

CTech™ SoloVPE® System (ViPER® ANALYTX Software)

User Guide



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Abbreviations

ADL	Application Development Language
DAQ	Data acquisition
FAS	Field Application Scientist
PM	Preventative Maintenance
SoloVPE	Solo Variable Pathlength Extension
SVCA	Solo Validation Cuvette Adapter
VPT	Variable Pathlength Technology

1. System Overview



The CTech™ SoloVPE® System hardware is composed of several individual components that are integrated to enable variable pathlength technology.

The SoloVPE System allows for dynamic adjustments of the optical pathlength between 0.005 mm (5 microns) and 15.000 mm, and the hardware components work seamlessly together to create the variable pathlength platform that enables the method known as Slope Spectroscopy®.

1.1 Cary 60 Spectrophotometer



The SoloVPE instrument functions by drawing its power directly from the Agilent Technologies Cary 60 UV-Vis spectrophotometer. The Cary 60 requires a Dual Use Fiber Optic Coupler, provided by Repligen's Analytics business unit, to ensure adequate light transmission through the Fiber Optic Cable to the SoloVPE instrument.

Note: Please reference documentation included with the Cary 60 spectrophotometer and computer for component-specific requirements, instructions, and safety considerations.

1.2 Dual Use Fiber Optic Coupler

The Dual Use Fiber Optic Coupler functions as an optical bridge by intercepting the beam of light from inside the Cary instrument and coupling it into an optical fiber that brings it to the SoloVPE instrument and the sample itself. Reference the *Dual Use Fiber Optic Coupler User Manual* DOC0047 for additional information.

1.3 ViPER ANALYTIX: SoloVPE System Software

The ViPER ANALYTIX software controls all aspects of configuration, data acquisition, analysis, and reporting. The overall platform is designed with an app-based architecture where each app is designed for a specific purpose.

For more detailed information about each application and software support, reference the online ViPER User Guide.

1.3.1 Computer Requirements

The following are required in order to run the system hardware correctly:

- Operating System: Windows 10
- Compatible Software Environment:
 - ⇒ ViPER ANALYTIX v1.1.x
 - ⇒ Agilent WinUV Software Suite v5.1.0.1019 or newer
- Computer Hardware (Repligen recommends):
 - ⇒ Min Processor: Intel i5 (i7 Preferred)
 - ⇒ Min Hard Drive: 250 GB (SSD Preferred)
 - ⇒ Min RAM: 8 GB (16 GB Preferred)

1.4 SoloVPE Device and Components

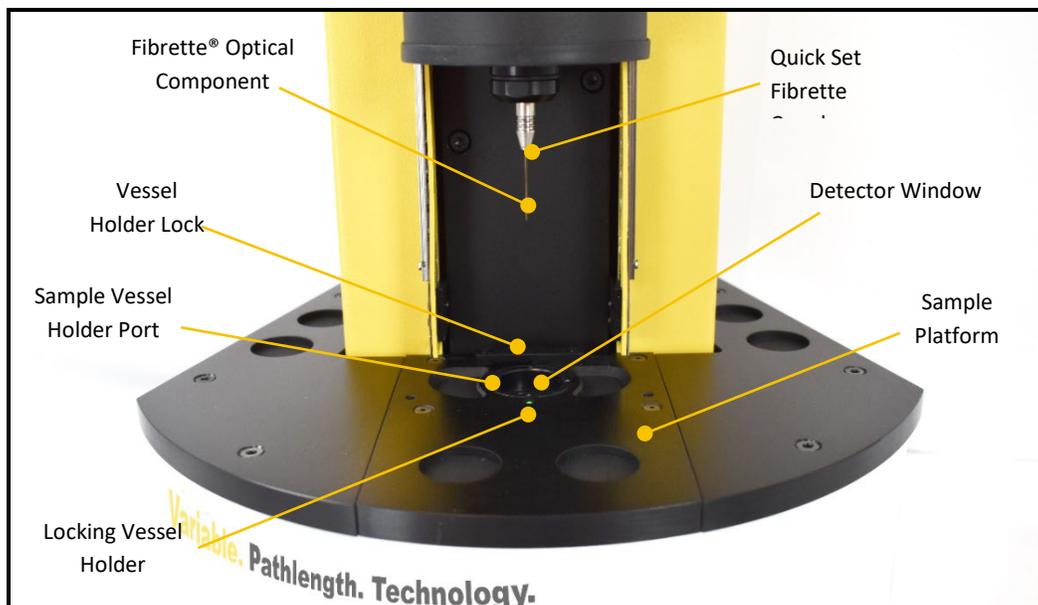


Figure 1. SoloVPE parts and components (cover up).

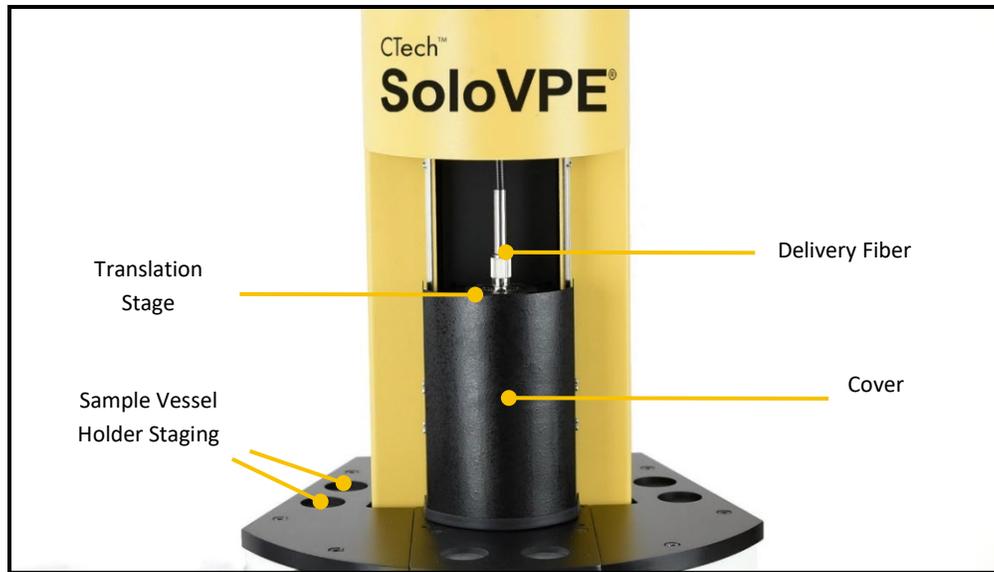


Figure 2. SoloVPE parts and components (cover down).

1.5 SoloVPE Consumables



Fibrette Optical Components



Sample Vessels
(from left to right: plastic, Fused Silica Micro, Fused Silica Small, Fused Silica Large)



Sample Vessel Holders
(from left to right: Micro/Small, Large)



TBA (Legacy) Fibrette Coupler Inserts



Quick Set Fibrette Coupler Inserts



Transmission Tool



Quick Set Fibrette Coupler Inserts

Figure 3. Images of SoloVPE consumables.

1.6 Solo Validation Cuvette Adapter (SoloVCA)*



The SoloVCA is an optional accessory that works exclusively with SoloVPE variable pathlength spectrophotometer system. The SoloVCA was developed to provide an additional technique for validating the SoloVPE device, specifically allowing the use of cuvette-form-factor filters and standards designed for standard spectrophotometers.

***Note:** The SoloVCA is not a general-use cuvette adapter that allows users to make standard cuvette measurements through the SoloVPE System. Use only as intended for validation purposes.

2. System Hardware Installation

Please read and understand the following instructions prior to making any connections. These step-by-step directions guide the user through the process of making the four primary connections required between the computer, the Agilent Cary 60, and the SoloVPE instrument.

Refer to the documents packaged with the computer and Cary 60 for further instruction on basic installation.

The following steps should be carried out after speaking with a certified Repligen analytical representative for confirmation on setting up the System. Prior to starting, please clear and designate the laboratory bench space for the intended setup of the SoloVPE System. The SoloVPE instrument and Cary 60 may be set up, as shown below.

