

Agilent Cary 3500 UV-Vis Spectrophotometer

User's Guide



Notices

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Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

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General Information and Safety Practices and Hazards

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Your Agilent instrument and accessories have been carefully designed so that when used properly you have an accurate, fast, flexible and safe analytical system.

Information about safety practices appears throughout the documentation (both hard copy and online) provided with your instrument and accessories to help you safely operate the instrument and accessories. Before using the instrument or accessories, you must thoroughly read these safety practices. ALWAYS operate the instrument and accessories in accordance with these safety practices.

User Documentation

You have been provided with the following additional documentation to help you set up and operate your Agilent Cary 3500 UV-Vis spectrophotometer:

- Cary UV software installation instruction sheet found in the software box
- Cary 3500 UV-Vis module instruction sheet found in the module box
- Cary 3500 UV-Vis engine instruction sheet found in the engine box

General Information and Safety Practices and Hazards

- This manual, with safety practices and hazards information, instructions for installing and maintaining the components of the Cary 3500 UV-Vis and troubleshooting information.
- The Cary UV Workstation Help and Learning Center provided with the Cary UV Workstation software which provide step-by-step instructions for installing selected accessories and programming applications, step-by-step instructions for frequently performed analyses and instructions for using any accessories you ordered.

Conventions

The following conventions have been used throughout the documentation:

- Menus, menu items, buttons and check boxes have been typed in bold. For example, 'click **OK**' and 'From the **Edit** menu, choose **Copy**'.
- ALL CAPITALS indicate keyboard commands. For example, 'Press ENTER' and 'Press SHIFT+F3'.

Notes and Tips

A Note is used to give advice or information.

A Tip is used to give practical hints to help you achieve the best possible performance from your instrument.

Verifying Safe State

The following general safety precautions must be observed during all phases of operation, maintenance and service of this instrument.

To ensure continued safety of the instrument after maintenance or service procedures verify the instrument is returned to a safe state for the user. This includes running performance checks to verify the instruments safety systems are functioning correctly. Check the general condition of the instrument during operation for wear or signs of corrosion that are likely to inhibit function or safety.

Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

Lamp Module

The lamp is enclosed in a self-contained module. This module contains components operating at high voltages. To avoid electric shock, NEVER disassemble the module.

Modules, Covers and Panels

The only routinely accessed panel is the Cary UV spectrophotometer sample compartment to introduce samples.

The only other cover and panel that is customer accessible is the lamp module and is to be removed ONLY when changing the lamp module. Consult the Cary UV Help and Learning Center for instructions and safety information.

Any other panels or covers that are retained by screws on the spectrophotometer and accessories may be opened ONLY by Agilent service engineers.

Compressed gas cylinders

Compressed gas cylinders contain highly pressurized gas. If storage conditions are outside of the recommended supplier's safety codes, the cylinders can explode or rapidly release gas into the environment. This may result in injury or death.

- Store and handle compressed gases carefully and in strict adherence to safety codes.
- Secure cylinders to an immovable structure or wall.
- Store and move cylinders in an upright, vertical position. Before transport, remove regulators and install cylinder cap.
- Store cylinders in a well-ventilated area away from heat, direct sunshine, freezing temperatures, and ignition sources.
- Clearly mark cylinders so there is no doubt as to their contents.
- Use only approved regulators and connections.
- Use only connector tubing that is chromatographically clean and has a pressure rating significantly greater than the highest outlet pressure from the regulator.

Other Precautions

Use of the Cary UV-Vis system and accessories may involve materials, solvents and solutions that are flammable, corrosive, toxic or otherwise hazardous.

Careless, improper, or unskilled use of such materials, solvents and solutions can create explosion hazards, fire hazards, toxicity and other hazards which can result in death, serious personal injury, and damage to equipment and property.

ALWAYS ensure that laboratory safety practices governing the use, handling and disposal of such materials are strictly observed. These safety practices should include the wearing of appropriate safety clothing and safety glasses.

