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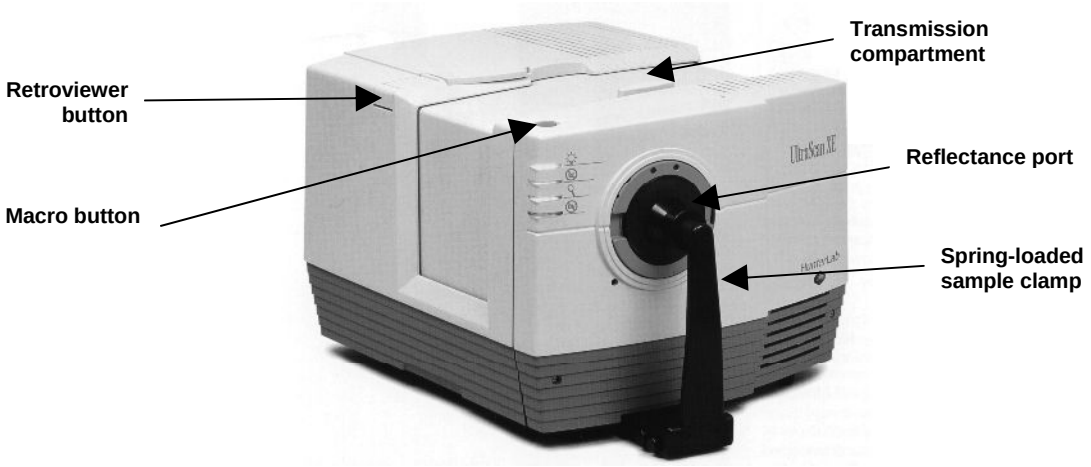
Chapter 11

UltraScan® XE

Notice: Use of this equipment in a manner not specified by the manufacturer may impair the protection afforded by the equipment.

The UltraScan XE is a dual beam xenon flash spectrophotometer with a wavelength range from 360 to 750 nanometers (nm). All tristimulus integrations are based on a triangular bandpass of ten nm and a wavelength interval of ten nm.

The sensor uses an integrating sphere that is six inches (152.4 mm) in diameter and coated with Spectraflect™. The instrument can measure either reflected or transmitted color of products.



The UltraScan XE

UltraScan XE Features

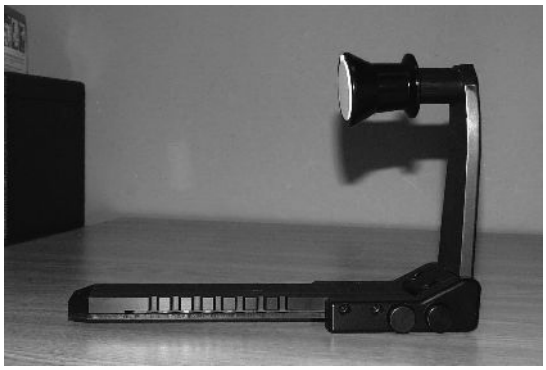
The UltraScan XE possesses the following default features:

Reflectance Port

The reflectance port is located at the front of the sensor. The port is covered by a spring-loaded sample clamp which is used to hold the specimen in place during measurement. Two guidance holes are also present to aid in placement of the white tile and light trap at the reflectance port.

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Sample Clamp



The UltraScan XE includes a spring-loaded sample clamp that can be used to hold samples flat and securely at the reflectance port. The clamp has two buttons, one which raises and lowers the arm, and one that moves the clamp toward and away from the reflectance port.

A magnetic white ceramic disk on the face of the clamp provides a consistent white background for measurements. A non-slip black pad (also magnetic) is also included that can be used to replace the white disk for applications that require a non-slip or dark backing. To change to the pad, simply pop out the white disk and insert the non-slip pad.

Transmission Compartment

The transmission compartment located in the middle of the sensor is used for measuring the transmitted color of transparent solids and liquids. The transmission compartment door should be closed while standardizing and taking measurements[1].

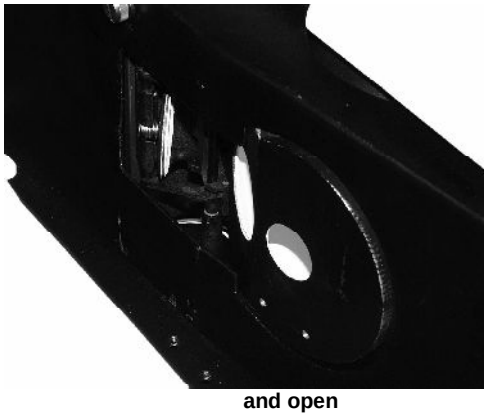


Specular Included/Excluded Port

The UltraScan XE sphere contains a specular exclusion port door which is closed during specular included and transmission measurements and opened during specular excluded measurements. The position of the door is controlled through the software. See the "UltraScan XE Standardization" section of this chapter for more information on the various measurement modes.



The specular exclusion port closed



and open

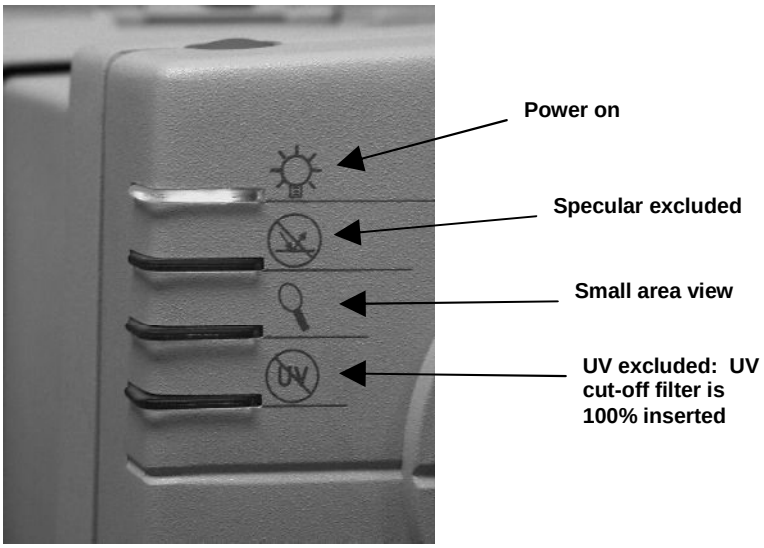
[1] Closing the transmission compartment door while making both reflectance and transmittance measurements is the best practice for this instrument. For more information, see the note in the UltraScan XE Standardization section.