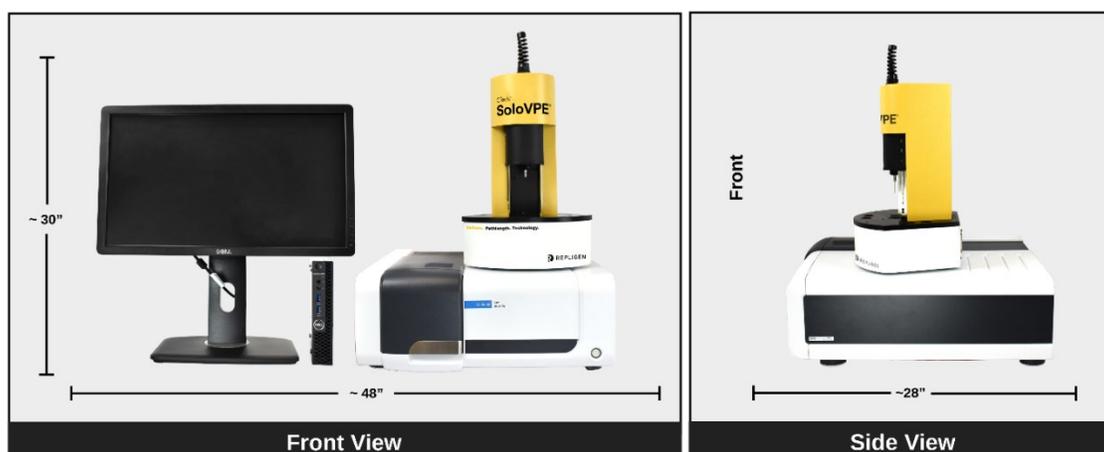


Figure 4. Dimensions of SoloVPE instrument, Cary 60 spectrophotometer, and computer.

For any questions or queries, contact Repligen at US +1 908-707-1009 or analytics-support@repligen.com



Configuration 1: On top of the Cary 60

Configuration 2: Adjacent to the Cary 60

Figure 5. Optional configurations of SoloVPE instrument and Cary 60.

2.1 System Hardware Installation: Step-by-Step



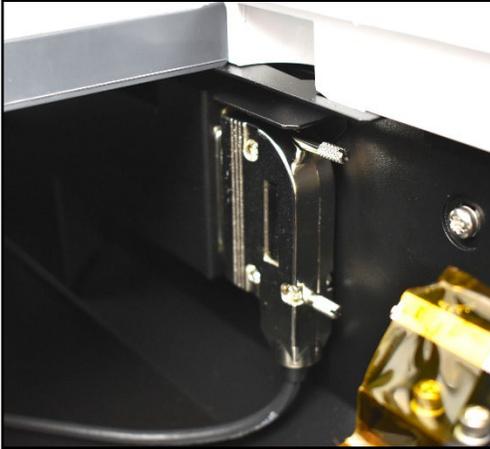
Step 1: Unpack and Verify

Carefully unpack the equipment and all accessories. Confirm receipt of all items on the packing list included with the shipment.



Step 2: System Computer Setup

Use the instructions provided with the computer system for proper setup. It is best to complete the balance of this procedure with the computer turned off.



Step 3: Connect Accessory Cable to Cary 60

Connect the Accessory Cable to the Accessory Port located on the inside right of the Cary 60 sample compartment. The 25-pin male connector connects to the housing mounted inside the sample compartment.



Step 4: Pass Accessory Cable through Access Panel

Pass the female 25-pin connector of the Accessory Cable through the opening made available when the access panel was removed from the back of the Cary 60.



Step 5: Connect Accessory Cable to SoloVPE Instrument

Connect the Accessory Cable to the Accessory Port on the back of the SoloVPE instrument. The 25-pin female Accessory Cable connector mates to the instrument's back panel.



Step 6: Connect Detector Cable to SoloVPE device

The Detector Cable has two different connectors. The black plastic connector is for the connection to the Cary 60. The silver connector is for the connection to the SoloVPE instrument's back panel. The silver connector is keyed.

To properly position the connector for insertion, align the red dots on the connector and the port and push firmly to make the connection to the back panel.



Step 7: Attaching SoloVPE Strain Relief

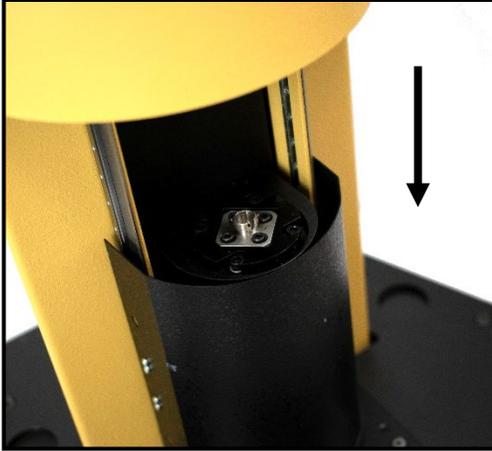
The Delivery Fiber Strain Relief is shipped with the SoloVPE instrument but packed separately. Attach the Strain Relief by screwing it onto the mating thread at the top of the SoloVPE instrument.



Step 8: Insert Delivery Fiber through Strain Relief

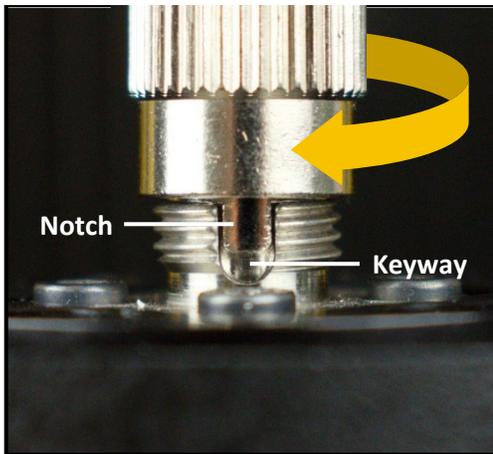
Insert the Delivery Fiber through the Strain Relief to properly connect it to the SoloVPE Translation Stage. This step should be performed with the protective plastic cap in place over the FC end of the Delivery Fiber.

The SoloVPE Delivery Fiber has two different connectors: an SMA connector with a hex-shaped nut and an FC connector with a keyed connector with a round knurled nut. The FC connector should be inserted into the SoloVPE instrument and the SMA end is for the Cary 60/Coupler side.



Step 9: Slide SoloVPE Cover into Down Position

To make the Delivery Fiber FC connection to the SoloVPE instrument, the Tower Cover must be slid into the down position.



Step 10: Connect Delivery Fiber to Translation Stage

The FC Connector is a keyed connection that can only be securely attached when aligned properly. Rotate the Delivery Fiber to line up the notch on the FC connector and the keyway on the Translation Stage. Fully insert the FC connector and tighten the knurled nut securely.

Note: When rotating the FC connector to align the notch, the entire Delivery Fiber will need to rotate. It is recommended that the FC connector be held with one hand as the Delivery Fiber is rotated with a free hand through the top of the Strain Relief.



Step 11: Pass the Cables into the Cary 60

Pass the Detector Cable (black, right-angle plug end) and the Delivery Fiber (SMA/hex-nut end) into the sample compartment through the now open sample compartment access port at the rear of the Cary 60.

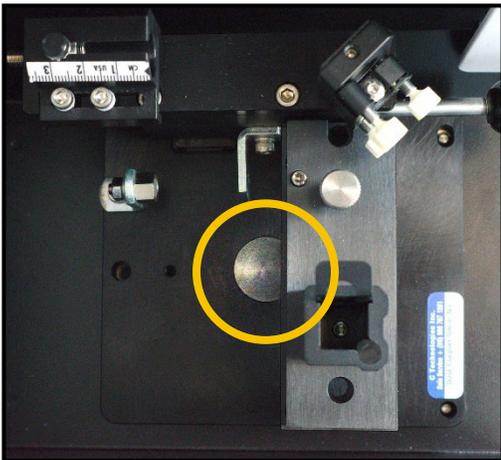
**Step 12: Connect Detector Cable to Cary 60**

Remove the Cary 60 sample compartment covers.

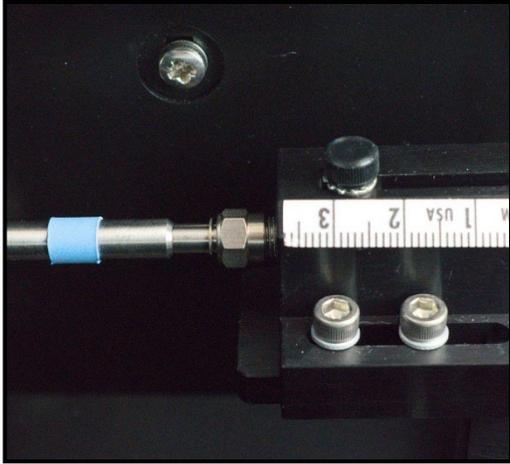
Connect the black, right-angle plug of the Detector Cable into the Cary 60. On the wall of the Cary 60 sample compartment, there are two connection ports: when using the onboard detector (cuvette option), the black plug that resides in the sample compartment is connected. When using the SoloVPE instrument, the onboard detector is unplugged and the SoloVPE detector is plugged in.

