Open Platform System (OPS) User Guide

Fluorescence, Reflectance, Absorbance and Transmission

Build the configuration that works best for you now, change it easily later.

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Identifying Parts

Figure 1. Open Platform parts identification (spectrometer and accessories are sold separately).

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Setting up the Open Platform System

The Open Platform System (OPS) allows multiple configurations:

- You can choose the spectrometer depending on the requirements of your work. All Flame-sized or larger Ocean Optics spectrometers work with the Wilson OPS. They are available for purchase through Wilson Analytical, or existing Ocean Optics units can be easily installed in the system.
- For guidance in choosing a suitable spectrometer refer to the following link to Ocean Optics "Interactive Product Search", which provides advice on selecting the spectrometer best suited to your needs: http://oceanoptics.com/product-category/modular-spectrometers/
- Other brands of small spectrometers may work, please contact us for further information. Spectrometer slide mounts and customer interface cables are available for all compatible systems.
- Note that the spectrometer must have an Ocean Optics #74-DA collimating lens attached to the fiber optic input port of the spectrometer for the system to work efficiently.
- You can choose the angle between the spectrometer and the light source (180° for absorbance and transmission work or 90° for fluorescence and reflectance work).
- You can choose the sample holder (cuvette holder for liquids or solid sampler for solids).
- For fluorescence work, you can choose the light source wavelength (based on the excitation profile of the sample).
- For fluorescence work, you can choose the spectrometer lens filter (based on the emission profile of the sample).
- For absorbance, transmission, or reflectance work, you can choose the light source (tungsten-halogen incandescent or white-light LED, depending on the requirements of your work).

Attaching the Cuvette Holder

1) First make sure that the light source and the spectrometer are pulled back from their operating positions. To move them back, loosen the brass thumbscrews on the mounts for the light source and the spectrometer and slide the units away from the sample holder.

2) Align the cuvette holder bottom with the corresponding cut-out in the baseplate of the OPS (see Figure 1), and then gently press the holder into place. The holder is designed to fit into the baseplate in only one orientation (see Figure 2).

3) Attach the cuvette holder to the baseplate of the OPS using the cuvette holder screws (stainless steel screws with hex socket caps). The short hole requires a 1/4” long #8-32 screw, whereas the long hole requires a 3/8” long #8-32 screw (both provided). Gently tighten both screws using the ball-shaped end of the 9/64” Allen key (provided).

4) Attach the interlock cable of the cuvette holder to the interlock cable socket in the control box. The interlock cable attaches to the socket with a headphone-jack connector.

5) Cover the unused port on the cuvette holder with the port cap (see Figure 3). This cap ensures that no light will enter from the unused port to interfere with the measurement. When running in fluorescence or reflectance mode (90° orientation), cover the port that is 180° from the light source. When running in absorbance or transmittance mode (180° orientation), cover the port that is 90° from the light source.

Figure 2. Overview of the OPS showing the cuvette holder positioning and the interlock cable connection to the control box. The 365 nm light source and the Flame spectrometer are mounted at a 90° angle.

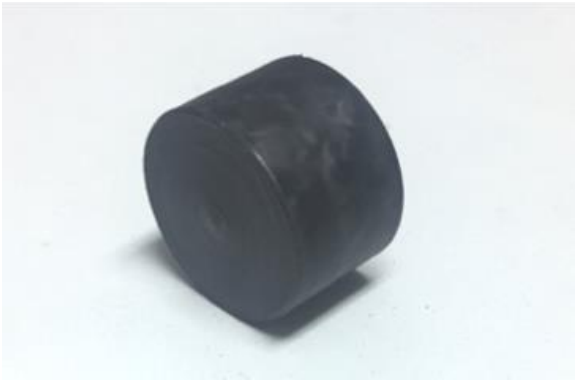


Figure 3. The port cap for the cuvette holder.

Attaching the Solid Sampler

1) First make sure that the light source and the spectrometer are pulled back from their operating positions. To move them back, loosen the brass thumb screws on the mounts for the light source and the spectrometer and slide the units away from the sample holder.

2) Place the two solid sampler mounting screws (1/4” long stainless steel #8-32 screws with hex socket caps; provided) into the holes in the base of the solid sampler. If you do this before placing the solid sampler on the OPS baseplate, it will be easier to mount the solid sampler.

3) Align the bottom of the solid sampler with the corresponding cut-out in the baseplate of the OPS (see Figure 1), and then gently press the sampler into place. The solid sampler is designed to fit into the baseplate in only one orientation.

4) Attach the solid sampler to the baseplate of the OPS with the two mounting screws. Gently tighten the screws using the ball-shaped end of the 9/64” Allen key (provided). If you use the Allen key at an angle, you will be able to access each mounting screw more easily.

5) Attach the interlock cable from the solid sampler to the interlock socket in the control box. The interlock cable attaches to the socket with a headphone-jack connector (see Figure 4).