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The UltraScan XE features automated specular included/excluded port control and sensing. This feature allows you to set the port to the desired position from EasyMatch QC. The computer reports the position, thereby allowing errorless measurements.

Indicator Lights

The UltraScan XE's indicator lights let you know what mode of standardization is currently in use. The top light indicates that power is on. The second light indicates that the specular exclusion port is open. The third light indicates that small area view is in use, and the bottom light indicates that the UV cut-off filter is 100% inserted.



Automated UV Control

Two UV exclusion filters are integral to the UltraScan XE. The 460-nm cutoff filter excludes all source light below 460 nm and can be either in or out of the light path. The 420-nm cutoff filter eliminates light below 420 nm and can be fully in the light path, partially in the light path to control UV content, or out of the light path. The positions of both filters are controlled through EasyMatch QC. The instrument should be standardized in the chosen configuration before measurements are made. A white fluorescent standard is used in the UV control and checking process.

For the measurement of optical brighteners or UV-induced fluorescence, the calibration and control of the source UV energy is important. UV-induced fluorescence can vary based on the geometry of the instrument used, the spectral properties of the simulated source (usually D65), the condition of the instrument's lamp, and the fluorescent characteristics of the sample. Using the variable UV filter available on the UltraScan XE, the proper ratio of the energy in the UV region of the electromagnetic spectrum to that in the visible region of the spectrum can be achieved and maintained. This improves the agreement of the illumination between different instruments.

Transfer standards marked with known values are used to set the correct illumination conditions. These standards are stable, white plastic samples traceable to a four-step cotton white scale from Hohenstein Institute in Germany. Their use keeps illumination constant as a lamp ages or after a lamp change.

Instructions for using UV control are described in the **Sensor** Menu chapter.

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Note: It is important to know what type of fluorescence is involved for the samples being measured. Some materials fluoresce due to excitation by visible rather than ultraviolet wavelengths. The UV-absorbing filters do not eliminate this type of fluorescence.

Small Area View

The small area view feature includes a small area view lens, port plate, and retroviewer (lamp in the sphere that allows viewing of the sample in a flip-up mirror for determining the proper placement of samples). To use the small area view feature:

1. Remove the original port plate from the reflectance port and replace it with the small area port plate.

2. Standardize the instrument. Be sure to select 0.375 inch (9.525 mm) as the area view in the Setup Mode window in EasyMatch QC. The lens will automatically adjust.

3. Place the sample at the reflectance port.

4. Press the retroview switch on the top left of the sensor (about halfway back). The sample is illuminated and an image appears on the screen on the top of the sensor. If necessary, adjust the door above the screen to see a mirror image of the screen display.

5. Be sure that the sample completely covers the reflectance port. Adjust the position of the sample if necessary.

6. Read the sample.

Any UltraScan XE with Firmware Version 1.20 or higher is equipped with the following retroviewer feature:

The retroviewer lamp has two modes of operation:

1. The lamp stays on between readings.

2. The lamp turns off after each reading.

Select the desired mode of operation using the retroviewer button as follows:

1. **Lamp Stay On Mode:** Press and hold the retroviewer button until a beep is heard. To turn the lamp off, press and immediately release the retroviewer button three times in a row.

2. **Lamp Turn Off Mode:** Press and immediately release the retroviewer button. The lamp will automatically turn itself off when you take a reading.

Note: In order to prevent heat build-up, the lamp will turn off automatically after four minutes of inactivity, regardless of the selected mode.

Macro Button

The macro button, also known as the "Sensor button," activates a sample measurement.

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UltraScan XE Accessories

The following accessories are provided with the UltraScan XE system and can be found in the standards case:

- White calibrated tile - an everwhite tile placed at the reflectance port (with pegs in the guidance holes) during standardization.
- Light trap - placed at the reflectance port (with pegs in the guidance holes) during standardization in reflectance modes.
- Black card device - placed in the transmission compartment during standardization in transmittance modes.
- Green tile - used to check instrument performance.
- Didymium filter - screwed into the lens as a check for wavelength accuracy.
- Tile data sheet - Gives calibration information for the standard tiles.
- Non-slip pad for sample clamp - can be placed into the sample clamp as a replacement for the white disk for applications that require a non-slip or dark backing.
- Standards care card - gives instructions on how to clean the standards.
- Fuses - two fuses are provided as spares.
- Allen wrench - one 7/16” wrench is provided.
- Lens brush.
- RS-232 communications cable.
- Power cord.
- Certificate of traceability for the standard tile.
- Diagnostics software CD.

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UltraScan XE Options and Sample Devices

There are many options and devices available for positioning samples at the measurement ports of the UltraScan XE and for making the instrument easier to use. Any or all of the following options and sample devices may be purchased for use with your UltraScan XE system. HunterLab part numbers are included for your convenience in ordering.

- Foot switch assembly (HL#B02-1005-211),
- Compression cell assembly (HL#D02-1008-147),
- Skein holder (HL#02-7396-00),
- 1-inch port plate with glass (HL#D02-1008-130),
- 4-mm port plate (HL#A02-1010-838),
- Reflectance sample shelf with light cover (HL#B02-1005-172, D02-1013-326 for shelf only),
- Semi-micro powder holder (HL#D02-1012-313),
- Reflectance preform holder (HL#D02-1011-841),
- Transmission clamp (HL#C02-1005-444),
- Transmission cell holder (HL#C02-1005-481),
- Transmission cells (HL#13-8573-20 for 50-mm, B04-1003-801 for 33-mm, 04-4592-00 for 20-mm, 13-8573-40 for 10-mm),
- Transmission cells with two screw tops (HL#D12-1011-893 for 10-mm, D12-1011-890 for 20-mm, D12-1011-891 for 33-mm, D12-1011-892 for 50-mm),
- Transmission spill tray (HL#D02-1011-568),
- Tall transmission cells [set of 3] (HL#B04-1002-672),
- Flow-through transmission cell holder and cells (HL#D02-1009-960 for holder, C04-1001-960 for 50-mm cell, C04-1001-959 for 20-mm cell, C04-1001-958 for 10-mm cell),
- Holder for small volume transmission cells and 10-mm small volume transmission cells (HL#D02-1011-886 for holder, A13-1011-613 for cell),
- Cylindrical cell holder (HL#D02-1011-550),
- Semi-micro cell holder and optical assembly (HL#L02-1012-202),
- Transmission preform holder (HL#D02-1011-833).