**Step 13: Install Fiber Optic Coupler (FOC) into Cary 60**

Position the FOC above the two raised pins in the base of the sample compartment and lower into place, making sure it connects securely.

**Step 14: Secure Fiber Optic Coupler Within Cary 60**

Using the large thumbscrew in its baseplate, secure the FOC to the base of the sample compartment. Tighten securely to prevent shifting.



Step 15: Connect Delivery Fiber to Fiber Optic Coupler

With the FOC installed, uncap the Delivery Fiber already present in the sample compartment and connect the SMA end of the Delivery Fiber to the threaded splice bushing at the back of the FOC. Use the hex nut to securely tighten the connection.

Note: The alignment procedure must be followed in the *Dual Use Fiber Optic Coupler User Manual DOC0047* to maximize transmission through the Fiber Optic Coupler.



Step 16: Reinstall Cary 60 Sample Compartment Top Cover

Carefully slide the Cary 60 sample compartment top cover back into place. Slide the cover back far enough to allow installation of the sample compartment front cover.



Step 17: Reinstall Cary 60 Sample Compartment Front Cover

Position and slide the sample compartment cover down into place. Once fully inserted, reposition the top cover to close the compartment.



Step 18: Connect Power Cable to Cary 60

Connect the power cord (supplied with the Cary 60) to the back of the Cary 60. The transformer has a separate cord that runs to the wall outlet to allow for various power connectors.



Step 19: Connect USB Cable to Cary 60

Connect the USB Cable that came with the Cary 60 to the back panel of the Cary 60.

Note: Do not connect the opposite end of the computer until directed to do so.



Step 20: Power on Computer

Press the Power button on the computer to turn it on.



Step 21: Follow Manual Directions to Install All Software

Installation of the SoloVPE and ViPER Software should only be done by a trained Support Specialist or under their guidance. While logged into the computer with administrator privileges, install the ViPER ANLYTX Software.



Step 22: Power on Cary 60

With the USB cable disconnected from the computer, press the Power button at the front of the Cary 60. Power up the Cary 60 and allow it to fully initialize.



Step 23: Allow Cary 60 to Complete Start-up Initialization

When the Cary 60 is powered on, the hardware will initialize and calibrate, and the Power button will light up and flash an orange color. After pressing the Power button to turn on the Cary 60, wait for it to turn green. A steady green light means the Cary 60 has initiated successfully.

Note: *If the System fails to initialize and calibrate successfully, the Power button will turn red. If it fails to start-up successfully, turn it off and turn it on again.*



Step 24: Connect USB Cable to Computer

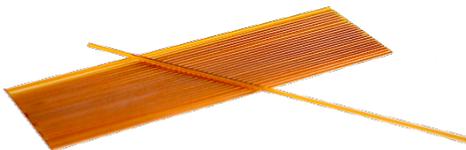
With the computer and Cary 60 powered up, make the final connection of the USB cable to the computer. The computer will audibly acknowledge that a USB device was connected and automatically detect and install the drivers for the Cary 60.

Congratulations!
The SoloVPE System is ready for use!

3. The CTech™ SoloVPE® System

This section provides detailed step-by-step instructions for the most commonly used features and functions of the SoloVPE System. The procedures include guidance on the proper use of the hardware and the software, as well as expectations and limitations of the system.

For more instruction on proper care, refer to CTech *SoloVPE Best Practices* DOC0153 and *VPT Support: SoloVPE Service Options* DOC0157 provided with the system.



3.1 Fibrette® Optical Components

The variable pathlength capability relies on the use of a light-transmitting component that moves in the sample solution, thus adjusting the pathlength. To reduce the risk of carryover and the time between measurements, the SoloVPE System has been designed to use disposable fiber optics called Fibrette Optical Components.

3.1.1 How to Clean Optical Surfaces of Fibrette Optical Component

***Warning:** Repligen strongly recommends that Fibrette Optical Components only be used once to avoid the risk of measurement errors associated with improper cleaning and storage, damage, or carryover. This procedure is provided strictly for support of noncritical, academic, and non-GxP implementations for which measurement accuracy tolerances have been deemed less critical.

1. After each use of a Fibrette Optical Component, store them in distilled water in a neoprene tube or a soft container to keep them wet.
 - Fibrette Optical Component must soak for a minimum of 30 minutes, but no longer than 24 hours.
 - Soaking longer than 24 hours can damage the polyamide coating.
 - Do not soak too many Fibrette Optical Components in a container; otherwise, they will clump together.
2. At the end of the day, properly dispose of the water and fill the tube with cleaning reagent (e.g., IPA, methanol, or ethanol) and let it soak for 2 to 5 minutes.
3. Pour out the solution and lay Fibrette Optical Component out on a paper towel to dry.
4. Wipe entire length of Fibrette Optical Component with a lint-free wipe. Then spin both ends on a folded lint-free wipe.
5. Place the Fibrette Optical Component back in the clean tube for future use.

3.2 Proper Cover Use

When taking measurements, the Tower Cover must always be in the closed position to avoid issues with ambient light. While the Cary 60 is substantially immune to the effects of room light, the presence of the Tower Cover improves stability, while at the same time protects users from the motion of the SoloVPE hardware as it changes pathlengths. When the cover is raised, the Fibrette Optical Component can be loaded and unloaded into the Fibrette Coupler.

3.3 SoloVPE TBA Fibrette Coupler



The TBA Fibrette Coupler is the original version of the Fibrette Coupler (originally called the Legacy Fibrette Coupler).

- Requires a manual pulldown of the Fibrette Optical Component for data acquisition
- Replacement recommended every 6 to 12 months

TBA Coupler Reusability

The TBA Fibrette Couplers are not single-use items. Depending on the frequency of use, it is recommended that TBA Fibrette Couplers be replaced every 6 to 12 months.

3.3.1 How to Remove TBA Fibrette Coupler Insert

Before installation and removal of TBA Fibrette Couplers, it is best to get assistance from a Repligen analytical representative. A TBA Fibrette Coupler has a blue back end and a transparent, tapered tip. The Fibrette Coupler is installed into the SoloVPE stage using the Luer thread on the blue back end.

1. Grasp the blue barrel of the Fibrette Coupler between the thumb and index finger and rotate it clockwise to unthread the unit from the mounting hole. One half to one full rotation will fully disengage the threaded portion of the Fibrette Coupler.
2. Once the thread has disengaged, gently pull the Fibrette Coupler straight down and out of the mounting hole.



Figure 6. TBA Coupler with Fibrette Optical Component inserted.

3.3.2 How to Install TBA Fibrette Coupler Insert

1. Hold the blue barrel of the Fibrette Coupler between the thumb and index finger with the blue back end of the Fibrette Coupler pointing up. Position the Fibrette Coupler below the SoloVPE stage to fit within the tapered mounting hole.
2. Insert the Fibrette Coupler up into the mounting hole.

Note: *The mounting system is designed to have a tight fit, so there will be a feeling of resistance as it is pushed into the mounting hole.*

- Next, gently rotate the Fibrette Coupler counterclockwise to engage the Luer thread and rotate until the Fibrette Coupler has been drawn fully into the mounting hole and is flush with the Translation Stage. This requires approximately one-half rotation (180°).
- Finger tighten only. Do not overtighten.

3.3.3 How to Load the TBA Fibrette Coupler

- Avoid touching the tip of the Fibrette Optical Component.
- Gently push the Fibrette Optical Component upward until it stops against the surface of the Delivery Fiber.
- To set, pull Fibrette Optical Component down slightly.
 - The distance between the Fibrette Optical Component and the Delivery Fiber should be between 2–10 mm.

Note: It is critical for proper functioning of the hardware and sample measurement that the Fibrette Optical Component be pulled down after being inserted fully.

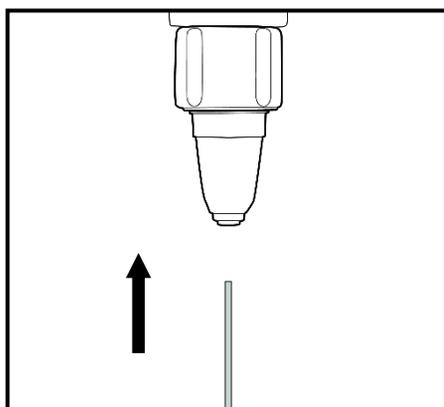


Figure 7. Insert Fibrette Optical Component (TBA).

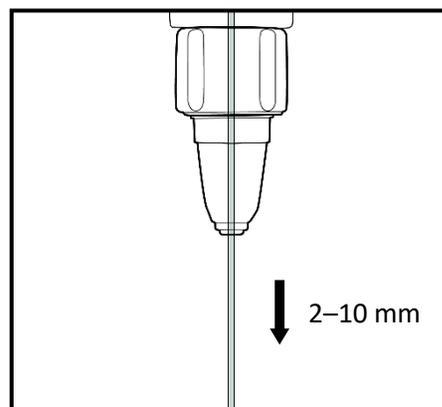


Figure 8. Lower Fibrette Optical Component (TBA).