Warning and Other Symbols

The following is a list of symbols that appear in conjunction with warnings on the spectrophotometer. The hazard they describe is also shown.

A triangular symbol indicates a warning. The meanings of the symbols that may appear alongside warnings in the documentation or on the instrument itself are as follows.



General Information and Safety Practices and Hazards

The following symbol may be used on warning labels attached to the instrument. When you see this symbol, refer to the relevant operation or service manual for the correct procedure referred to by that warning label.



The following symbols appear on the instrument or accessories:



Mains power on



Mains power off



Fuse



Single phase alternating current



Protective earth ground terminal



Earth ground terminal



Frame or chassis ground terminal



Nitrogen purge input at the specified flow rate



Caution, disconnect all supplies, risk of electric shock

CE Compliance

Your Agilent Cary UV spectrophotometer has been designed to comply with the requirements of the Electromagnetic Compatibility (EMC) Directive and the Low Voltage (electrical safety) Directive (commonly referred to as the LVD) of the European Union. Agilent has confirmed that each product complies with the relevant Directives by testing a prototype against the prescribed EN (European Norm) standards.

Proof that a product complies with these directives is indicated by:

- the CE Marking appearing on the rear of the product, and
- the documentation package that accompanies the product containing a copy of the Declaration of Conformity. The Declaration of Conformity is the legal declaration by Agilent that the product complies with the directives listed above, and shows the EN standards to which the product was tested to demonstrate compliance.

Electromagnetic Compatibility

EN55011/CISPR11

Group 1 ISM equipment: group 1 contains all Industrial, Scientific and Medical (ISM) equipment in which there is intentionally generated and/or used conductively coupled radio- frequency energy which is necessary for the internal functioning of the equipment itself.

Class A equipment is equipment suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

This device complies with the requirements of CISPR11, Group 1, Class A as radiation professional equipment. Therefore, there may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

Operation is subject to the following two conditions:

- 1 This device may not cause harmful interference.
- 2 This device must accept any interference received, including interference that may cause undesired operation.

General Information and Safety Practices and Hazards

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try one or more of the following measures:

- 1** Relocate the radio or antenna.
- 2** Move the device away from the radio or television.
- 3** Plug the device into a different electrical outlet, so that the device and the radio or television are on separate electrical circuits.
- 4** Make sure that all peripheral devices are also certified.
- 5** Make sure that appropriate cables are used to connect the device to peripheral equipment.
- 6** Consult your equipment dealer, Agilent Technologies, or an experienced technician for assistance.

Changes or modifications not expressly approved by Agilent Technologies could void the user's authority to operate the equipment.

ICES/NMB-001

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est conforme à la norme NMB-001 du Canada.

General Information and Safety Practices and Hazards

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Site Preparation Checklist

Upon purchasing your Cary 3500 UV-Vis system, you were sent the Cary 3500 UV-Vis System Site Preparation Checklist. You must have prepared your site according to the requirements listed in the checklist before installing and using the instrument. To obtain another copy of the site preparation checklist, go to the Agilent website at www.agilent.com and search for 'Cary 3500 Site Preparation Checklist'.

Measurement category

The Measurement category is IEC61010:I. Do not to use this equipment for measurements within measurement categories II, III and IV.

Pollution degree

The pollution degree is IEC61010:2. Pollution degree '2' applies to a normal indoor atmosphere.

Specifications

Environmental conditions

For detailed environmental conditions, see the Site Preparation Checklist.

The area should have no drafts, no corrosive fumes and no vibrations.

NOTE

For **optimum analytical performance**, it is recommended that the ambient temperature of the laboratory be between **20 and 25 °C** and be held constant to within ± 2 °C throughout the entire working day.

The area should have a dust-free, low humidity atmosphere. Air conditioning is recommended. The room should be temperature-controlled if your analyses are particularly sensitive.

Weights and dimensions

WARNING



Danger to hands and feet

Heavy weight. Always use two people to lift the Cary 3500 UV-Vis engine and module.