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Foot Switch Assembly

Pressing the foot switch performs the same function as the macro switch on the front of the sensor. Install the foot switch by plugging it into the round connector on the back of the UltraScan XE.



Compression Cell Assembly

This option provides a compression cell assembly for the UltraScan XE. This assembly is used for compressing fibers into a compact mass that permits repeatable color analysis. The assembly, sans modified port insert and glass sample cup, may also be used to hold carpet, fabric, and other soft samples at the reflectance port with constant pressure.

The option consists of the following components:



- Modified port insert
- Protective cap for port plate
- Glass 2.5-inch (64-mm) sample cup



- Modified sample clamp
- Ten feet of 1/4-inch tubing line
- Pressure valve.

A compressed air source and filter dryer are also required.

To install the compression cell assembly:

1. Remove the original port insert and replace it with the modified port insert (after removing the protective cap). The white lining of the insert should face in toward the instrument.

2. Replace the original sample clamp with the modified sample clamp.

3. Connect the air compressor to the lower input port of the modified sample clamp assembly using the 1/4” tubing. Also connect the compressor to a power source.

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To operate the compression cell assembly:

1. Temporarily replace the modified port insert with the original port insert.

2. Standardize the instrument and then return the modified port insert to the port.

3. Weigh the specified amount of sample material into the sample cup. The fibers should completely fill the sample cup. For comparability of measurements, the same weight of sample should always be used.

4. Place the sample cup into the cup holder port plate. Adjust the location of the sample clamp to hold the cup in place. The front button on the arm raises and lowers the arm, while the back button moves the clamp in and out.

5. Turn on the flow of clean, dry, compressed air to the clamp. You should attach a filter dryer to the assembly.

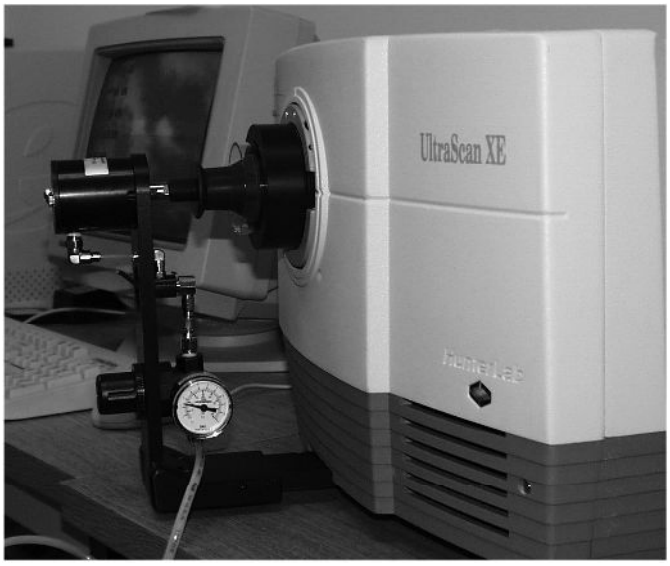
6. Pull out the knob on the sample clamp and turn it until the desired pressure is obtained as shown on the pressure gauge. The recommended pressure is 30-40 psi, but must not exceed 100 psi. Push the knob back in. For comparability of measurements, all samples should be measured under the same pressure. Monitor the pressure so that fluctuations that might affect measurements are known.

7. Flip the pressure switch on the sample clamp to the on position (up). The clamp will compress the sample into the sample cup.

8. Initiate a reading.

9. Turn off the air pressure, remove the sample from the port, and continue with measurement of additional samples.

Note: Always return the modified port insert to its protective cap after use.

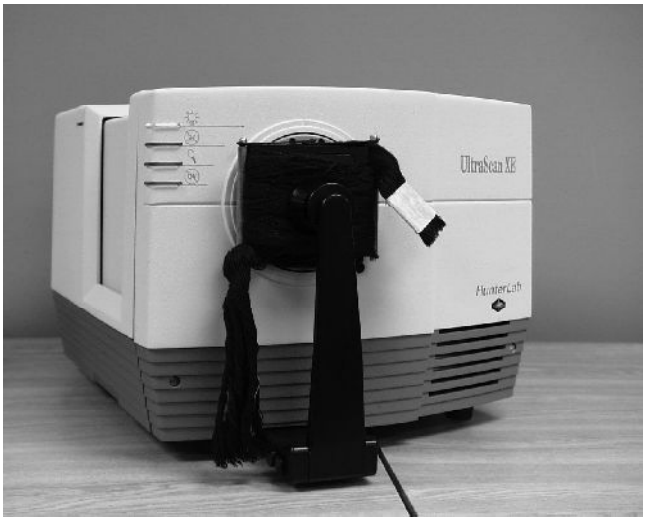


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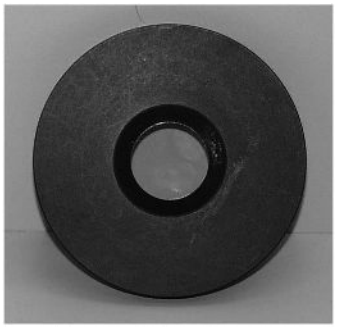
Skein Holder

This is a device for measuring yarn skeins. Wind the yarn around the skein holder in multiple taut layers until it is effectively opaque and is as flat as possible. Secure it in place with the detachable arms on the sides of the skein holder. Place the skein holder at the reflectance port and back it with the sample clamp or a white backing tile to provide a consistent background and pressure. Make several measurements of the skein, rotating the holder 90° between measurements and averaging the readings for the final result.