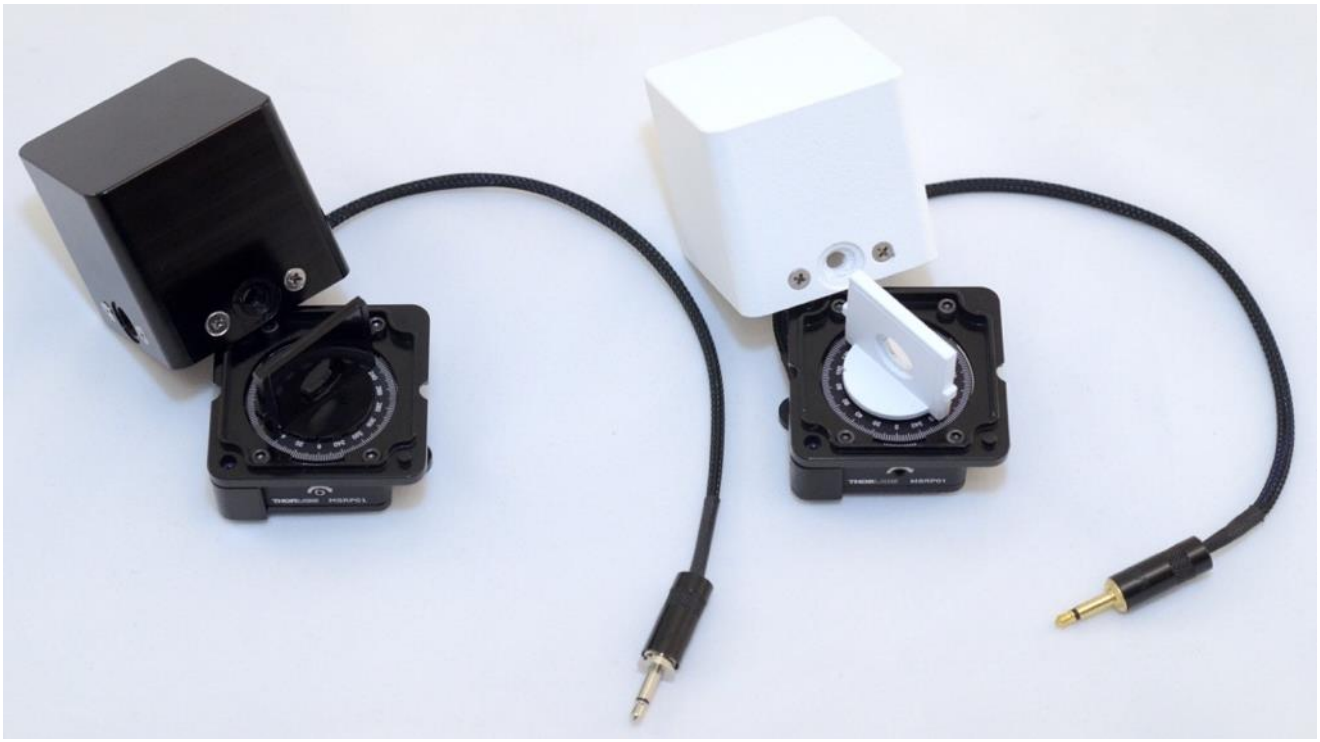


Figure 4. Two solid samplers with interlock cables terminating in headphone-jack connectors. They have been opened to show the lids, the rotation bases, and the sample holders for 13 mm disks.

6) Position the solid sampler lid on top of the base so that the small setscrew protruding from the bottom of the lid pushes down on the recessed rubber pad in the base (see Figure 5). This rubber pad contains a microswitch that turns off the OPS safety interlock system. (This safety system prevents the light source from turning on when the solid sampler is open.) The interlock indicator light on the control box will be green when the lid is correctly in place and red when it is not.

7) If the light source is too bright for your work, attach a light attenuator disk to a mounting clip inside the lid of the solid sampler. The solid sampler comes with several light attenuators (see Figure 6) that can change the amount of light entering or exiting the solid sampler (see Table 1).

8) Cover the unused opening on the solid sampler using the Disk A light attenuator (solid disk; see Figure 6). This disk ensures that no light will enter from the unused opening to interfere with your measurement. When running in fluorescence or reflectance mode (90° orientation), cover the opening that is 180° from the light source. When running in absorbance or transmittance mode (180° orientation), cover the opening that is 90° from the light source.

Figure 5. The location of the rubber pad (with the embedded interlock microswitch) in the base of the solid sampler.

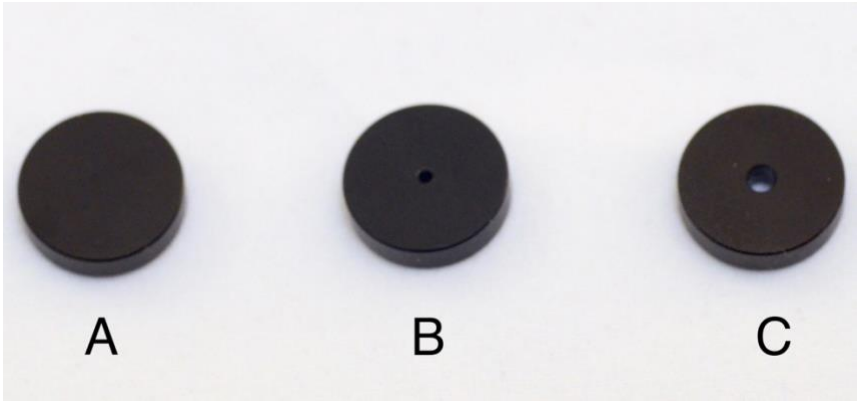


Figure 6. Light attenuators for the solid sampler. Disk A is solid, Disk B has a small hole, and Disk C has a large hole.

Table 1. Attenuators for varying the transmission of light in the solid sampler.