3.4 SoloVPE Quick Set Fibrette Coupler



The Quick Set Fibrette Coupler enables a highly repeatable method for preparing the Fibrette Optical Component for data acquisition.

- Allows consistent Fibrette Optical Component positioning
- Low maintenance: Replaced during annual PM service by VPT Support Specialist

Quick Set Coupler Reusability:

For upgrade installation of the new Quick Set Fibrette Coupler, please contact Repligen analytical representative for assistance. Quick Set Fibrette Couplers are not single-use items. It is not necessary to change this coupler frequently.



Figure 9. Quick Set Coupler with Fibrette Optical Component inserted.

3.4.1 How to Remove Quick Set Fibrette Coupler Insert

Before initial installation or removal of a Quick Set Fibrette Coupler Insert, it is best to get assistance from a Repligen analytical support specialist.

1. Raise the Tower Cover of the SoloVPE instrument to view the Quick Set Fibrette Coupler Insert.
2. With your thumb and index finger, grip the black Quick Set Fibrette Coupler Insert Holder.
3. You will see its octagonal shape.
4. Rotate the Holder clockwise until it becomes free from the Translation Stage, as shown in Figure 10.

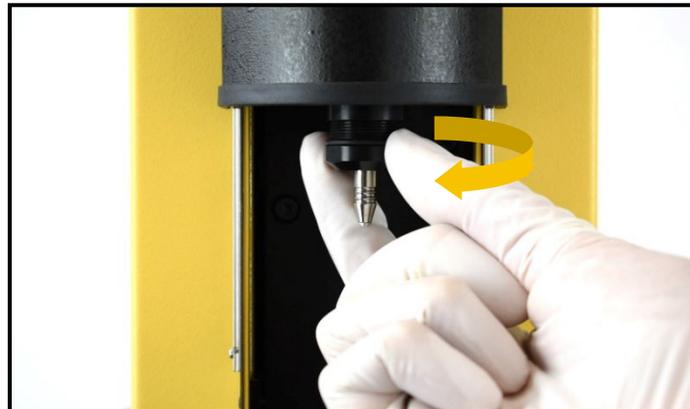


Figure 10. Removing Quick Set Fibrette Coupler.

5. Push the insert up through the Holder for removal, keeping the white O-ring in place. Their connection is magnetized, so there will be some resistance (see Figure 11 and 12).



Figure 11. Push Quick Set Fibrette Coupler Insert.



Figure 12. White O-ring.

3.4.2 How to Install Quick Set Fibrette Coupler Insert

1. To install a new Quick Set Fibrette Coupler Insert, place the insert directly into the holder, passing the tip of the insert through the larger opening. You should feel the magnetization pull the insert into the holder.
2. Place the holder back onto the Translation Stage of the SoloVPE instrument and rotate counterclockwise until fully secure.
3. To ensure the Quick Set Fibrette Coupler Insert was installed properly, actuate the coupler a few times (as if loading a Fibrette Optical Component).
4. You should feel the magnetization smoothly pull the insert back down, as you push up and let go.

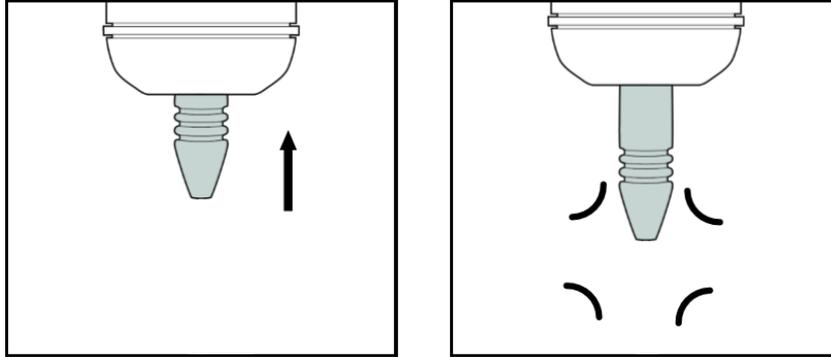
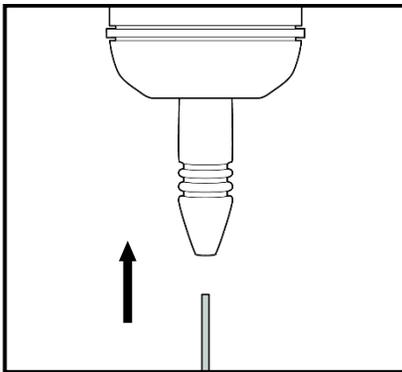


Figure 13. Actuate Quick Set Fibrette Coupler.

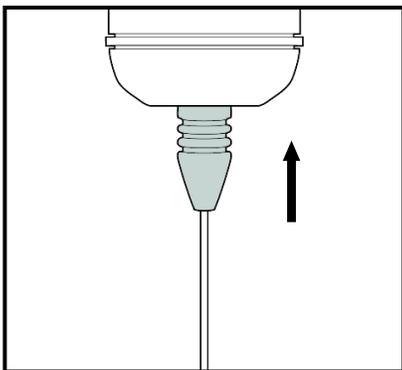
3.4.3 How to Load the Quick Set Fibrette Coupler

The unique design of the Quick Set Fibrette Coupler eliminates the need for setting or pulling the Fibrette Optical Component down. The Quick Set Fibrette Coupler will automatically set the distance of the Fibrette Optical Component for the user.



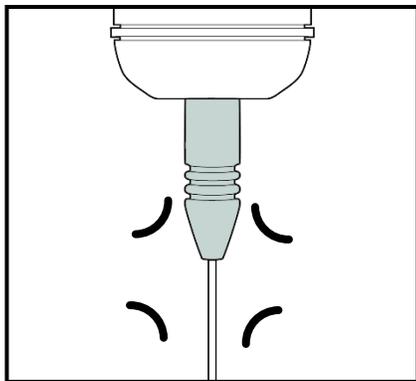
Step 1: Load the Fibrette Optical Component

To load the Fibrette Optical Component into the Quick Set Coupler, gently push the Fibrette Optical Component fully upward until it stops against the surface of the Delivery Fiber.



Step 2: Push Up Against Quick Set Coupler

Push up against the Quick Set Coupler insert until it stops. An audible click may be heard.



Step 3: Engaging the Quick Set Coupler

Release the Quick Set Coupler Insert to set the Fibrette Optical Component gap in preparation for sample acquisition.

3.5 How to Clean Delivery Fiber Surfaces

1. Delivery Fiber must be disconnected from the SoloVPE System.
2. To disconnect the Delivery Fiber, unscrew the connector and pull straight up through the Strain Relief to remove the fiber end from the transport mechanism.
3. Fold a lint-free wipe and firmly wipe the fiber connector surface in one direction. Repeat a few times.
4. Spray compressed air over connector surface.
5. If residue persists, add cleaning reagent to a lint-free wipe. Wipe the fiber optic surface in one direction until the residue is removed. See weekly actions in *CTech SoloVPE Best Practices* DOC0153.
6. Repeat if necessary.
7. Reconnect Delivery Fiber, making sure the connector key is properly positioned in the Delivery Fiber. Mount and tighten by turning the nut clockwise (see Figure 14).

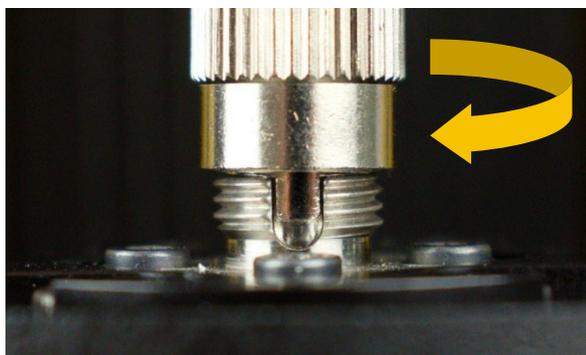


Figure 14. Reconnect Delivery Fiber to Translation Stage.

3.6 Sample Vessels and Sample Vessel Holders

The following section will explain the proper use of both plastic and fused silica sample vessels, sample vessel holders, and their specifications and best practices. Reference this section when identifying which vessel to use for samples of certain concentrations and types and their recommended volumes.

