522 nm (optional)
10. Make sure the cuvette adapter is empty, place it in the Sample Compartment. Close the lid.
11. Set zero Abs by pressing the 0A/100%T (∧) button. Wait a few seconds when the display flashes. The reading should then be 0.000A. If not repeat step 11.
12. Remove the cuvette adapter and insert the Didymium filter into it. Place it in the Sample Compartment again and close the lid.
13. Record the absorbance reading on the Digital Display window.
14. Advance the wavelength setting by 1 nm and repeat step 10 to 13.
15. Repeat step 14 until the wavelength setting reaches 536 nm. Again, look for the maximum absorbance reading. It should be within 527~531 nm.

ABSORBANCE ACCURACY CHECK

Specification: ± 2% at 1A (1100), ± 1% at 1A and 2A (1100RS).

The absorbance accuracy should be checked against a set of neutral density filters accurately calibrated to the NIST standards. Contact your UNICO® representative for more information.

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

Reference: Johnson E A

Potassium Dichromate as an absorbance standard; PSG Bulletin 1967, No. 17, page 505

1. Make up N/100 sulfuric acid as the solvent and use part of it to make a solution containing 120 + 0.5 mg/l of potassium dichromate.
2. Wash out a square cuvette with solvent, and fill with solvent.
3. Put the cuvette in the cuvette adapter, then into the Sample Compartment and close the lid.
4. Set the wavelength to 350 nm.
5. Set the MODE button to A.
6. Set the reading to 0.000A using the 0A/100%T (∧) button.
7. Empty the cuvette. Wash out with dichromate solution, and fill with dichromate solution.
8. Put the cuvette in the Holder, then into the Sample Compartment and close the lid.
9. Read the absorbance of the standard from the Digital Display window. The value should be

1.288 ± 0.04 A. Refer to the notes above when interpreting the result.

STRAY LIGHT CHECK

Specification: Less than 0.5%T at 340 nm by ASTM E 387 A good indication as to whether the stray light level is within specification may be obtained as follows:

1. Set the wavelength to 340 nm, set the MODE button to T.
2. With the square cuvette adapter in the Sample Compartment, but no cuvette, close the lid and press the 0A/100%T (∧) button to set the display to 100.0%.
3. Remove the cuvette adapter from the Sample Compartment and close the lid. Make a note of the reading that should be at or near 0.00.
4. Prepare a 5% (50g/L) solution of sodium nitrite ($NaNO_2$) in distilled water and fill a square cuvette with this solution.
6. Insert the cuvette into the cuvette adapter, place it in the Sample Compartment, and close the lid. The display should read < 0.5%T. If the reading obtained in step 4 is greater than 0.00, it should be subtracted from the displayed reading to give the correct reading for the stray light value.

1100 and 1100RS PARTS LIST

Item Number	Description
S-1100	UNICO® Model 1100 Spectrophotometer 20 nm Bandpass
	Wavelength range: 335~1000 nm. Voltage preset at 110V
	Complete with 10 mm Test Tube Cuvettes (12 pcs.)
	10 mm Cuvette Adapter, Dust Cover, User Manual
S-1100RS	UNICO® Model 1100RS Spectrophotometer 10 nm Bandpass
	Wavelength range: 335~1000 nm. Voltage preset at 110V
	Complete with 10 mm Test Tube Cuvettes (12pcs.)
	10 mm Cuvette Adapter, RS-232C Port, Dust Cover, User Manual
S-1100-401	UNICO® Software for Window's. Programs include Standard Curve, Abs./%T/Conc., and Abs.vs.Time.
Accessories	
S-1100-102	Test Tube Sample Holder for 10 mm diameter Test Tubes
S-1100-103	Square Cuvette Adapter for 10 mm Cuvettes
S-1100-113	Test Tube Sample Holder for ¾ inch Test Tubes
S-1100-114	Test Tube Sample Holder for 1 inch Test Tubes
S-1100-115	COD Vial Sample Holder
S-90-9115	Holmium Oxide Filter 10 mm x 10 mm x 45 mm (requires S-1100-103)
S-90-9116	Didymium Filter 10 mm x 10 mm x 45 mm (requires S-1100-103)
S-90-301	Test Tube Cuvette, 10 mm diameter, 12 pcs.
S-90-302P-100	Disposable Cuvette, Polystyrene, 10 mm pathlength, 100 pcs.
S-90-302P-500	Disposable Cuvette, Polystyrene, 10 mm pathlength, 500 pcs.
S-90-304G	Square Cuvettes, Optical Glass, Set of 2
S-90-305P	Disposable semi-micro Cuvette, Polystyrene, 10 mm pathlength, 500 pcs.
S-1100-505	Tungsten-Halogen Lamps, Package of 2 (6V 10W G4 type)
S-1100-512	Dust Cover
S-1100-513	Fuse, 3A, quantity 1 (size 5 x 20)
S1100-520	Service Manual

S-1100-521	Allen Wrench

TROUBLESHOOTING

PROBLEM	Possible Cause	Solution
Instrument Inoperative (Power indicator has no light)	Power cord not connected to outlet	Plug instrument in
	Dead Power outlet Wrong voltage setting	Change to a different outlet
	Internal fuse blown or defective electronic component	Call an authorized service engineer
Instrument can not set 100%T (0.000A)	No Cuvette Adapter in the Sample Compartment	Cuvette Adapter must be in Sample Compartment to open sample holder shutter
	Light beam blocked: • Holder misaligned • Shutter	Check sample holder
	Lamp is old or defective	Replace Lamp
	Lamp is off alignment	Refer to Lamp Replacement instructions in this manual
	Defective electronic component	Call an authorized service engineer
%T can not be set to 00.0%T	Sample holder	Remove Cuvette Adapter or test tube
	Sample holder shutter	May be stuck open Close shutter
	Defective electronic component	Call an authorized service engineer
Incorrect Transmittance to Absorbance correlation	Bubbles or particles in solution	Check sample preparation and analytical procedure
	Defective electronic component	Call an authorized service engineer
PROBLEM	Possible Cause	Solution
Digital Display does not change regardless of sample concentration	Concentration reading “frozen”	Change MODE from C to F, T or A and back to C Restart measurement procedure
	Wrong wavelength setting	Check sample procedure and wavelength setting
	Insufficient sample volume	Fill cuvette with more sample
	Stray sample preparation vapors	Prepare the sample away from the instrument. Use proper ventilation
	Bubbles or particles in solution	Check sample preparation and analytical procedure
	Defective electronic component or loose wiring	Call an authorized service engineer
Instrument drift	No sufficient warm up time	Check lamp has been

and noise	Significant temperature change Lamp not adjusted properly	properly installed or has moved during transit Refer to Lamp Replacement instructions in this manual
	Lamp old or defective	Replace with a new lamp
	Sample Holder Misaligned	Refer to Lamp Replacement instructions in this manual
	Unstable power supply Defective or dirty detector or defective electronic component	Call an authorized service engineer
Incorrect readings obtained	Insufficient sample volume	Fill cuvette with more sample
	Wrong wavelength setting Failed to blank (0A/100%T) Failed to set 0%T	Check analytical procedure and wavelength setting Check wavelength accuracy according to procedure in this manual
	Stray sample preparation vapors	Prepare sample away from instrument. Use proper ventilation
	Bubbles or particles in solution	Check sample preparation and analytical procedure
	Instrument out of electronic calibration	Call an authorized service engineer