1-inch Port Plate with Glass



This option provides a snap-in port plate with an opening one inch in diameter that is covered with glass. The glass insert protects the inside of the instrument from sample and airborne particles.

To install the port insert,

1. Remove the standard port insert by pulling it out of the port insert retainer. Replace it with the desired port insert, making sure that the flat portion of the insert is facing outward with the beveled portion toward the interior of the sensor.

2. Standardize the instrument. When using the glass cover, standardize the instrument with the glass in place. However, you should check measurements of the green and white tile and perform any other diagnostics without the glass cover. Difference measurements using the glass cover will be more accurate than absolute measurements.

4-mm Port Plate

This option provides a modified port plate with a 4-mm round opening. This port plate should only be used with the small area view feature. To install the port plate, remove the standard port plate and snap the modified port plate into place at the reflectance port. Standardize the instrument in a reflectance mode for the 0.375-inch (9.525-mm) area view.

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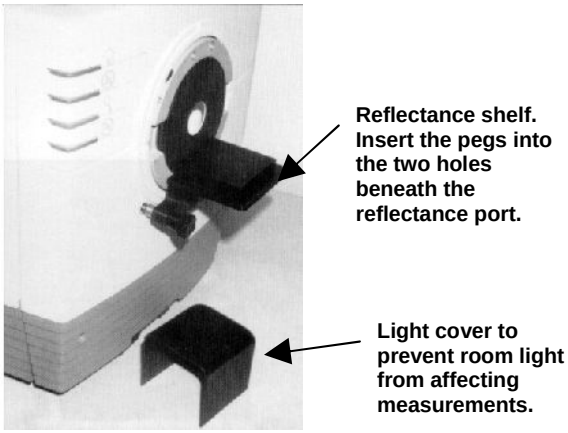
Note: This port plate has an opening that is smaller than the usual 1-inch port plate. Performance specifications (i.e., factory-supplied color values, stability, accuracy) are based on the standard 1-inch round port plate. These specifications will not be met with the modified port plate. The change of geometry that occurs will cause a slight shift in the color values of the calibration standards.

Reflectance Sample Shelf with Light Cover

The optional reflectance sample shelf with light cover can be placed at the reflectance port for measurement of powders, granules, pastes, or liquids held in a transmission cell (10-mm, 20-mm, 33-mm, or 50-mm cell). An opaque cover is also available to prevent ambient room light from affecting the measurement.

To install the reflectance sample shelf:

1. Lower the sample clamp as far as it will go.
2. Insert the two finger clamps of the sample shelf into the guidance holes located below the reflectance port on the front of the UltraScan XE.
3. Tighten the sample shelf into place by turning both knobs clockwise.
4. Place your sample on the shelf and cover it with the light cover (if included).
5. Measure the sample.



Semi-micro Powder Holder

This option provides a holder and special port plate that allow the measurement of small quantities (approximately 0.4 cc) of packed powder.

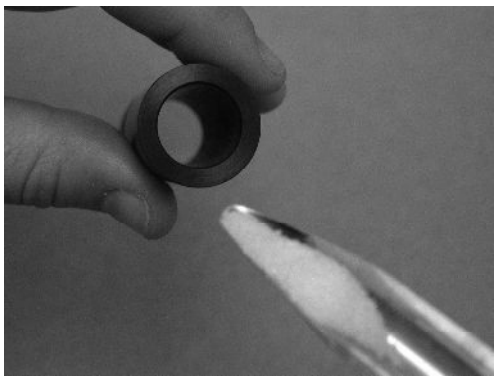
To install and use the powder holder, complete the steps below.

1. Install the small area view port plate and standardize the UltraScan XE in a reflectance mode for the 0.375-inch (9.525-mm) area view.
2. Replace the standard port plate with the modified port plate.

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3. Place the powder to be read into the powder holder.



4. Pack the powder down using the plunger. Do not overtighten the powder holder. The powder should be at least 1/2-cm deep in the holder.



5. Place the powder holder into the port plate.

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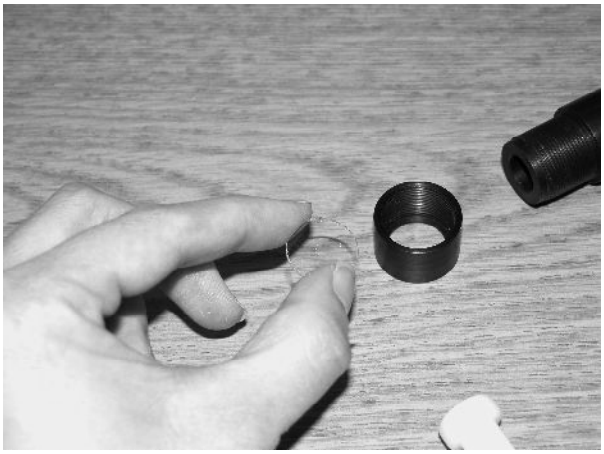


6. Measure the sample.

Note: The powder holder should be used ONLY for color difference measurements.

7. Between measurements, remove the powder holder, unscrew the top, and clean the glass. The glass insert may be removed from the powder holder for cleaning or replacement. Replacement inserts may be purchased from HunterLab. No adhesive is required.