3.6.1 Fused Silica Sample Vessels

The system ships with three styles of fused silica sample vessels and the sample vessel holders required to use them. The three sample vessels provided are the large, small, and micro sizes. Each sample vessel has an associated maximum vessel pathlength and volume requirements based upon its geometry. Figure 9 provides information to help users choose the appropriate vessel for their application. Repligen does not recommend reuse of sample vessels. If you do wish to reuse a sample vessel, please follow the steps for proper cleaning listed in *CTech SoloVPE Best Practices* DOC0153.



3.6.2 Standard Vessel Data

Table 1. Table of recommended volumes of standard vessels

Vessel Size	Concentration Range	Sample Type	Volume
Micro Max pathlength 5 mm	0.1 mg/ml to 330 mg/ml	Antibody/Protein	60 µl
Small Max pathlength 5 mm	0.1 mg/ml to 330 mg/ml	Antibody/Protein	120 µl
Large Max pathlength 15 mm	0.1 mg/ml or less*	Antibody/Protein	2.5 ml

*The volumes listed cover the maximum pathlength of the vessel. Large vessels are typically used to measure dilute samples of 0.1 mg/ml or less.

Each sample vessel must be used with the correct sample vessel holder. The holder securely positions the sample vessel properly in the SoloVPE System for measurement. The large and small/micro Vessel Holders are included with every new SoloVPE System sold.

3.6.3 Plastic Sample Vessels

In addition to the fused silica vessels, Repligen's Analytics business unit provides OC0009-1 small disposable UV-grade plastic vessels.

Plastic vessels can be used across a broad wavelength range (220 nm to 800 nm) while providing excellent resistance to a wide variety of chemical species. The UV plastic vessel fits into the existing micro/small Vessel Holder and the volume requirements are the same as the small fused silica vessel. Samples can also be retrieved prior to disposing of vessel, if desired.

Table 2. Plastic vessel physical properties

Required Volume at Max Pathlength (5 mm)	Pathlength Range	Shelf Life	Wavelength Range
120 µm	0.005 mm–5.0 mm	18 months	120 µm

3.7 How to Handle Hardware and Maintenance

The following section contains excerpts from *CTech SoloVPE Best Practices* DOC0153 for basic System scheduled maintenance.

System Maintenance Checklist				
	Daily	Weekly	Monthly	Biannually
Quick Check Test	✓	✓	✓	✓
Clean Fibrette® Optical Components & Fused Silica Vessels	✓	✓	✓	✓
Clean Delivery Fiber		✓	✓	✓

Restart Cary Spectrophotometer		✓	✓	✓
Run Standard Test			✓	✓
Coupler Check (V3/ViPER® only)			✓	✓
Biannual System PM (CT)				✓

System Maintenance Guidelines

Quick Check Test	Cleaning Delivery Fiber (SoloVPE Instrument)
------------------	--

Perform with a new Fibrette Optical Component.
V2 Passing Criteria: %T at 35.00% or greater.
V3/ViPER Passing Criteria: %T at 70.00% or greater.

Fibrette Optical Components (only if cleaning)

After each use of a Fibrette Optical Component, store in distilled water in a small beaker or neoprene tube to keep them wet (minimum 30 minutes). Fibrette Optical Components are not to be stored in water for longer than one day.

Note: Do not soak too many Fibrette Optical Components in a container, otherwise they will clump together.

- At the end of the day, pour out water and fill tube with IPA, Methanol, or Ethanol, and let is soak for 2–5 minutes.
- Pour out solution and lay Fibrette Optical Components out on paper towel to dry.
- Wipe entire length of Fibrette Optical Component with a lint-free wipe then spin **both** ends on a folded lint-free wipe.
- Place the Fibrette Optical Component back in the clean tube for future use.

Fused Silica Sample Vessels

Clean after each use. Follow current procedures for fused silica vessel cleaning. Water rinse followed by cleaning agent (IPA, Methanol, or Ethanol). Rinse, then air dry or spray with compressed air.

Cary Spectrophotometer

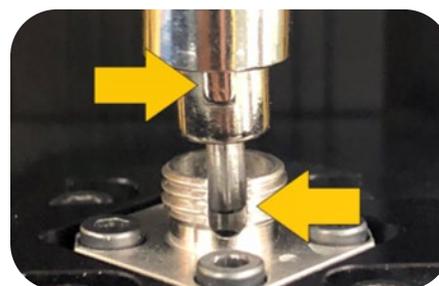
Restart the Cary once a week. This is recommended by Repligen for consistent performance.

Coupler Check (V3 only)

Run a Coupler Check after cleaning Delivery Fiber.

See corresponding section in the *SoloVPE User Manual* for cleaning of Delivery Fiber surfaces.

- Disconnect Delivery Fiber from SoloVPE instrument by turning the nut counterclockwise.
- Fold a lint-free wipe and firmly wipe the fiber connector surface in one direction a 3–5 times.
- Use compressed air over connector surface (optional).
- Reconnect Delivery Fiber, making sure the notch is properly positioned in the fiber platform, and tighten the nut by turning clockwise.



- With no vessel and no vessel holder installed, blow compressed air across the Detector Window in the sample platform. Clean with a lint-free wipe if necessary.

Cary Spectrophotometer	Run System Suitability Standard Test
------------------------	--------------------------------------

Run provided CHEM013 standard, ConfIRM®, or the current UV standard (e.g., NIST reference standard).

Coupler Check (V3 only)	Annual System PM & Service Contract
-------------------------	-------------------------------------

Both services provided by Repligen.

4. Performing Transmission Tests

4.1 The Coupler Check Test

The Coupler Check test conducts a transmission check using the Transmission Tool. The Coupler Check test establishes a baseline transmission reading for the SoloVPE System. This will also measure the maximum transmission of the system. Quick Check then takes a transmission reading and compares it with the Coupler Check results. The output displayed in the Quick Check window is the percentage transmission achieved using Coupler Check as the baseline. Users can confidently determine that their system is receiving acceptable overall transmission.

4.1.1 Run a Coupler Check Test

This procedure describes how to perform a Coupler Check using the Validation Check application.

1. Press the Coupler Check button on the Instrument Control panel in the Validation Check app, as seen in Figure 15.

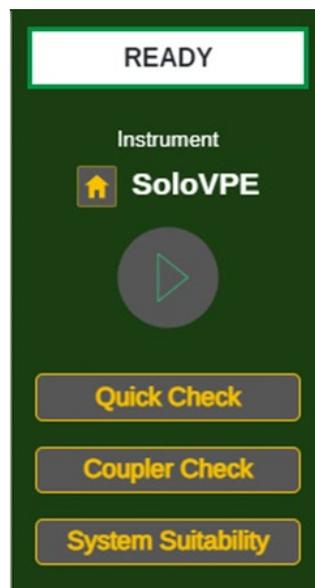


Figure 15. Validation Check App: Instrument Control panel.

2. Press the Coupler Check button to baseline the Quick Check. A prompt will appear with instructions (see Figure 16).

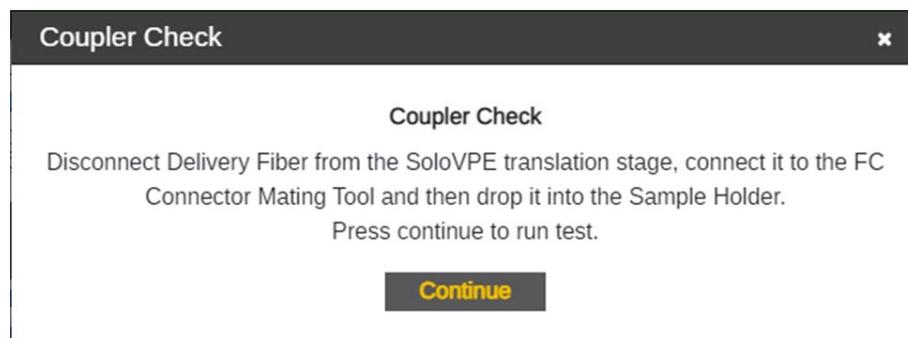


Figure 16. Coupler Check window prompt.

3. Follow the prompt to remove the Delivery Fiber from the Translation Stage by turning the FC connector end of the Delivery Fiber counter-clockwise (see Figure 17). Attach the FC end of the Delivery Fiber to the Transmission Tool and place both connected devices on top of the SoloVPE Detector Window. Be sure to align the notch on the Delivery Fiber to the keyway on the Transmission Tool (refer to Figures 18 and 19).