For detailed weight information, see the Site Preparation Checklist.

The workbench should be about 90 cm (36 in) high. Remember to provide space for the computer, monitor and printer.

To avoid damage through spillage of solutions and samples being analyzed, the worktops should be covered with a material that is corrosion resistant and impervious to liquids.

Do not block any ventilation grills present on the computer. Consult the manuals supplied with your PC, monitor and printer/plotter for their specific ventilation requirements.

For models with Peltier control you must allow for the circulation of air for cooling. Allow for 20 cm (8 inches) of space on both sides and approximately 10 cm (4 inches) in the rear for electrical, gas connections and air flow.

Specifications

For models that have Peltier temperature control, clear and unobstructed airflow of the inlet and outlet must be maintained. Ambient air must be allowed to enter the inlet and other heat sources such as exhausts, computers or other nearby Peltier modules must be avoided.

For models without Peltier control, you must allow for the circulation of air for cooling. Allow for 10 cm (4 inches) of space on both sides and approximately 10 cm (4 inches) in the rear for electrical connections and air flow.

Electrical specifications

For detailed power requirements see the Site Preparation Checklist.

The power cord and all other connections are located at the rear of the instrument or on the side of the module. The power switch is located on the rear of the engine and on the side panel of the module. Position the instrument for easy access to the disconnecting device.

Mains Supply

Power cords are provided based on the user's country requirements. Only the supplied power cord is to be used with this equipment.

The installation of electrical power supplies must comply with the rules and/or regulations imposed by local authorities responsible for the supply of electrical energy to the workplace.

WARNING



Shock Hazard

Danger of electrocution. Good electrical grounding is essential to avoid potentially serious shock hazards. A 3-wire outlet with ground connection must be provided for the Cary 3500 UV-Vis. Make certain that power outlets are earth-grounded at the grounding pin.

For safety reasons, a separate power outlet receptacle should be provided for each unit in the system. The use of extension cords or outlet adaptors is not recommended.

If necessary, replace the power cord only with a cord equivalent to the one specified in the Site Preparation Checklist.

Computer requirements

Cary UV systems are evaluated under Agilent's ISO9001 procedures using Cary UV Workstation software and a desktop computer. We strongly recommend a computer configuration that matches the system that was used during evaluations.

Table 1 Computer requirements

Component	Requirement
Processor	3.3 GHz, 8MB cache
Memory	8 GB RAM
Storage	500 GB SATA 7200 RPM HDD
DVD drive	16x DVD+ -RW
Graphics	Intel® HD Graphics P530
Communications	PCIe GbE Controller; 2nd Serial Port Adapter, 2 nd LAN NIC
Operating system	Microsoft Windows 10 64-bit

Locate the PC keyboard and mouse for ergonomically correct access.

Gas requirements

The Cary 3500 UV-Vis requires the supply of a compressed gas (nitrogen or air) when the Peltier temperature-controlled modules are used. It is required to prevent condensation of the sample compartment when temperatures below ambient are used. The supplied gas must be dry, oil and particle free and non-combustible.

Table 2 Purge gas purity requirements

Compressed gas	Description
Nitrogen	Water vapor <2570 ppm (dew point @ -10 °C). Acceptable sources are from bottled gas with industrial, medical or food grade nitrogen.
Air	Compressed Air: ISO 8573-1:2010 CLASS 1.3.1

3 Installation

Use the following checklist to make sure you have the work area ready to install the Cary 3500 UV-Vis.

<u>Preparation requirement</u>	<u>Complete</u>
All equipment is on site and has been checked for damage.	<input type="checkbox"/>
The work area meets the environmental requirements (see Page 14).	<input type="checkbox"/>
A suitable workbench is available (see Page 14).	<input type="checkbox"/>
Suitable electrical power supplies are available (see Page 15).	<input type="checkbox"/>
A computer that meets requirements is available (see Page 16).	<input type="checkbox"/>
A working Microsoft Windows operating system is installed on the computer. For instructions on installing this, refer to the documentation supplied with the operating system.	<input type="checkbox"/>

The Agilent Cary 3500 UV-Vis spectrophotometer is designed to be completely customer-installable. Instructions for setting up the system are included in the Cary UV-Vis Installation Video that is installed on the computer desktop during the software installation.

