Technical Overview

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The Cary Sipper—Pump and Measure Multiple Samples Simultaneously

Introduction

The Cary Sipper is an accessory available for the Agilent Cary 3500 UV-Vis spectrophotometer. It includes a novel three-channel pump that fills and rinses up to three flow cells at the same time.

The Sipper was designed to replace manual filling, cleaning, and handling of cuvettes for UV-Vis measurements. By pumping samples and a rinse solution through flow cells positioned within the instrument, considerable time savings along with accuracy improvements are possible.

Cary 3500 UV-Vis instrument configurations

The Cary 3500 instrument can be configured with either a two cuvette holder (the Compact configuration) or with an eight cuvette holder (the Multicell configuration). Both configurations are double-beam, with a reference cuvette position at the rear of the cell holder.

Functionality of the Sipper accessory

The Cary Sipper has three peristaltic pump channels to pump samples from any vessel, through flow cells inside the Cary 3500 UV-Vis and then to a waste container. Samples can either be pumped from test tubes held in the holder attached to the side of the Sipper, or from a vessel positioned nearby. The capillary tubing can be extended if necessary.

Pump tubing options

The peristaltic pump tubing can be changed to suit the solvents you are using. Agilent offers:

- PVC tubing for aqueous samples
- PVC Solva tubing for low volatile organic samples (e.g. alcohols, medium-highly concentrated acids and bases)
- Marprene tubing for ketone based organic samples (e.g. methyl isobutyl ketone and diisobutyl ketone)

Modes of operation

The Sipper mode of operation depends on the Cary 3500 system it is attached to:

- **Cary 3500 Compact**—A single channel from the sipper pumps sample to a flow cell in the instrument. A reference solution, in a standard cuvette, is placed in the reference position.
- **Cary 3500 Multicell**—Three different samples can be pumped into three flow cells. A reference solution can be placed in a standard cuvette in the fourth cell holder position, as shown in Figure 1.
  All three samples are measured at the same time, increasing sample throughput and ensuring they are under the same conditions. The temperature of the samples can be controlled from the Cary UV workstation software[1].
  The temperature to be held constant for measurements or you can measure the absorbance while changing the temperature of the samples.

The Sipper can be operated using either the Cary UV Workstation software, or using the activation button on the Sipper unit.

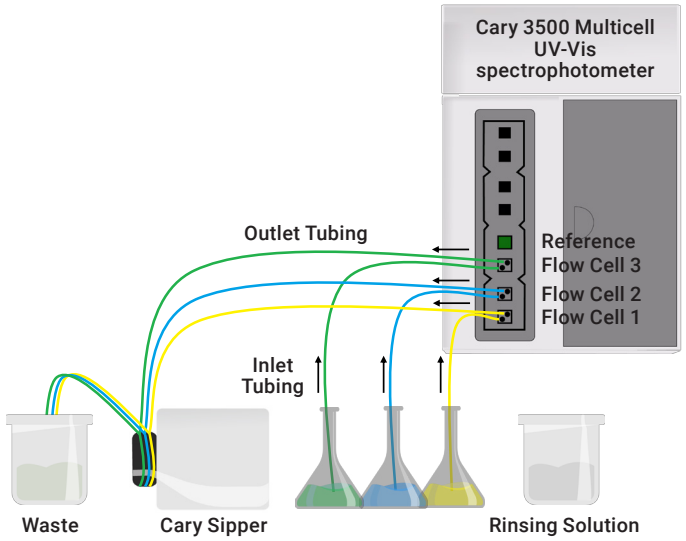

Figure 1. When used with the Cary 3500 Multicell UV-Vis instrument, the Sipper can pump up to three samples into flow cells, to be measured at the same time.

Software controls

The operating parameters of the Sipper are set within the Cary UV Workstation software, as shown in Figure 2.
The Fill time can be set to suit the viscosity of the sample. The Hold time controls the time between the pump stopping and the measurement being taken. The Hold time allows any bubbles or particles to settle before the measurement. The Rinse time can be set to ensure no carry-over between samples, depending on the viscosity and concentration of your samples. The Sipper settings can be stored as part of a method within the software.

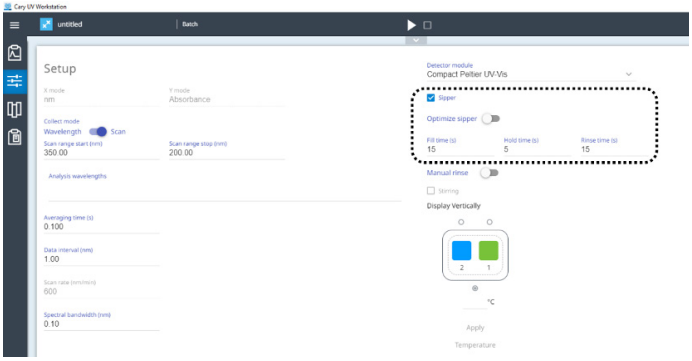

Figure 2. The software controls for the Sipper. You can set the Fill time, the Hold time, and the Rinse time to suit your samples.

[1] *It is not possible to use the in-cuvette temperature probes with the flow cells in place. The temperature of the cell block will be used to control the temperature of the samples.*

Flow cells

The Sipper can be used with any flow cell that has a Z-height[2] of 15 mm and external dimensions the same as a standard 10 mm pathlength cuvette. Using flow cells instead of standard cuvettes prevents inaccurate measurements due to fingerprints on cuvettes or contamination from poor cleaning. The Sipper is offered with two flow cell options, a 10 mm pathlength, 390 µL quartz flow cell or a 10 mm pathlength, 80 µL quartz flow cell. Agilent offers a range of flow cells, many of which can be used with the Cary Sipper/Cary 3500.

Reduce sample measurement time

The Sipper offers considerable time saving, compared to manually filling cuvettes. To quantify the time saved, 30 samples were measured four different ways:

1. Without the Sipper, using a single 3.5 mL cuvette and the Cary 3500 Compact instrument (which has a single cuvette position). The cuvette was manually filled, emptied, and rinsed for each measurement.
2. Without the Sipper, using three standard 3.5 mL cuvettes and a Cary 3500 Multicell instrument (which has seven cuvette positions). The cuvettes were manually filled, emptied, and rinsed for each measurement.
3. With the Sipper installed on the Cary 3500 Compact instrument, pumping to a single flow cell.
4. With the Sipper installed on the Cary 3500 Multicell instrument, pumping to three flow cells.

Identical measurement parameters were used for all measurements: A wavelength range of 200–350 nm, a signal averaging time of 0.1 second, a data interval of 1 nm and a spectral band width of 1 nm. For those measurements done using the Sipper, a fill time of 15 seconds, a holding time of 5 seconds and a rinse time of 15 seconds were used.

Table 1. The time taken to measure 30 samples using the four different instrument setups.

Mode of Operation	Measurement Time n = 30	Time Reduction (%) (Compared to manual handling with compact)
Manual cuvette handling		
1. Compact module (1 sample cuvette)	21 min 30 s	
2. Multicell module (3 sample cuvettes)	16 min 26 s	24%
Using the Sipper Filling Time (15 s), Holding Time (5 s), Rinsing Time (15 s)		
3. 1 flow cell	19 min 32 s	9%
4. 3 flow cells	7 min 30 s	65%

As shown in Table 1, using the Sipper with three flow cells reduced the time to measure 30 samples by 65%, compared to measuring the samples one by one using a standard cuvette.

[2] The Z-height is the distance from the bottom of the cuvette to the center of the aperture. It's sometimes called the center height.

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