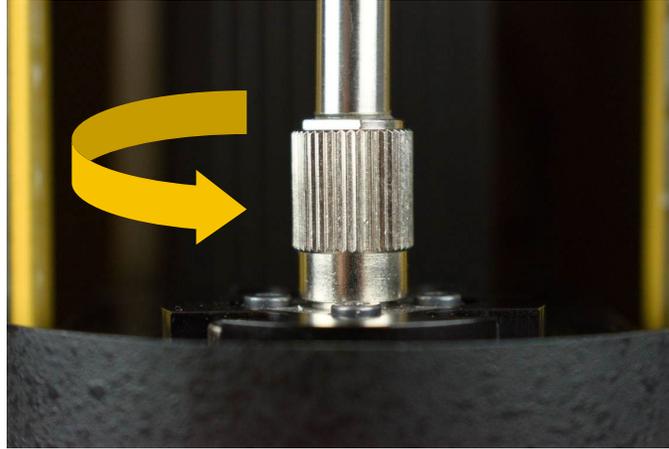


Figure 17. Disconnect Delivery Fiber from Translation Stage.

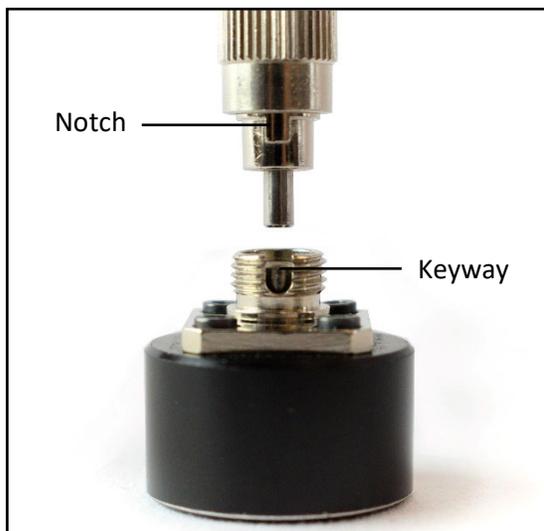


Figure 18. Connect Delivery Fiber to Transmission Tool.

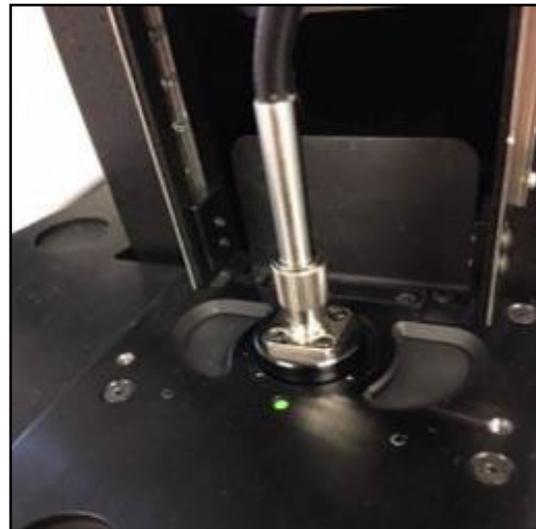


Figure 19. Connect Transmission Tool to Translation Stage.

4. Press Continue on the prompt window when ready. The Coupler Check will then be performed.
5. Once completed, the results are displayed in the prompt window. User may add comments to be added to the Validation Check Log.
6. The system will assess a change threshold check to determine if the system requires cleaning. This setting is configured within the App Configuration tab of Admin Settings. The default is set to 15.00%.

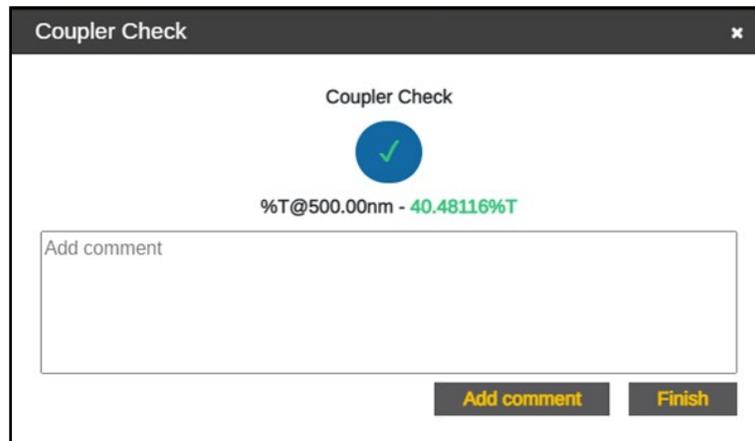


Figure 20. Coupler Check window with Coupler Check results.

- If the Coupler Check fails and returns a result that surpasses the threshold, a prompt recommending a system clean will appear. Perform the Daily and Weekly Maintenance Best Practices and retry the Coupler Check once completed.
7. Remove the Delivery Fiber from the SoloVPE device and detach the Fiber from the Transmission Tool.
 8. Reinsert the Delivery Fiber through the top of the SoloVPE device via the Strain Relief and reattach it to the SoloVPE Translation Stage connection by aligning the notch into the keyway and rotating the FC connector end clockwise (see the image below).

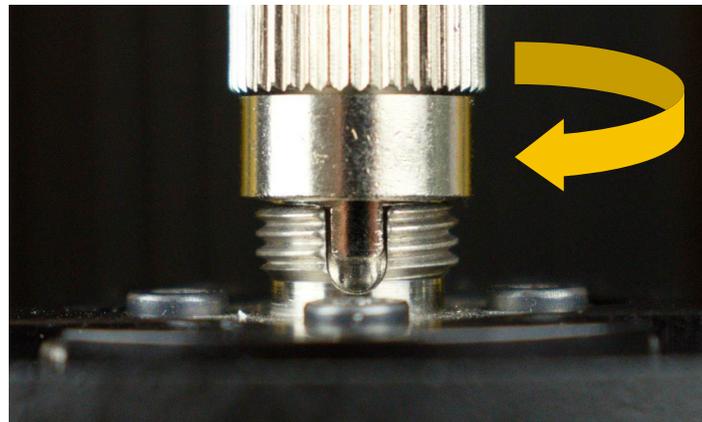


Figure 21. Reconnect Delivery Fiber to Translation Stage.

4.1.2 Run a Quick Check Test

1. Click the Quick Check button on the Instrument Control panel in the Validation Check app.
2. Quick Check will present a prompt instructing the user on how to prepare the Fibrette Optical Component and SoloVPE System for the test (see Figure 22). It is critical that the test is run under the following conditions:
 - A clean, new Fibrette Optical Component should be pushed fully upward until it stops. Do not pull down.
 - The SoloVPE Detector Window should not have a sample vessel or sample vessel holder in place.
 - The SoloVPE cover should be in the down position.

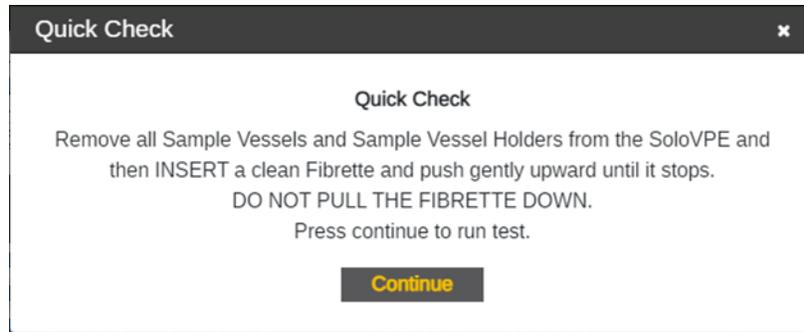


Figure 22. Prepare for Quick Check window prompt and requirements.

3. Once the Fibrette Optical Component and SoloVPE System are prepared as described, click the Continue button to run the test.
 - Quick Check will automatically move the Fibrette Optical Component to make transmission measurements.
4. Once completed, the results will display the disposition of the SoloVPE System, which can be Fail or Pass (see Figures 23 and 24). The user may add comments that will be recorded in the Validation Check Log.
 - A passing result means the system observed a transmission of 70.00% or greater at 500.00 nm. This number is derived from the baseline transmission using the Coupler Check.
 - A failed result means transmission is too low for most measurements, either through particulates, debris, or blockage in or in front of the optical path. Perform the Daily and Weekly Maintenance Best Practices and retry the Quick Check once completed.
 - The Pass/Fail criteria and the Disposition Value (Pass/Fail) can be revised in the App Configuration tab in Admin Settings. Repligen recommends keeping this value at 70.00% for 500.00 nm..

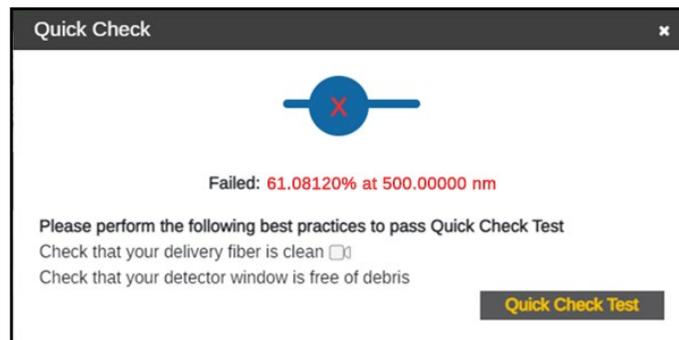


Figure 23. Failed Quick Check.