There are three main steps to install your Cary UV system:

- 1** Install the software – instructions are provided in the Cary UV software box
- 2** Install the hardware including both the engine and module – instructions are provided in the installation video installed on your computer desktop
- 3** Run the System Health tests to ensure the installation was successful – instructions are provided in the installation video installed on your computer desktop and in the Cary UV-Vis Help and Learning Center

Once the installation is complete, open the Cary UV-Vis Help and Learning Center. Click “Learning” to access a self-guided familiarization of the hardware and software, including instructions on how to setup and run a method and how to analyze the data.

Installation

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[_Toc506284002](#) **Modular concept**

The Cary 3500 UV-Vis introduces a modular concept to the Agilent Cary range of high performance spectrophotometers. Modularity splits instrument function between light generation and light measurement. The Cary 3500 UV-Vis engine produces monochromatic light which is measured by the various Cary 3500 UV-Vis sample measurement modules. This allows for the tailored development of specific modules for applications while maximizing the flexibility of the system.

The Cary engine is based around Xenon flash lamp technology coupled with a compact dual out of plane monochromator. As with any spectrophotometer photometric performance is largely determined by the quality of the monochromator. With UV-Vis instruments, the monochromator design is aimed at providing a desired wavelength resolution while maintaining high light throughput and low stray light.

Modules

Cary 3500 UV-Vis modules couple with the engine to provide measurement functionality for target applications. The Multicell and Compact UV-Vis modules provide measurement solutions for cuvette-based applications.

Introduction

Both modules employ fiber optic technology to split and distribute light from the engine to each of their measurement channels.

The Compact UV-Vis module has 2 measurement channels: sample and reference/blank. The Multicell module provides 8 measurement channels. Both modules come as ambient or Peltier variants.

Cary Multicell Ambient and Peltier

This module provides thermal control of the 8 cuvette stations. Control is arranged in 4 zones each containing one channel pair (positions 1/2, 3/4, etc.).

For the Peltier version, the temperature of each zone can be varied over a range of 0 to 110 °C and can be controlled based on either the temperature of the cell holder (block) or the temperature of the sample by using the sample temperature probe accessory. The Multizone feature allows for individual control of each zone.

WARNING



Hot surface

The sample compartment and cuvettes may become extremely hot during instrument operation and remain hot for some time after the temperature has reduced. Allow the sample compartment and cuvettes to cool for at least five minutes before attempting to remove cuvettes.

NOTE

Laboratory conditions directly affect temperature control. Because this is an air-cooled system, when working at the lower temperature ranges, the laboratory conditions must meet the lower end of the [Environmental Specifications](#).

Compact Ambient and Peltier

This module provides thermal control of the two cuvette positions.

The Peltier version provides similar thermal control as Multicell Peltier in one channel pair (zone). Control may be based on either the cell holder (block) or the actual sample temperature by using the sample temperature probe accessory.

Configurations

The following configurations are available.

Table 3 Cary 3500 UV-Vis configurations

Product number	Description
G9862AA	Cary 3500 Compact Peltier UV-Vis
G9894A	Cary Compact Peltier UV-Vis Module
G9866AA	Cary 3500 Multicell Peltier UV-Vis
G9867AA	Cary 3500 Multizone Peltier UV-Vis
G9889A	Cary Multicell Peltier UV-Vis Module