Transmission of light	Attenuator
None	Disk A - no hole (solid disk)
Low	Disk B - small hole
High	Disk C - large hole
Maximum	None (no disk mounted)

Attaching the Light Source

1) Ensure that the thumbscrew on the light source faces the outside edge of the OPS, and ensure that this thumbscrew is fully raised. The thumbscrew should not touch the bottom of the slot when sliding the light source into place (see Figures 1 and 2).

2) Insert the light source slide into the slot marked (LS) on the OPS baseplate. The dovetail on the light source slide fits into the dovetail slot of the OPS baseplate.

3) Slide the light source as far forward as it can go, so that the light output hole touches the sample holder port.

4) Tighten the thumbscrew on the light source slide to lock the light source in place.

5) Connect the DB15 connector on the control box to the output port on the back of the light source using the light source cable (provided). Make sure the cable is firmly attached at both ends (see Figure 7).

Figure 7. The cable connection between the control box (left) and the light source (right).Note that the thumbscrew on the light source slide faces the outside edge of the OPS base plate.

Attaching the Spectrometer

1) Choose a spectrometer that will be suitable for your work.

2) Remove the rubber feet from the bottom of the spectrometer (if any are present).

3) Attach the spectrometer to the correct slide (supplied). Note that various spectrometers use slides of different sizes. The locations of the attachment holes in the spectrometers also differ. See the Appendix (Table 6) for a list of spectrometers, the correct slides for each one, and how to attach them together.

4) For fluorescence mode:

   a) Choose a lens and screw-on optical filter to attach to the spectrometer (see Figures 8 and 9). The filter is used to remove the excitation light before it enters the spectrometer. See the Appendix (Table 3) for the spectrometer optical filters recommended for each light source.

   b) Screw the lens onto the externally threaded fiber optic input port of the spectrometer (the lens is internally threaded) until it is finger tight.

   c) Once the lens is attached, screw the filter mount onto the external thread of the lens. Tighten it very gently: the connection does not need to be tight. Overtightening will make it difficult to separate the lens from the filter mount later.

5) For all other measurement modes (absorbance, transmission, or reflection):

   a) Choose a lens to attach to the spectrometer (see Figures 8 and 9).

   b) Screw the lens onto the externally threaded fiber optic input port of the spectrometer (the lens is internally threaded) until it is finger tight.

   c) Once the lens is attached, screw the filter mount onto the external thread of the lens. Tighten it very gently: the connection does not need to be tight. Overtightening will make it difficult to separate the lens from the filter mount later.

   d) Leave the filter holder empty for the initial work, as no optical filter is required to run these experiments. However, if the light source is so intense that it causes the spectrometer detector to go off-scale, then an attenuator disk (see Figure 6) and/or a neutral density filter can be placed in the filter holder as needed to reduce the light level at the detector.

6) Ensure that the thumbscrew on the spectrometer slide faces the outside edge of the OPS, and ensure that this thumbscrew is fully raised. The thumbscrew should not touch the bottom of the slot when sliding the spectrometer into place.

7) For absorbance or transmission mode (see Figure 10), the spectrometer will go in the slot 180° from the light source (marked AB on the OPS baseplate). For fluorescence or reflectance mode, the spectrometer will go in the slot 90° from the light source (marked FL on the OPS baseplate). Insert the spectrometer into the appropriate slot. The dovetail on the spectrometer slide fits into the dovetail slot of the OPS baseplate.

Figure 8. Filter holder and lens mounted on a USB4000 spectrometer.

Figure 9. Expanded view showing spectrometer filter holder parts and a lens.

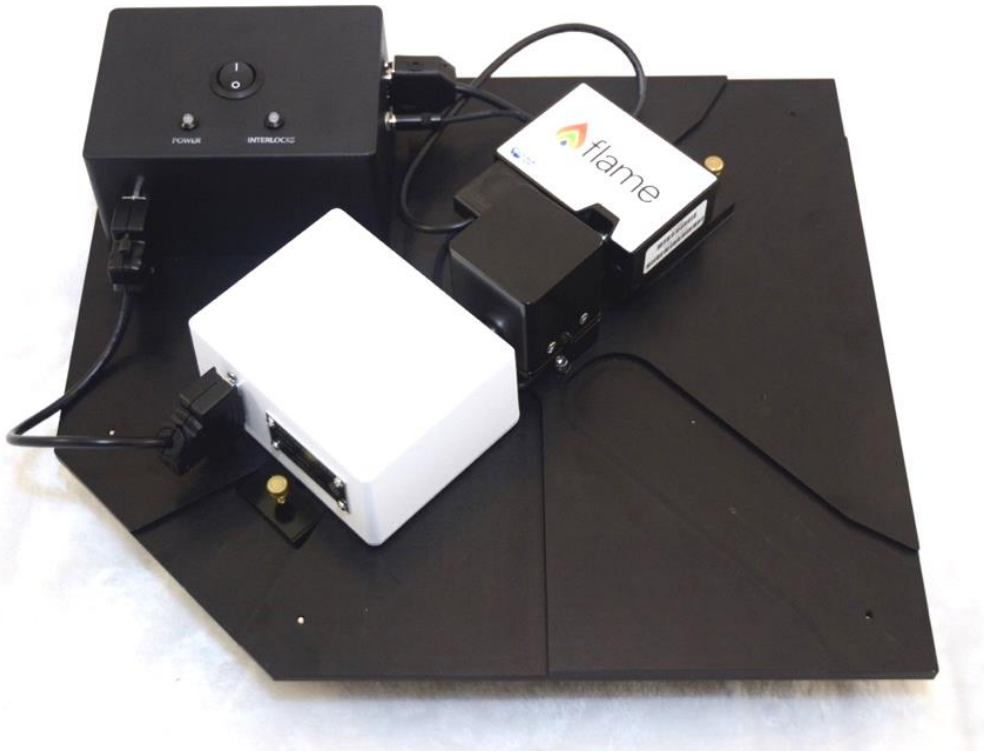


Figure 10. The solid sampler in absorbance mode. Note the 180° geometry between the light source and spectrometer.