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Reflectance Preform Holder

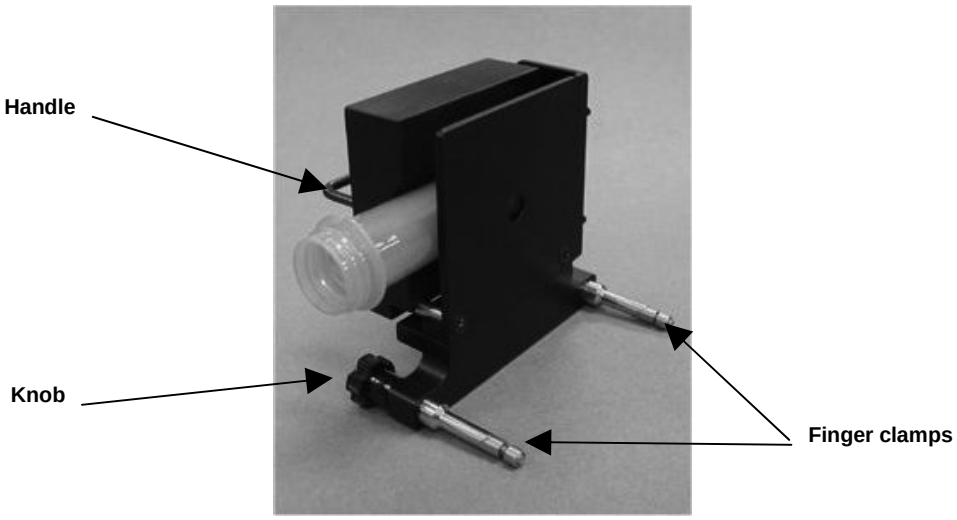
This option provides an adjustable holder for measuring translucent and opaque preforms at the reflectance port of the UltraScan XE. The holder is appropriate for preforms with a shaft diameter between 15 and 40 mm and a length of at least 50 mm.

Complete the following steps to install the holder into the instrument.

1. Lower the sample clamp as far as it will go.

2. Insert the two finger clamps of the preform holder into the guidance holes located below the reflectance port on the front of the instrument.

3. Tighten the holder into place by turning both knobs clockwise.



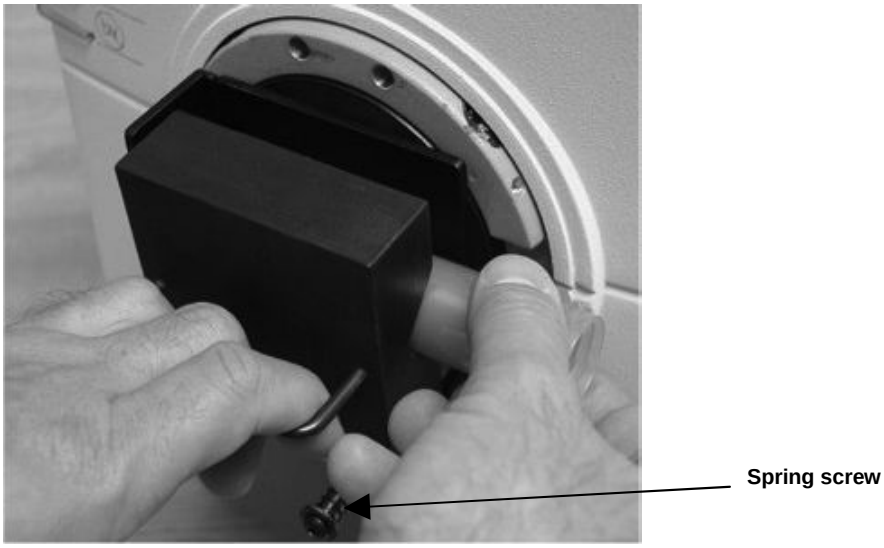
Use the preform holder as follows:

1. Standardize the instrument in RSIN mode using **0.375 inch (9.525 mm) as the area view**. You will need to remove the preform holder to standardize or else standardize before installing the holder.

2. Open the holder. It is easiest to do this by placing the fingers around the handle and resting the thumb of the same hand on the end of one of the spring screws. Pull the handle toward the thumb until the holder provides an opening large enough for insertion of the desired preform.

3. Insert the preform into the holder as far as the preform will go with the threads to the right. Then close the holder and confirm that the preform is held securely in place.

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4. Make your measurement.

5. Rotate the preform and measure it again.

6. Repeat step 5 until the preform has been measured the desired number of times.

Transmission Clamp

The optional transmission clamp holds transparent film or sheets in position for regular or total transmission measurements.

For measurements in Regular Transmission:

1. Position the transmission clamp so that the curved opening is aligned at the **lens port** located at the rear of the transmission compartment. The inner curvature of the clamp should align with the outer curvature of the lens.

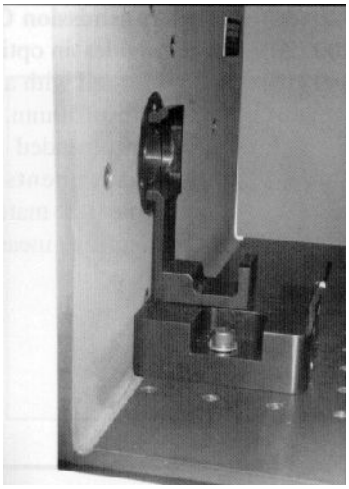
2. When properly aligned, the holes in the bottom of the clamp assembly will align with holes in the floor of the transmission compartment. Place a washer and one 1/4-20 7/8-inch screw in each of the holes and tighten by turning the screw clockwise. (You may finger-tighten the screws or you may use the Allen wrench that is included with the transmission clamp.)

3. Follow the software prompts to standardize in regular transmission (RTRAN).

4. Place the film sample at the lens port by pulling forward on the tab at the bottom of the clamp and sliding the transmission clamp holder forward. Place the film at the lens and release the tab. The rubber grommet at the rear of the transmission clamp will firmly hold the sample in place for measurement.

5. Close the transmission compartment door and make the measurement.

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Transmission clamp as placed in the transmission compartment for measurements in regular transmission. The clamp is placed flat at the lens.

For measurements in Total Transmission:

1. Position the transmission clamp so that the curved opening is aligned at the opening of the **sphere** at the front of the transmission compartment. The inner curvature of the clamp should align with the outer curvature of the sphere.

2. When properly aligned, the holes in the bottom of the clamp assembly will align with holes in the floor of the transmission compartment. Place a washer and one 1/4-20 7/8-inch screw in each of the holes and tighten by turning the screw clockwise. (You may finger-tighten the screws or you may use the Allen wrench that is included with the transmission clamp.)

3. Follow the software prompts to standardize in total transmission (TTRAN).

4. Place the film sample at the sphere opening by pulling back on the tab at the bottom of the clamp and sliding the transmission clamp holder backward. Place the film at the sphere opening and release the tab. The rubber grommet at the front of the transmission clamp will firmly hold the sample in place for measurement.