Temperature probes

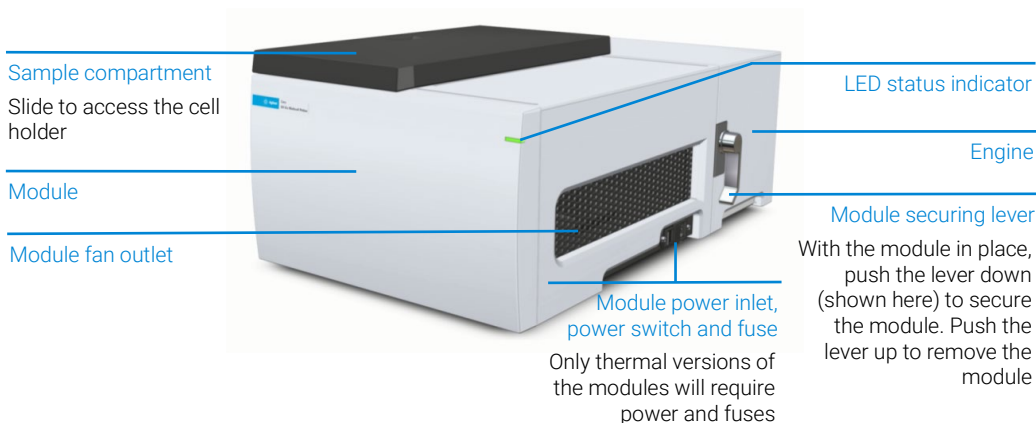
Cary 3500 UV-Vis Temperature Probes, G9892A, can be purchased separately to provide temperature control for each individual zone. Search for 'Temperature Probe' in the Cary UV-Vis Help and Learning Center for detailed information on use, maintenance, and installation.

Instrument overview

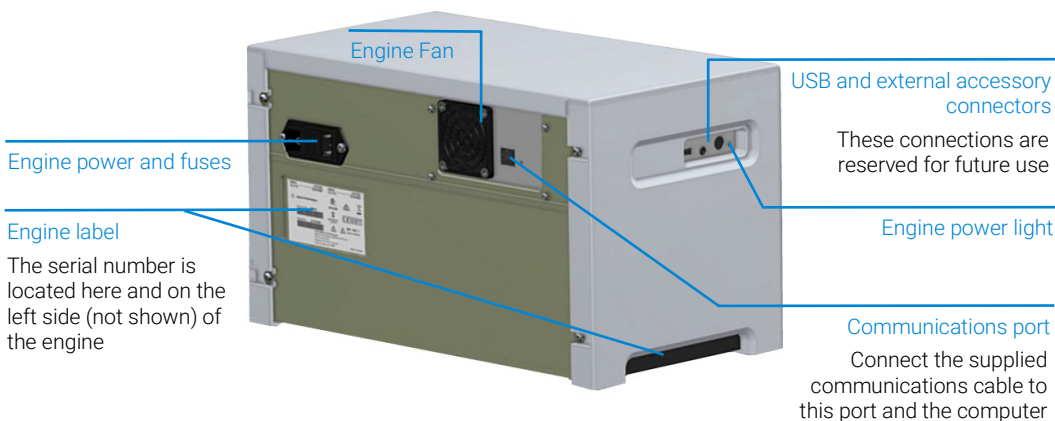
The Multicell module and engine are shown here. Component locations are the same for the Compact module.

Introduction

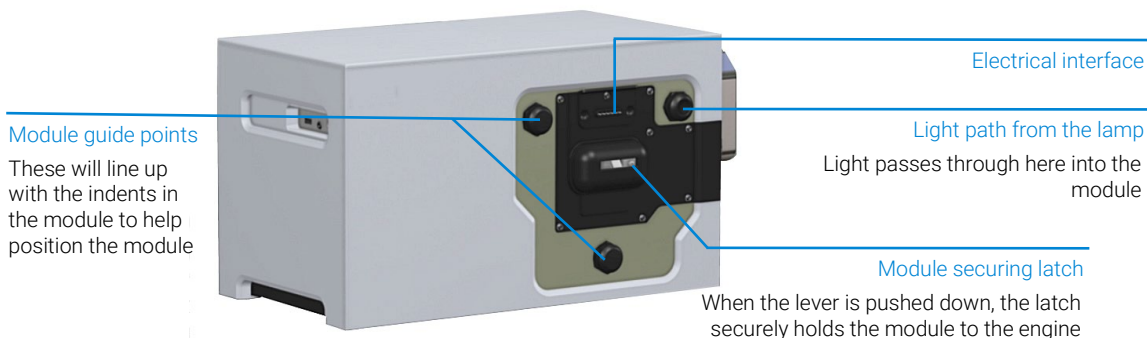
Front and right side of the module and engine