8) Slide the spectrometer as far forward as it can go, so that the spectrometer lens assembly touches the sample holder port.

9) Tighten the thumb screw on the spectrometer slide to lock the spectrometer into place.

10) Select the correct control cable (supplied) for the spectrometer you are using and attach it to the spectrometer. The connector location will be on the front of the spectrometer near the lens.

11) Attach the other end of the spectrometer control cable to the DB9 connection on the side of the control box (see Figure 11).

12) Attach the USB computer connection cable to the spectrometer. Note that the type of USB cable used varies depending on the spectrometer. See the Appendix (Table 4) for a full list.

Figure 11. The cable connection from the spectrometer to the DB9 connector on the control box.

Figure 12. A completed setup of the OPS in fluorescence mode. Note the connections of the parts via the supplied cables.

Powering On the Unit and Connecting It to the Computer

1) Insert the 12 V (round cable) end of the power adapter into the power socket on the back of the control box (see Figure 13). Plug the other end of the power adapter into a power outlet.

Figure 13. The back of the control box. Note the power switch and the LED indicator lights on the top, the DB9 connection on the side, and the power connection on the back.

2) Before starting the OPS, close the hat on top of the cuvette holder or attach the lid of the solid sample holder properly. If this is not done, the Interlock LED will stay red when steps 3) and 4) below have been completed.

3) Turn on the power switch on the top of the control box. After an initial colourful start-up sequence, the Power LED on the top of the box will stay green and the Interlock LED will be yellow.

4) Boot up the computer that will be used to run the spectrometer software. When the Windows operating system is running on the computer, connect the computer end of the USB spectrometer connection cable (provided with the spectrometer) into a free USB port on the computer. When the spectrometer is connected to a running computer, the Interlock LED on the top of the control box will change from yellow to green. If the computer is turned off, the Interlock LED will turn yellow again even if the USB cable remains connected between the computer and the spectrometer. See Table 2 for LED indicator colour combinations under various spectrometer conditions.

Note: If you are using an Ocean Optics QE Pro spectrometer, a yellow Interlock LED light may also indicate that the separate power supply for the QE Pro is not plugged in.

5) Start the spectrometer software. The software should recognize the spectrometer and generate a pane for controlling it. The OPS is now running under computer software control via the spectrometer interface, and two green lights on the top of the control box will indicate that everything has been set up correctly.

Table 2. LED indicator colours for various spectrometer and Ocean Optics software conditions.

Interlock LED	Power LED	Strobe/lamp enabled in software	Light source	Conditions
Yellow	Green	No	Off	The OPS is not ready. The computer is off or the USB cable is not connected.
Red	Green	No	Off	The OPS is not ready. Either the cuvette holder hat is open or the solid sampler lid is off.
Green	Green	No	Off	The OPS is ready, but the light source is off. The computer is on, the USB cable is connected, the cuvette holder hat is closed or the solid sampler lid is on and the toggle switch is off.
Green	Blue	Yes	On	The OPS is measuring with the light source on. The computer is on, the USB cable is connected, the cuvette holder hat is closed or the solid sampler lid is on and the toggle switch is off.
Green	Cyan	Yes	On	The OPS is measuring with the light source on. The computer is on, the USB cable is connected, the cuvette holder hat is closed or the solid sampler lid is on and the toggle switch is on.

Operating the Open Platform System

1) The LED-based light sources for the OPS do not require any warm-up time, so the OPS is ready to run samples immediately after start-up.

2) Turn on the LED-based light source by checking the “Strobe/Lamp Enable” box in the Ocean Optics spectrometer software. (Turn it off by unchecking the same box.) The Power LED on the top of the control box will turn blue while the light source is on and will turn green when the light source is off.

3) The LED-based light source can also be turned on by switching the toggle switch to the on position. (Turn it off by pushing the TTL toggle switch to the downward off position.) The power LED on the top of the control box will turn to cyan while the light is on and will turn green when the light source is off. Note that the LED light source requires both the “Strobe/Lamp Enable” button and the TTL toggle switch to be off in order to turn the light source off. Remember when the toggle switch is in upwards position or “ON”, it is manual on and when the toggle switch is in the downward position or “TTL”, it is off.

4) The sample holders for the OPS are interlocked to the LED light sources to prevent the system from running without the cuvette holder hat in the closed position or the solid sampler lid closed properly. If the hat is open or the lid is off, the internal light source will not turn on and the Interlock LED on the top of the control box will turn red (see Figure 14). Closing the hat or putting the lid on will turn the Interlock LED back to green and allow measurements to take place (see Table 2).