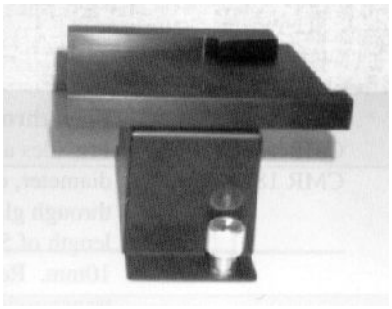
5. Close the transmission compartment door and make the measurement.



Transmission clamp as placed in the transmission compartment for measurement in total transmission. The clamp is placed flat at the sphere.

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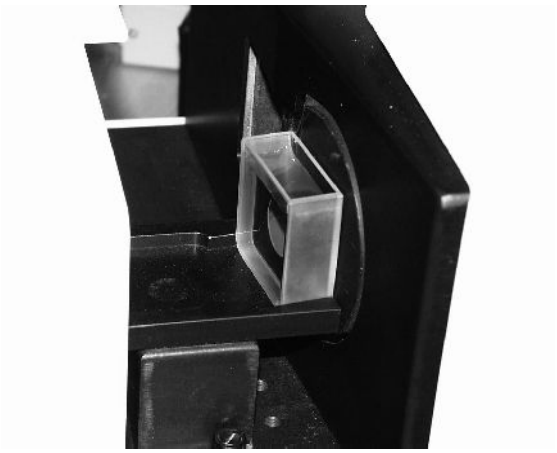
Transmission Cell Holder



The optional transmission cell holder permits measurement of liquids in 10-mm, 20-mm, 33-mm, or 50-mm transmission cells.

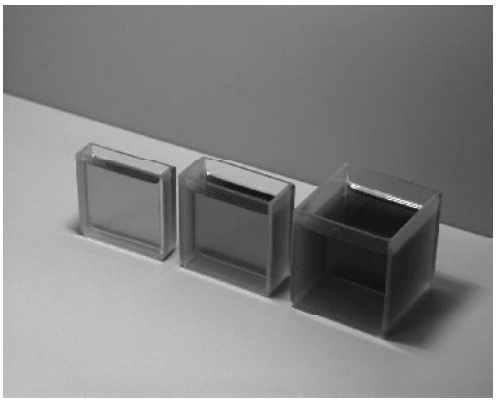
Slide the transmission cell holder into the transmission compartment at the center, widest part of the transmission compartment. To use the transmission cell holder, position the holder inside the transmission compartment so that the flat end of the holder is aligned with the rear wall of the transmission compartment. Ensure that the holder is flush against the sphere wall. Depress and turn the captive screws clockwise. If the holder is slightly off-line, reposition it so that the screws align properly in the holes on the floor of the transmission compartment.

You may use the holder for measurements in either total or regular transmission by following the software prompts to standardize in the desired mode. If you are using total transmission (TTRAN), place the cell at the **sphere** opening at the front of the transmission compartment. If you are using regular transmission (RTRAN), place the cell at the **lens port** at the rear of the transmission compartment.



The transmission cell holder holding a 20-mm cell at the sphere opening.

Transmission Cells



The transmission cell option provides an optically-clear glass cell with a fixed path length of 50 mm, 33 mm, 20 mm, or 10 mm. These cells are recommended for transmission measurements of lightly-pigmented materials and some reflectance measurements. When used for transmission measurements of liquids, the cell filled with distilled water or another clear solvent should be used during standardization to set the top of the scale.

For transmission measurements, use the cell size recommended by your measurement specification (such as an ASTM method), or use the general rule that smaller path lengths should be used for more concentrated colorants.

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The dimensions and volumes of the various transmission cells are as follows:

Path Length (mm)	Minimum Sample Volume for Measurement (mL)	Dimensions of Measurement Face (Width x Height in mm)
10	20	55 x 57
20	40	55 x 57
33	70	55 x 57
50	100	55 x 57

Transmission Cells with Two Screw Tops

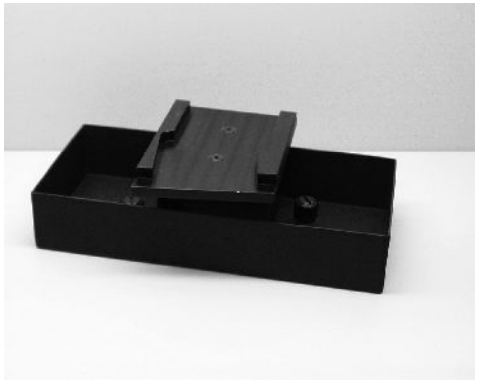
This option provides an optically-clear glass transmission cell with a fixed path length of 50 mm, 33 mm, 20 mm, or 10 mm that is enclosed and has two Teflon®-lined screw caps for injecting and removing volatile liquids from the cell. Otherwise, these transmission cells are used in exactly the same manner as those described above.







Transmission Spill Tray



The transmission spill tray, when installed in the UltraScan XE's transmission compartment, protects the compartment from spills of liquid samples. The tray can hold up to 600 mL of liquid. The top portion of the spill tray simulates the function of the transmission cell holder.

Slide the spill tray into the transmission compartment at the center, widest part of the transmission compartment. Position it so that the flat end of the transmission cell holder portion is aligned with the rear wall of the transmission compartment. Ensure that the holder is flush against the sphere wall. Depress and turn the spill tray's captive screws clockwise. If it is slightly off-line, reposition it so that the screws align properly in the holes on the floor of the transmission compartment. Then use the transmission cell holder portion as you would the normal transmission cell holder device.

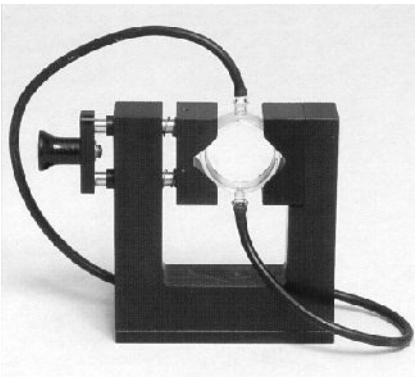
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Tall Transmission Cells

This option provides a set of three transmission cells that have path lengths of 20-mm, but that are 40-mm wide and 204 mm tall, quite a bit taller than the standard transmission cells.