Back of the engine



Front of the engine



Introduction

Back of the module

Electrical interface

Information is sent between the module and engine

Lightbeam entry port

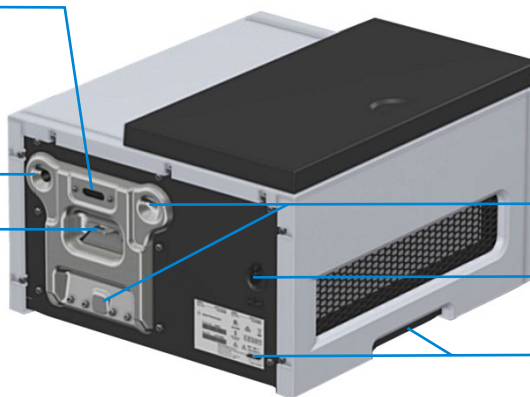
Module securing latch

Module positioning indents

Purge inlet

Module label

The serial number is located here and on the left side (not shown) of the module



Indicator LED

The LED on the front of the module indicates the status of the system:

- Off – no power to the instrument
- Solid yellow – the engine is starting up, a calibration has started, a calibration error occurred, or the calibration was not completed.
- Slow flashing yellow – the lamp is flashing during calibration
- Fast flashing yellow – the instrument is waiting to perform a scan
- Red – an instrument error occurred, or the module is powering on
- Solid green – the instrument is ready
- Flashing green – the instrument is scanning
- The engine power LED, located on the left side of the engine, is green if power is on, and off if there is no power.

Using the software

For information on how to use the software, double-click the Cary UV Workstation Help and Learning Center icon installed on your computer desktop during the Cary UV Workstation software installation.

Compressed gas purging

The sample compartment of the Cary 3500 UV-Vis can be nitrogen or compressed air purged if the purge tubing is fitted. The gas supply should be attached to the inlet tube on the back of the module.

You may need to purge the instrument with nitrogen or compressed air under the following circumstances:

- When using temperatures lower than the ambient temperature to prevent condensation in the sample compartment
- When operational conditions are such that environmental vapors or solid particles could cause damage to optical surfaces.

Purge kit

The Cary 3500 UV-Vis Purge kit, G9891A, includes the 0-30 LPM flow meter and 5 meters of 6 mm OD/4 mm ID tubing. See the Cary UV Workstation Help and Learning Center for instructions on how to install the purge kit.

Table 4 Purge kit pressure requirements

Product number	Description	Maximum Pressure
G9891A	Cary 3500 UV-Vis Purge Kit	689 kpa (100 PSIG)

Pressure regulator and gauge

The operating pressure of the Agilent supplied gauge is up to a maximum of 689 kPa (100 PSIG). Always use an appropriate regulator and gauge to ensure that the purge gas supply is consistently maintained at the correct pressure. If a different flow meter is used, then the maximum operating temperature will be different. Refer to the manufacturers advice.

Supply tubing

Use clean, flexible plastic (polyvinyl chloride (PVC) or equivalent) 6 mm OD/4 mm ID tubing.

CAUTION

Never use rubber tubing, because it may be treated internally with talc that can be blown into the optical system.

Introduction

CAUTION

Never connect the gas directly to the module. Always use a pressure regulator that meets the specifications listed in this manual.

Table 5 Purge gas flow rate requirements

Product number	Description	Flow rate (LPM)
G9862AA	Cary 3500 Compact Peltier UV-Vis	5
G9866AA	Cary 3500 Multicell Peltier UV-Vis	15
G9867AA	Cary 3500 Multizone Peltier UV-Vis	15
G9894A	Cary Compact Peltier UV-Vis Module	5
G9889A	Cary Multicell Peltier UV-Vis Module	15

NOTE

If samples are frequently changed, you may need to increase the flow rate through the sample compartment.