Figure 14. Power switch, Power LED, and Interlock LED.
See Table 2 for LED Indicator colours under various spectrometer conditions.

Running Samples Using the Cuvette Holder

1) To run a sample in the cuvette holder, first open the hat (i.e., the lid; see Figure 15). The Interlock LED on the top of the control box will turn red while the hat is open.

2) Insert a 10 mm sample cuvette (containing a transparent liquid sample) into the cuvette holder opening. The cuvette should be at least half full of liquid, because the measurement takes place in the bottom third of the cuvette. Close the hat, which will turn the Interlock LED back to green and allow measurements to take place.

3) Ensure that the port cap of the cuvette holder is in the proper position, so that light from the unused port will not interfere with the measurement. See “Attaching the Cuvette Holder” in this user guide for further details on using the port cap.

4) Use the Ocean Optics spectrometer software on the computer to acquire data on the sample. Check the “Strobe/Lamp Enable” box in the spectrometer software to turn on the Open Platform light source during data collection. The Power LED on the top of the control box will turn blue while the light source is on. The light source is turned off by unchecking the “Strobe/Lamp Enable” box in the spectrometer software. The Power LED on the top of the control box will return to green when the light source is off (see Table 2).

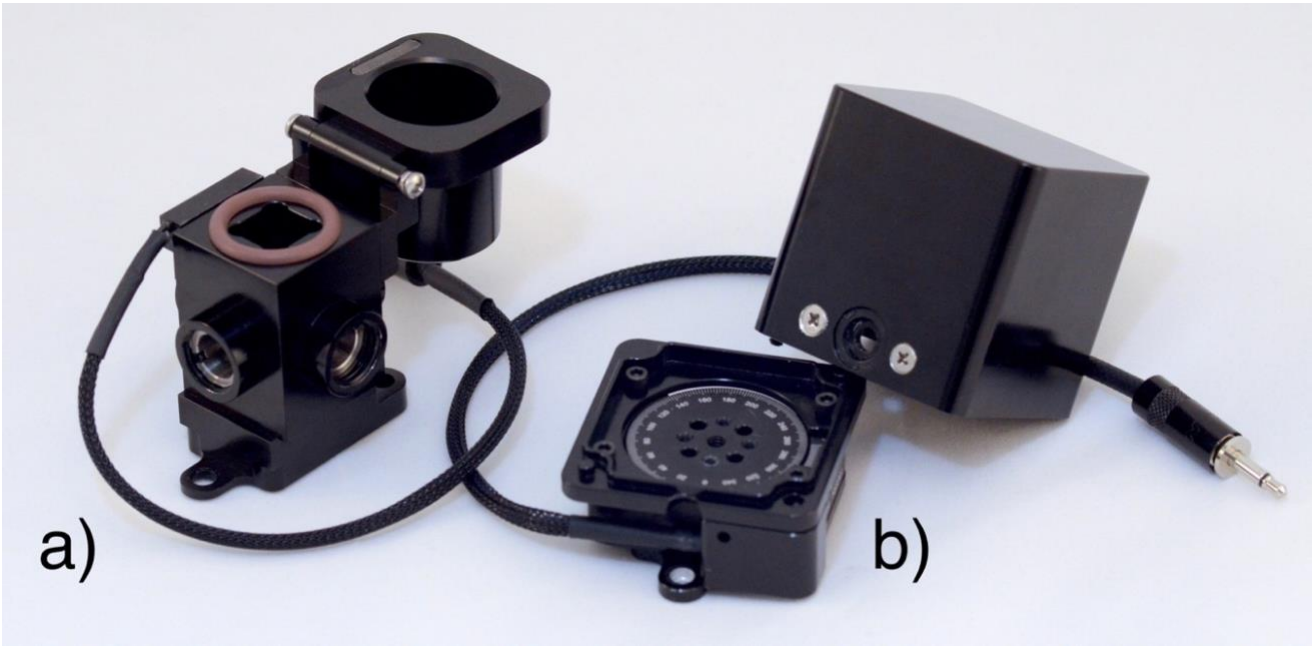


Figure 15. a) The cuvette holder with the hat open.. b) The solid sampler with the lid off. Note the angle-calibrated rotation stage for mounting sample holders in the solid sampler.

Running Samples Using the Solid Sampler

1) To run a sample in the solid sampler, first remove the top (i.e., the lid) of the solid sampler to access the solid sample mount on the rotation stage (see Figures 4 and 15). The Interlock LED on the top of the control box will turn red while the lid is off.

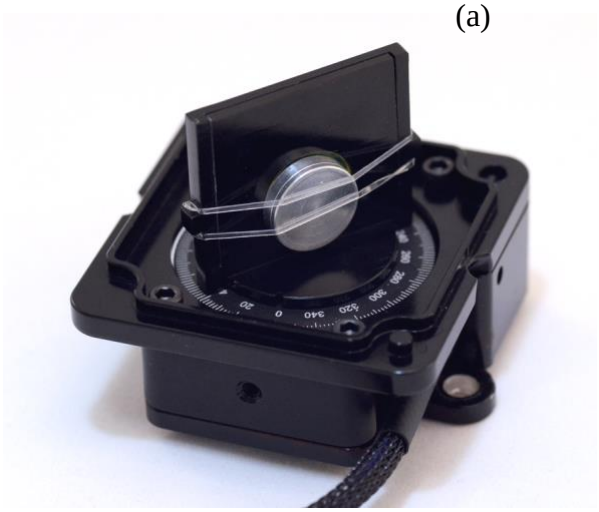
2) Remove the sample mount from the solid sampler rotation stage. The sample mount fits into the stage using the four pegs on the bottom of the mount (see Figures 4 and 15).