Flow-Through Transmission Cell Holder and Cells



This option provides an optically clear, 2-inch diameter, 10 mm, 20 mm, or 50 mm-path length flow-through cell for use with the UltraScan XE flow-through cell holder. The flow-through cell is placed in the holder at the sphere transmission port or at the lens. Flexible plastic tubing with an inside diameter of 9 mm (not sold by HunterLab) is connected from the liquid source to the inlet (lower) tube of the cell and from the outlet (upper) tube to a drain. Using a pump (not sold by HunterLab), the liquid is pumped into the cell until the cell is filled. A sample reading is then taken and the liquid pumped from the cell to the drain.

The dimensions and volumes of the various flow-through transmission cells are as follows:

Path Length (mm)	Minimum Sample Volume for Measurement (mL)	Diameter of Measurement Face (mm)
10	20	51
20	35	51
50	90	51

The flow-through transmission cell can be used with manual or automated pumps, such as peristaltic pumps, to inject the liquid into or extract the liquid from the cell.

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To install the flow-through cell and holder:

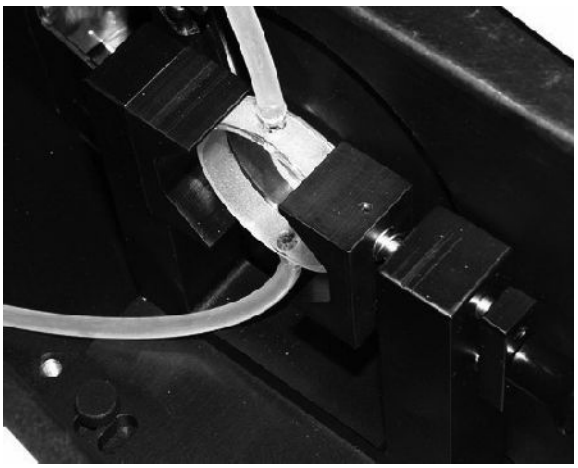
1. Place the instrument on a level surface.

2. Open the instrument transmission compartment door. If you have a transmission sample holder installed, remove it. Be sure that the specular exclusion port door is closed.

3. Place the flow-through transmission cell in the cell holder using the handle on the right side of the cell holder to open and close the holder. Orient the inlet and outlet tubes vertically.

4. If you wish to make total transmission measurements, place the cell holder into the instrument transmission compartment and orient the cell holder so that the cell is almost touching the **sphere**. The cell must be centered over the instrument transmission port. If you will be making regular transmittance measurements, place the cell holder against the **lens** in the opposite orientation.

5. Locate the two 1/4-20 tapped mounting holes inside the instrument transmission compartment and fasten the cell holder to the instrument with the two thumb screws. Be sure that the screws are snug and that the cell holder is held securely in place.



To operate the flow-through cell assembly:

1. Standardize the instrument in a transmittance mode. The flow-through cell should be filled with distilled water or another clear solvent to set the top of scale.

2. Inject the sample to be measured into the cell.

Note: The pressure used to inject the liquid into the cell should not exceed 1 atmosphere (14.7 lbs/in$^{2.}$)

3. Measure the sample.

4. Drain the sample from the cell.

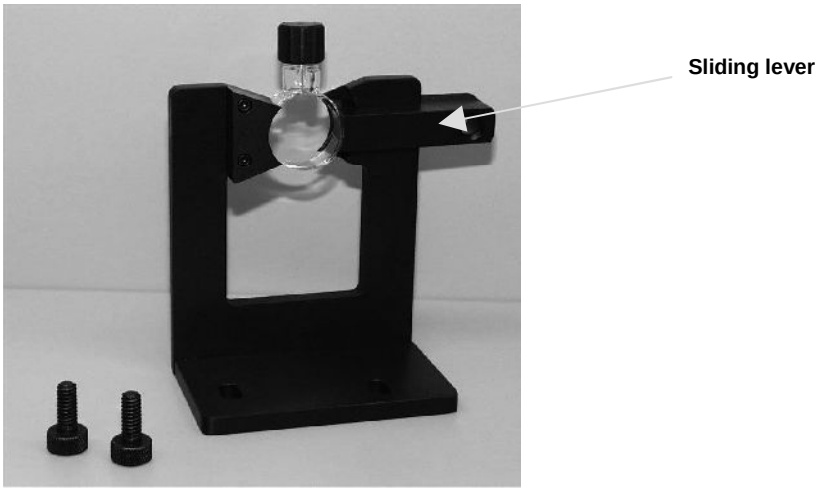
CAUTION
Do not standardize in RSEX mode with the flow-through cell assembly in place. This may damage the cell and/or instrument.

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The flow-through transmission cell may need to be cleaned periodically. Use a glass cleaner on the exterior of the cell and distilled water pumped through the cell for the interior.

Holder for Small Volume Transmission Cells and 10-mm Small Volume Transmission Cells

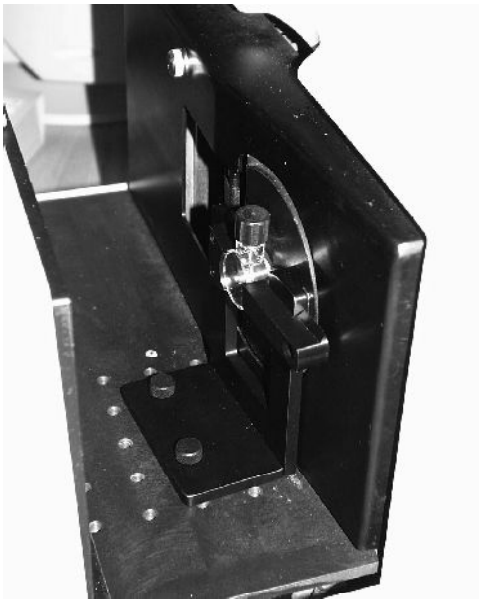
This option provides a holder for a cylindrical small volume transmission cell. Each cell is shipped with two caps, one that is solid and screws on, and one that is threaded and covered with injectable Teflon®. The cell has an outside diameter of 28 mm, an inside diameter of 25 mm, and a 10-mm path length. The cell and holder together are used for total transmission measurements of small quantities of liquids.