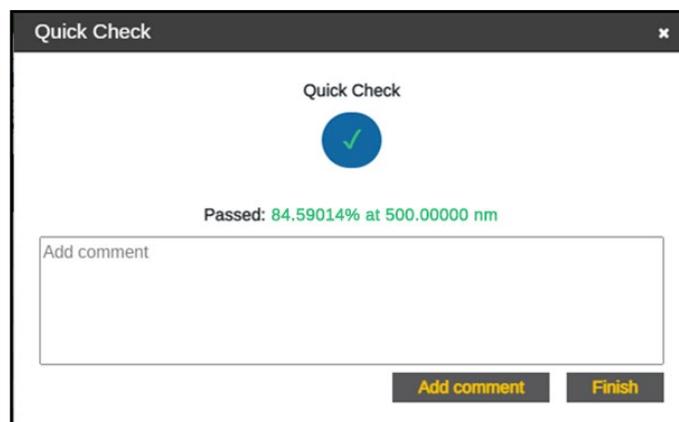


Figure 24. Passed Quick Check.

5. View your results in the Validation Check Log to see more details about the Quick Check results.
 - Filter Type allows the user to sort the results between All Types, Coupler Check, and Quick Check.
 - Users can define specific dates and times to find results. Press Apply after selecting the range of dates and times to see the search result.
6. Press Done to close the Quick Check window.

5. General Troubleshooting

The SoloVPE System is a robust and powerful system. Understanding its behavior is critical to getting the maximum results from it. This chapter describes possible unexpected performance of the system, what causes these conditions, and how to resolve the issue.

Table 3. General troubleshooting issues and suggested actions

Issue	Cause	Action
Cary 60 Indicator Lamp Not Lit	<ul style="list-style-type: none"> • The Cary 60 instrument is powered off. • Power is not reaching the Cary 60. • The Cary 60 is not plugged into a power outlet. 	<ul style="list-style-type: none"> • Confirm if instrument power is turned on. If not, press the power button located in the front of the unit to turn it on. • Check to make sure the power cable is securely connected to the Cary 60 and power outlet.
Low Transmission (Failing Quick Check Test)	<ul style="list-style-type: none"> • Possible contamination in the optical path reduces the amount of light available to make measurements. 	<ul style="list-style-type: none"> • Check transmission using the Quick Check Test to verify the functionality of the system. • Systematically cleaning the Delivery Fiber and SoloVPE Detector Window surfaces will help clear the optical path.
SoloVPE Not Moving	<ul style="list-style-type: none"> • The SoloVPE has no onboard power supply. It draws power through the Accessory Cable that is connected to the Cary 60. • Improper connection to the Cary 60 Accessory Port in the Cary 60 sample compartment. • The Cary 60 is not powered on. • Two-or-more SoloVPE software windows may be open. Only one can be connected to the instrument at one time. 	<ul style="list-style-type: none"> • Check transmission using the Quick Check Test to verify the functionality of the system. • Systematically cleaning the Delivery Fiber and SoloVPE Detector Window surfaces will help clear the optical path.
Cary Displaying Red LED Upon Start-Up	<ul style="list-style-type: none"> • Cary 60 is not properly calibrated. • Light is not being read by the sample and/or reference detector. 	<ul style="list-style-type: none"> • Power down the Cary 60 and restart the instrument. • Make sure Cary 60 is not plugged into an intermittent power supply.
Hockey Stick Shape in Data Plot 	<ul style="list-style-type: none"> • The Fibrette Optical Component is bending in the sample. • Zero position has been changed or modified. • Broken pieces of Fibrette Optical Component are trapped in the Quick Set Coupler. 	<ul style="list-style-type: none"> • Check Zero Position with a large, empty vessel. Check Fibrette Optical Component for tightness by rotating the vessel in the holder. • Inspect Fibrette Coupler for broken pieces of Fibrette Optical Component, and clean or replace Fibrette Coupler if needed. Retest with a new aliquot to see if the hockey stick is present.

Inconsistent Measurement Reading	<ul style="list-style-type: none"> • Cary 60 is not properly calibrated. • Dirty vessel and/or Fibrette Optical Component. • The optical pathway is obstructed. 	<ul style="list-style-type: none"> • Restart the Cary 60 for self-calibration by turning the instrument off and then on. • Clean the Delivery Fiber. • Clean Fibrette Optical Component and sample vessel, or use a new Fibrette Optical Component and vessel. • Make sure the optical path is clean and that dust particles or debris are not present in sample compartment.
Plateau in Section Curve Upper End (Similar Abs Values at Long Pathlengths) 	<ul style="list-style-type: none"> • Insufficient sample volume to cover pathlength range specified. • Fibrette Optical Component came out of the sample and resulted in a plateau in the pathlength cross-sectional curve. 	<ul style="list-style-type: none"> • Add more sample volume to the sample vessel and repeat the test. Refer to Appendix 1: Sample Volume Help Sheet for additional guidance.
Plateau in Section Curve Lower End (Similar Abs Values at Small Pathlengths)	<ul style="list-style-type: none"> • Sample vessel or Sample Vessel Holder not properly installed/seated in the sample platform. • Incorrect sample vessel selected in the software. 	<ul style="list-style-type: none"> • Reseat the sample vessel and Sample Vessel Holder. • Confirm the correct sample vessel was selected in the software.
No Transmission	<ul style="list-style-type: none"> • SoloVPE Detector Cable unplugged. • Possible broken Delivery Fiber. • Obstruction in the optical path. 	<ul style="list-style-type: none"> • Check to make sure the SoloVPE Detector Cable is properly connected between the Detector Port on the SoloVPE and the Detector Port inside the Cary 60 sample compartment. • Disconnect both ends of the Delivery Fiber and hold it up to the light to make sure there is not a break. If broken, contact Repligen's Analytics Support. The light should be visible through the fiber. • Ensure that the Fiber Optic Coupler is set in the proper position.
Noisy Spectra	<ul style="list-style-type: none"> • Poor optical alignment. • Obstructed optical path. • Cover not lowered into data collection position. • FC connector of the Delivery Fiber not fully secured. 	<ul style="list-style-type: none"> • Confirm that the cover is slid into the down position prior to measurement. • Clean the optical path. • Restart Cary 60. • Check and secure the FC connector of the Delivery Fiber on the SoloVPE Translation Stage.
Unable to Access SoloVPE Software (Error Alerts)	<ul style="list-style-type: none"> • Permissions may not be set properly after a computer was connected to a network. 	<ul style="list-style-type: none"> • SoloVPE software uses Windows active directory for permission—confirm that the user has proper permission to access software according to VPE Software: SoloVPE Software V3 Security Configuration KB16008.
No Light Coming from Cary 60	<ul style="list-style-type: none"> • Cary 60 or Fiber Optic Coupler could be misaligned. • Xenon flash lamp could need replacing. 	<ul style="list-style-type: none"> • Perform a Coupler Check (see Section 5.3.14). Follow the No Transmission Actions. Then, if results are still Zero, please contact Repligen.

Random Spikes in Spectra

- Cary 60 is not calibrated properly.
- SoloVPE detector is malfunctioning and could need replacing.
- Xenon flash lamp could need replacing.
- Restart Cary 60.
- Run CHEM013 standard to verify the accuracy of the SoloVPE Detector.
- If you suspect the Xenon flash lamp needs replacing, contact Repligen.

For additional assistance, please call VPT Support at (908) 707-1201 or email analytics-support@repligen.com

Appendix 1 | Sample Volume Help Sheet

When using the variable pathlength technology of the SoloVPE System, it is always important to make sure that enough sample volume has been dispensed to cover the range of pathlengths to be measured. Use the following suggestions and the volume matrix provided in Table 4 to help guarantee adequate sample volume is available for the desired measurement pathlengths.

For estimated volumes for use in concentration determination, please reference Section 3.7 or view *CTech SoloVPE Best Practices* DOC0153.

Tip: When using the Quick Tools such as Quick Slope and Quick Survey, it is always preferable to use the maximum volume allowed by the sample vessel being used.

Table 4. Sample volume matrix.