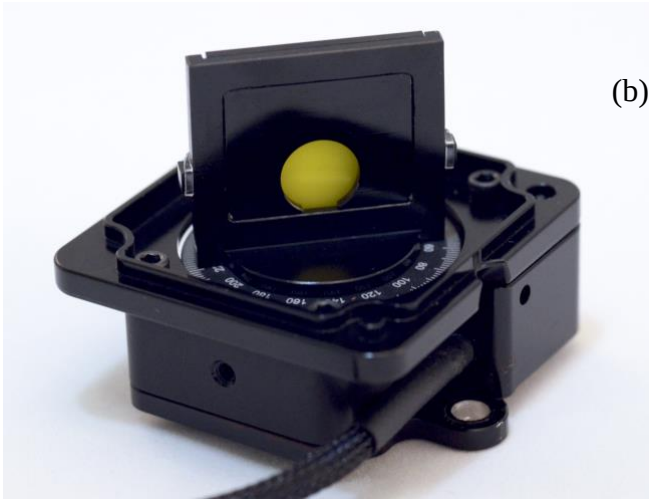
3) The sample mount is designed to accommodate surface samples, pressed pellets, or pastes.

   a) To test sticky powders and pastes, smear the sample onto a blank 13 mm pellet or disk and then place it into the back of the 13 mm recess of the sample mount. Use an elastic band around the back of the sample to hold the sample securely in place (as shown in Figure 16).

   b) To test 13 mm pressed pellets or surface-coated disks, place the sample into the back of the 13 mm recess of the sample mount and secure it with an elastic band (as shown in Figure 16).

(a)





(b)

Figure 16. (a) The back of the Solid Sampler mount with a 13 mm sample disk held in place by an elastic band. (b) Spectra are collected from the front of the sample through the 10 mm aperture in the front of the mount. This holder ensures that the front surface of the sample is always at the same position in the mount. Therefore, the sample always has the same spatial relationship with the light source and the spectrometer.

4) Place the sample mount on to the rotation stage of the solid sampler.

   a) Rotate the stage so that 0° on the rotation stage is aligned with 0° on the base plate. Align the four mounting pins on the bottom of the sample mount with the four holes in the rotation stage. Ensure that the front of the sample is perpendicular to the intersects 135° on the dial (see Figure 17). The sample should now be set at a 45° angle to both the light source and the spectrometer during a 90° geometry measurement.

   b) If a different angle between the sample and the light source is required, the rotation stage of the solid sampler can be set to any angle desired.

Figure 17. Lining up the solid sampler rotation stage to 0° so that the sample mount sits at a 45° angle to both the light source and the spectrometer.

5) Place the lid of the solid sampler back onto the base. Ensure that the setscrew on the lid bottom is pressing into the small rubber microswitch pad in the solid sampler base. If the lid is on correctly, the Interlock LED will turn from red to green (see Figure 5).

6) Use the Ocean Optics spectrometer software on the computer to acquire data on the sample. Check the “Strobe/Lamp Enable” box in the spectrometer software or push the toggle switch to the on position to turn on the OPS light source during data collection. The Power LED on the top of the control box will turn blue or cyan while the light source is on. The light source can be turned off by unchecking the “Strobe/Lamp Enable” box in the spectrometer software or by pushing the toggle switch to the downward off position. The Power LED on the top of the control box will return to green once the light source is off (see Table 2).

7) The solid sampler also allows for measurements on liquids. We have designed two types of cuvette holders for the solid sampler:

   a) An “offset” cuvette holder for measurements directly off the surface of sample within the cuvette (see Figure 18). This holder allows front-surface measurements of materials that do not transmit light well, such as dark liquids, slurries, and solids. It can be used

for surface reflection or surface fluorescence analyses and for electrochemical measurements where reflection electrodes are placed close to the wall of the cuvette. Use a 90° geometry between the light source and the spectrometer and set the cuvette at the appropriate angle to the incident light source, typically close to 45 degrees.

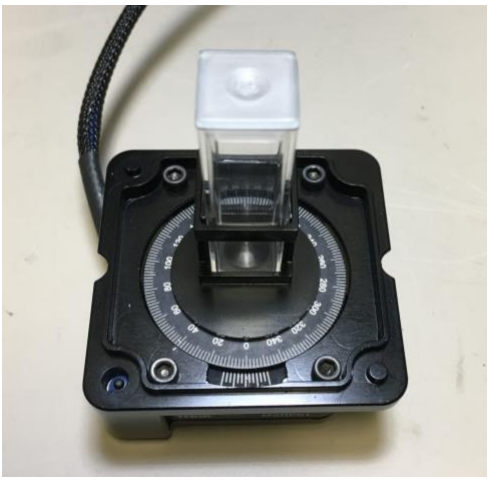


Figure 18. Offset cuvette holder (with cuvette) mounted on the rotation stage of the solid sampler base.

b) A “centered” cuvette holder for regular transparent sample solution analyses (see Figure 19). Incident light passes through the liquid to allow molecular excitation (for solution fluorescence) or molecular absorption (for absorption or transmission measurements). This holder may also be used for electrochemical measurements where the electrodes are designed to transmit light.