Drain outlet

In case of spills within the sample compartment, liquid will drain out of the drain outlet located under the module. To avoid spilling liquid onto the benchtop, the Cary 3500 UV-Vis needs a drain vessel and tubing that will fit over the 6 mm OD sized tubing of the drain outlet for disposal of any fluids spilled in sample compartment. You must supply drain tubing and vessel that is suitable for the solvent in use.

To install the drain tubing, slide the drain tubing over the drain outlet tubing on the module and then insert the free end of the tubing into the drain vessel.

A chemically inert container, not glass or of a narrow-necked style, to hold a minimum of 2 liters (4 pints) of waste must be provided by the user. It should be located below the sample compartment where it is protected by the bench and in full view of the operator.

Introduction

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5 Troubleshooting, Maintenance and Spare Parts

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All troubleshooting and maintenance procedures are in the Cary UV Help and Learning Center.

Double-click the Cary UV Help and Learning Center icon on the computer desktop, then search or use the table of contents to find the required information.

Any procedures not specifically mentioned in the Cary UV Help and Learning Center should be carried out only by Agilent field service engineers.

NOTE

The Help and Learning center refers only to maintenance procedures for the instrument. You should refer to your PC and printer manuals for their maintenance procedures, and to the Cary UV Help and Learning Center for the maintenance procedures for any accessories you ordered.

Fuses

The instrument contains a fuse assembly which is located at the back of the engine or side of the module next to the power cord and switch. To replace a fuse, disconnect the spectrophotometer from the power supply, and replace the blown fuse with one of the type and rating as indicated in the on the rear of the instrument. See the Cary UV Workstation Help and Learning Center for fuse replacement instructions.

NOTE

For safety reasons, any other internal fuse or circuit breaker is not operator-accessible and should be replaced only by Agilent authorized personnel.

Fuse information on the rear of the instrument is the most up-to-date.

WARNING



Electrical Shock and Fire Hazards

To prevent reduced safety protection or unwanted fusing, **ALWAYS** ensure that the code on the fuse cap matches the information printed next to the fuse holders.

Spills

Any spills in the sample compartment should be wiped up immediately. Any liquid spilled into the cuvette positions drains out through the drain tube located on the bottom of the module. It is recommended that an additional length of PTFE tubing is slid over the 6 mm OD drain tubing and inserted into a collection vessel to avoid liquid spilling onto the bench.

The drain outlet tubing and vessel should be checked regularly for kinks in the tubing, blockages, or a full vessel.

The exterior surfaces of the instrument should be kept clean. All cleaning should be done with a soft cloth. If necessary, this cloth can be dampened with water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

The RESPONSIBLE BODY shall ensure that:

- a) appropriate decontamination is carried out if hazardous material is spilled onto or into the equipment;
- b) no decontamination or cleaning agents are used which could cause a HAZARD as a result of a reaction with parts of the equipment or with material contained in it;
- c) the manufacturer or his agent is consulted if there is any doubt about the compatibility of decontamination or cleaning agents with parts of the equipment or with material contained in it.

Spare Parts

The following spare parts are available for use with your Cary 3500 UV-Vis instrument. Always use Agilent-supplied spare parts, unless otherwise indicated.

Troubleshooting, Maintenance and Spare Parts

Table 6 Spare parts

Part	Part Number
Lamp module	G9864-67019
Temperature probe	G9892A
Magnetic stirrer bar PTFE star type	7418000400
Flow meter	K8003-60001
Purge tubing	3710043100

Ordering details for other accessories are available on the Agilent Technologies website, www.agilent.com

In This Book

The manual describes the following:

- General Information and Safety Practices and Hazards
- Specifications
- Installation
- Introduction
- Troubleshooting, Maintenance and Spare Parts

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