Vessel	Vessel Name	Pathlength (mm)	Minimum Volume (ml)
	Micro Vessel	0.1	0.010
		0.2	0.010
		0.5	0.010
		1.0	0.013
		2.0	0.025
		5.0	0.062*
	Small Vessel	0.1	0.010
		0.2	0.010
		0.5	0.012
		1.0	0.025
		2.0	0.050
		5.0	0.125*
	Large Vessel	0.1	0.016
		0.5	0.080
		1.0	0.160
		2.0	0.320
		5.0	0.800
		10.0	1.600
		12.5	2.100
		15.0	2.400*
	Plastic Vessel	0.1	0.010
		0.2	0.010
		0.5	0.012
		1.0	0.024
		2.0	0.048
		5.0	0.063*

Appendix 2 | The Derivation of the Slope Spectroscopy Equation

The SoloVPE System is the enabling technology for Slope Spectroscopy methods. The Slope Spectroscopy equation is derived from the Beer-Lambert law. The standard equation of a line is as follows:

Equation	Definitions
$A = \epsilon lc$ Beer-Lambert Law	Where: A is the absorbance of the sample. ϵ is the absorption coefficient or the molar absorptivity of the absorber. l is the distance that the light travels through the material (the pathlength). c is the concentration of absorbing species in the material.
$y = mx + b$ Linear Equation	Where: y is the predicted value of the dependent variable/axis. m is the slope of the line. x is the given variable. b is the y-intercept of the line.

Derivation and Version of the Slope Spectroscopy Equation:

$$A = \epsilon lc$$

$$\frac{A}{l} = \epsilon c$$

We know $\frac{A}{l} = m$ therefore, $m = \epsilon c$

and $c = \frac{m}{\epsilon}$ $\epsilon = \frac{m}{c}$

Appendix 3 | SoloVPE Pathlength Defined

To clearly show how the pathlength is defined, Figure 25 shows a SoloVPE sample vessel and Fibrette Optical Component as they are used in the SoloVPE System. The pathlength is defined by the tip of the Fibrette Optical Component and the bottom of the sample vessel.

By dynamically changing this gap, the SoloVPE System can produce thousands of different pathlengths for measurement.

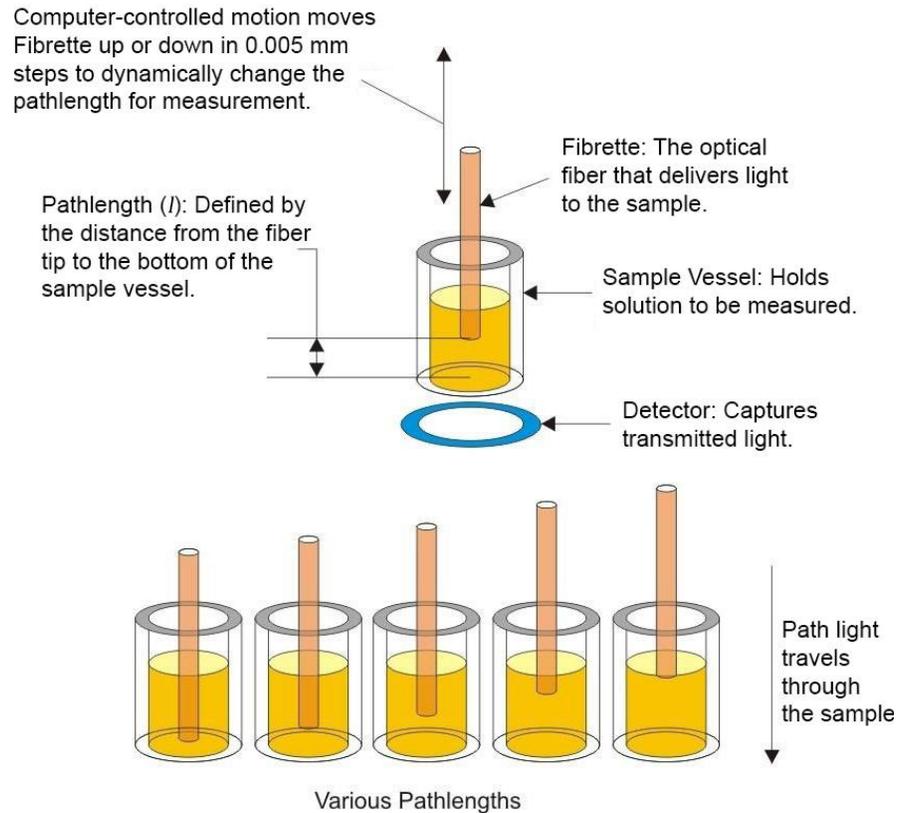


Figure 25. SoloVPE pathlength geometry.

Glossary

There are many terms, definitions, and naming conventions associated with your SoloVPE System that are helpful to know and understand. This section of the manual provides an overview of these concepts and serves as a quick reference.

This glossary contains content developed by Repligen subject-matter experts or retrieved (whole or in part) from the American Society for Quality glossary, the International Accreditation Forum website, and *Spectroscopy* magazine's "The Molecular Spectroscopy Terminology Guide" online.

Averaging Time: The Cary Spectrophotometer setting that configures how long the system will collect data at each wavelength. Able to be configured in seconds, this number corresponds to many pulses of the Xenon flash lamp. One pulse corresponds to 1/80th of a second or 0.0125 seconds; therefore, each second is 80 pulses of the lamp.

Beer-Lambert Law: The law of physics that describes the proportional relationship between absorbance, pathlength, and concentration.

Delivery Fiber: The fiber-optic cable that carries light from the Cary spectrophotometer to the variable pathlength device.

Detector: A device used to detect light being transmitted through the sample.

Detector Cable: This component sends absorbance information from the VPT instrument to the Cary 60 to be analyzed and displayed for the user.

Detector Window: The transparent, protective cover of the VPT instrument's Detector.

Extinction Coefficient (EC): An intrinsic property of a substance, described by a numerical value that quantifies the propensity of a substance to absorb electromagnetic radiation at a specific wavelength. It is one of the terms used in Beer-Lambert law (ϵ).

Fibrette Optical Component: The component of the SoloVPE system that delivers the light from the Delivery Fiber to the sample. It allows the measurement pathlength to be changed based upon its vertical motion within the sample.

Fixed Zero: The position the system drives down to prepare the SoloVPE and Fibrette Optical Component for data acquisition. When in this position, the Fibrette tip is in contact with the bottom of the sample vessel. All pathlength parameters and motion are referenced from this position, which corresponds to a pathlength of zero millimeters. Also referred to as Zero Position and Zero Pathlength.

Home Position: This is the fully raised position of the SoloVPE System. This allows maximum access to the sample vessel, sample vessel holder, and the Fibrette Coupler. It is the position the SoloVPE needs to be in for loading and unloading of Fibrette Optical Component and Fibrette Couplers for the SoloVPE System.

Insert Holder: The component of the SoloVPE that holds the Quick Set Fibrette Coupler Insert, connecting it to the Translation Stage.

Pathlength: The distance the measured light travels through the sample when making absorbance spectroscopy measurements based upon the Beer-Lambert law. In the variable pathlength system, this distance, generally expressed in millimeters, is defined by the physical gap between the bottom of the sample vessel containing the solution and the tip of the Fibrette Optical Component that is submerged in the sample.

Quick Set Fibrette Coupler: The current Fibrette Coupler design. Comprising the stainless-steel Insert and the black-plastic Insert Holder, it allows consistent positioning of the Fibrette Optical Component.

Quick Set Fibrette Coupler Insert: The stainless steel Fibrette holder. A replaceable, disposable part to be used with the Quick Set Fibrette Coupler.

Sample Vessel: The component of the SoloVPE system that holds the sample to be measured. There are different sizes (volumes) of sample vessels and materials (fused silica and UV plastic).

Sample Vessel Holder: The component of the SoloVPE system that properly secures the sample vessel in the instrument in preparation for measurement. Sample vessel holders come in different configurations to match the style of sample vessel being used (micro/small and large).

Slope Spectroscopy: An analytical technique based upon the Beer-Lambert law, which utilizes the slope term of a statistically analyzed absorbance vs. pathlength plot to make calculations and predictions of sample properties.

Solo Validation Cuvette Adapter: The SVCA is an optional accessory that provides an additional technique for validating the SoloVPE device and specifically allows the use of filters and standards based on a cuvette form factor.

SoloVPE (Variable Pathlength Extension): The variable pathlength instrument that enables Slope Spectroscopy measurement methods.

TBA Fibrette Coupler: The older version of the Fibrette Coupler, which requires a manual pulldown to create the offset for the Zero Position.

Threshold: A user-specified limit specified in absorbance units (Au) that the SoloVPE system will scan the pathlength range to find, if possible.

Zero Pathlength: The position the system drives down to to prepare the SoloVPE and Fibrette Optical Component for data acquisition. When in this position, the Fibrette tip is in contact with the bottom of the sample vessel. All pathlength parameters and motions are referenced from this position, which corresponds to a pathlength of zero millimeters. Also referred to as Zero Position and Fixed Zero.

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