Figure 19. Centered cuvette holder (with cuvette) mounted on the rotation stage of the solid sampler base.

Running the 365 nm Excitation Fluorescence QC Test Sample

1) A QC test sample is included with the OPC when a 365 nm fluorescence setup is purchased (see Figure 20). The test sample is intended to be used as a quick check to ensure that the system is working correctly. When the OPS is in fluorescence mode and the QC test sample is excited with the 365 nm light source, the reference spectrum shown in Figure 21 should be obtained.

Figure 20. QC test sample for checking the fluorescence operation of the OPS at 365 nm.

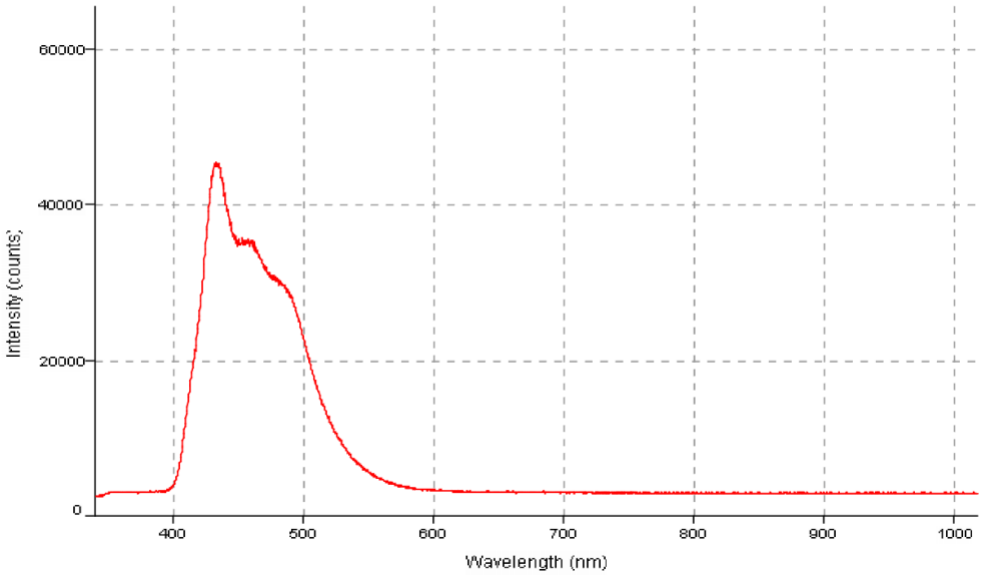


Figure 21. Reference fluorescence spectrum for the QC test sample in the OPS after excitation at 365 nm.

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Appendix: Fluorescent Dyes, Optical Filters, Light Sources, Spectrometers, and Spectrometer Slide Mounts

Table 3. Light sources and filters available from Wilson Analytical

Wavelength of light source	Optical filter for light source*	Screw-on optical filter for spectrometer*
265 nm (UV)		
280 nm (UV)		
300 nm (UV)		
365 nm (UV)	Hoya U-340 UV SP	Thin Film UV Sheet LP
405 nm (violet)	450 nm SP OD 4	450 nm LP OD 4
460 nm (blue)	475 nm SP OD 4	500 nm LP OD 4
525 nm (green)	550 nm SP OD 4	575 nm LP OD 4
850 nm (near IR)		
White-light LED (400–850 nm)		
Tungsten-halogen incandescent (380–2500 nm)		

*****Other filters are available by request. See Table 5 for dye/filter combinations.

Table 4. USB and spectrometer cable attachments for Ocean Optics spectrometers

	Ocean Optics spectrometer					
	STS	**USB2000+**	**USB4000**	**Flame**	**Maya**	**QE Pro**
Spectrometer USB connection to computer	Micro B	B	B	Micro B	B	B
External interface connector on spectrometer	Mini HDMI	22 pin connector	22 pin connector	40 pin micro connector	Ribbon connector	Ribbon connector

Table 5. Specific filter combinations for fluorescent dyes (systems for other dyes are available upon request)

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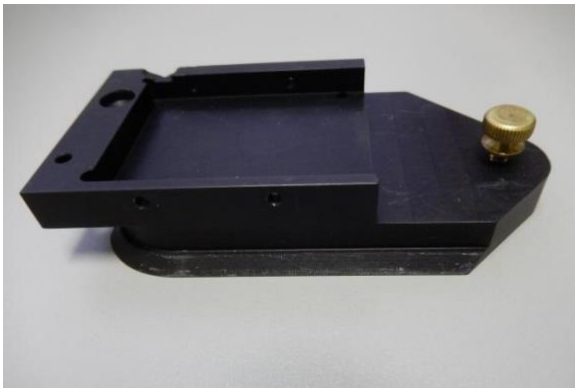
Fluorescent dye	Excitation max in nm	Emission max in nm	Excitation light source wavelength in nm (colour)	Optical filter for light source	Screw-on optical filter for spectrometer
Heochst 33342	350	461	365 (UV)	Hoya U-340 UV SP	Thin Film UV Sheet LP
Oilfield corrosion inhibitors with APQs	325	492	365 (UV)	Hoya U-340 UV SP	Thin Film UV Sheet LP
8-Hydroxypyrene-1,3,6-trisulfonic acid trisodium salt (HTPS)	403	520	405 (Violet)	450 nm SP OD 4	450 nm LP OD 4
Fluorescein or uranine (disodium salt)	491	516	450 (Blue)	475 nm SP OD 4	500 nm LP OD 4
Fluorescein isothiocyanate (FITC)	495	519	450 (Blue)	475 nm SP OD 4	500 nm LP OD 4
Rhodamine WT	555	580	520 (Green)	550 nm SP OD 4	575 nm LP OD 4
7-AAD	546	647	520 (Green)	600 nm SP OD 4	620 nm Hoya R-62 LP

Table 6. Spectrometer and slide combinations for the OPS

OPS small slide used for STS, USB 2000+, USB 4000, and Flame spectrometers	
	
OPS large slide used for Maya and QE Pro spectrometers	
	

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Spectrometer	Bottom view
 STS	Under development
 USB2000+	
 USB4000	

Mounted spectrometer	Screw size	Comments
STS mounted: under development	—	—
 USB2000+ with small slide	4-40 x ¼” and 4-40 x ¾”	Line up the special plug on the cable for the spectrometer so that the screw holes line up
 USB4000 with small slide	4-40 x ¼” and 4-40 x ¾”	Line up the special plug on the cable for the spectrometer so that the screw holes line up

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Spectrometer	Bottom view
 Flame	
 Maya	
 QE Pro	

Mounted spectrometer	Screw size	Comments
 Flame with small slide	4-40 x ¼” and 4-40 x ¾”	A red Power LED light on the control box may indicate that the Flame spectrometer is not plugged in
 Maya with large slide	Two (2) 4-40 x ½”	A red Power LED light on the control box may indicate that the Maya spectrometer is not plugged in
 QE Pro with large slide	Two (2) 4-40 x ½”	A red Power LED light on the control box may indicate that the QE Pro spectrometer is not plugged in. The 110V power supply for the QE Pro must also be plugged in and connected to the QE Pro

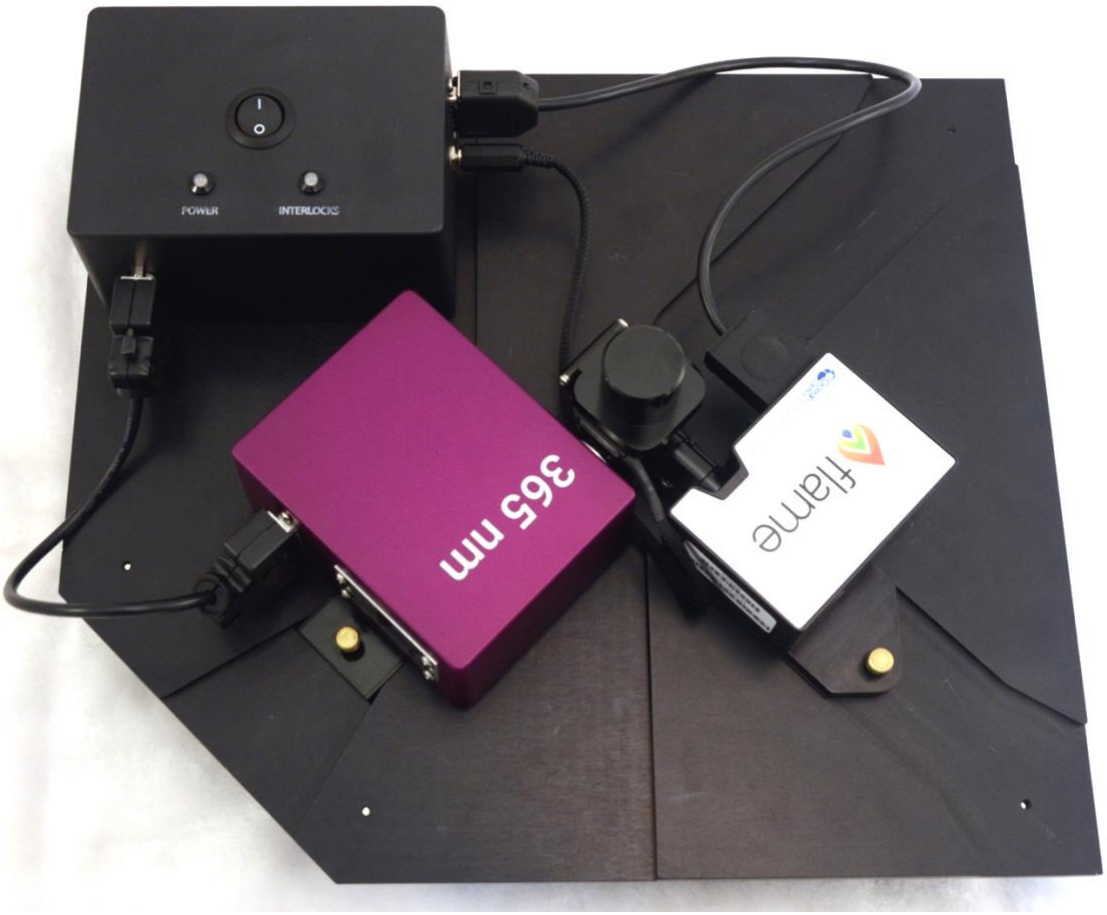

Figure 22. The OPS with the cuvette holder and with the Flame spectrometer in a 90° orientation with the 365 nm light source.

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