To install the holder, position it so that the holes in its base are down toward the floor of the transmission compartment and the cutout in the vertical section is at the transmission port (hole in the sphere). The base holes should be positioned over two of the threaded holes in the transmission compartment floor. Insert the two thumbscrews provided and tighten.

To operate, fill the cylindrical cell with the clear solvent that is to be used as a blank for standardization. Then, slide the lever of the cell holder out to open the space for the cell. Insert the cell into the holder and gently release the lever until the cell is held securely in place. Standardize the instrument in TTRAN mode using the blank to set the top of scale. Remove the solvent from the cell and replace it with the sample liquid. Return the cell to the holder and measure the sample.

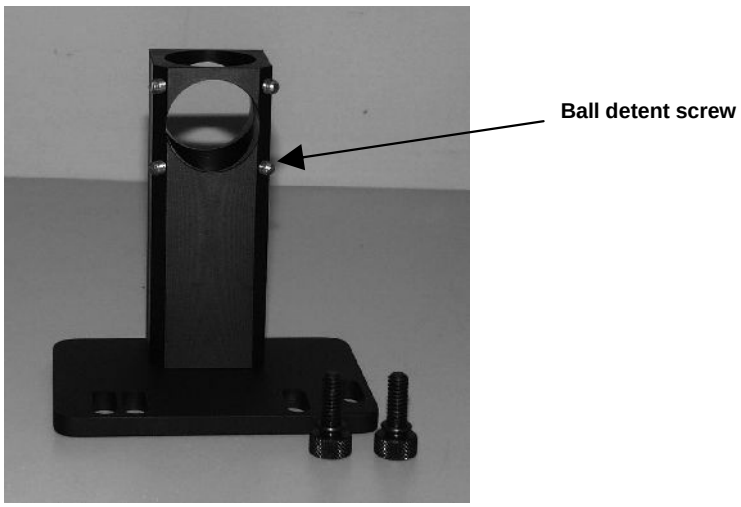
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CAUTION
Do not standardize in RSEX mode with the small volume cell holder in place. This may damage the cell and/or instrument.

Cylindrical Cell Holder

This option provides a holder for 27-mm to 30-mm (OD) cylindrical sample tubes at the instrument transmission port. This holder may be used for measurement of transparent liquids in cylindrical glass tubes with 20-mL, 40-mL, or 60-mL volumes (not sold by HunterLab).



Complete the following steps to install and use the tube holder:

1. Place the tube holder in the transmission compartment, orienting the holder so that the slotted portion of the base faces away from the sphere with the flat side at the sphere. The open viewing hole in the holder must be centered over the hole in the sphere.

2. Locate the appropriate two mounting holes in the transmission compartment floor and fasten the tube holder to the instrument using the two thumb screws provided.

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3. Standardize the instrument in TTRAN mode using the 1.000 inch (25.400-mm) area view. When prompted to read the black card, slide it between the tube holder and the transmission port. Use a tube of the type you will be using for samples filled with distilled water (for water solution samples) or a clear organic solvent (for organic solution samples) as your standardization blank.

4. Remove the blank liquid and fill the glass tube with sample and then insert the tube into the open column in the tube holder. If needed, adjust the ball detent screws until the tube is held snugly in place. Read the sample.

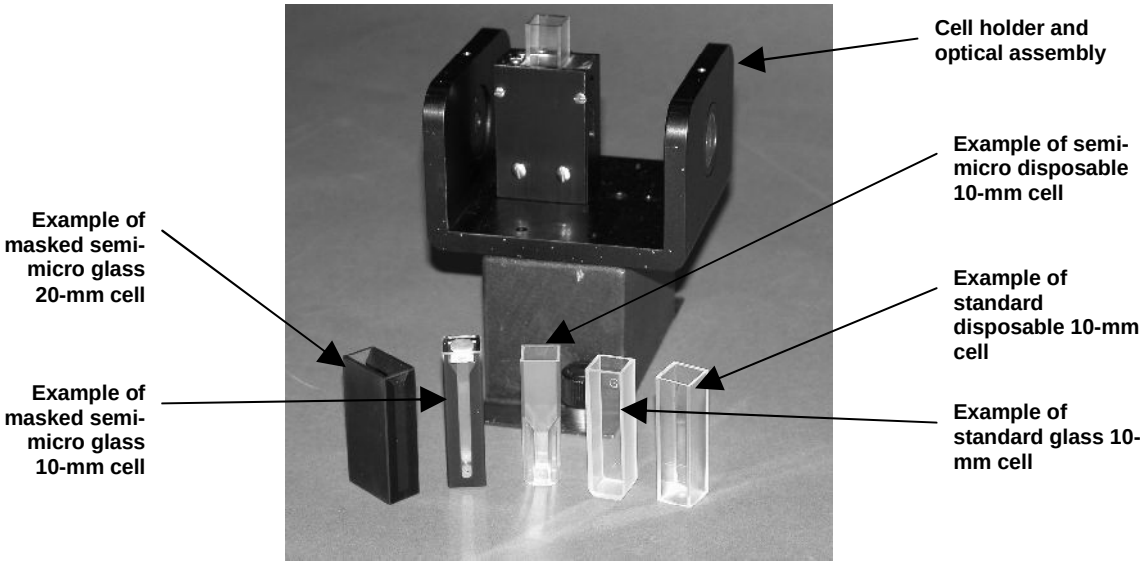


Semi-micro Cell Holder and Optical Assembly

This option provides an optical assembly and holder that center 10-mm and 20-mm standard and semi-micro analytical cells (cuvettes) in the transmission compartment for measurement of small and semi-micro volumes of clear liquids. The analytical cells to be used with this holder are not sold by HunterLab, though several disposable semi-micro 10-mm cells are included as examples. Approximate sample volumes required for the various types of cells are as follows:

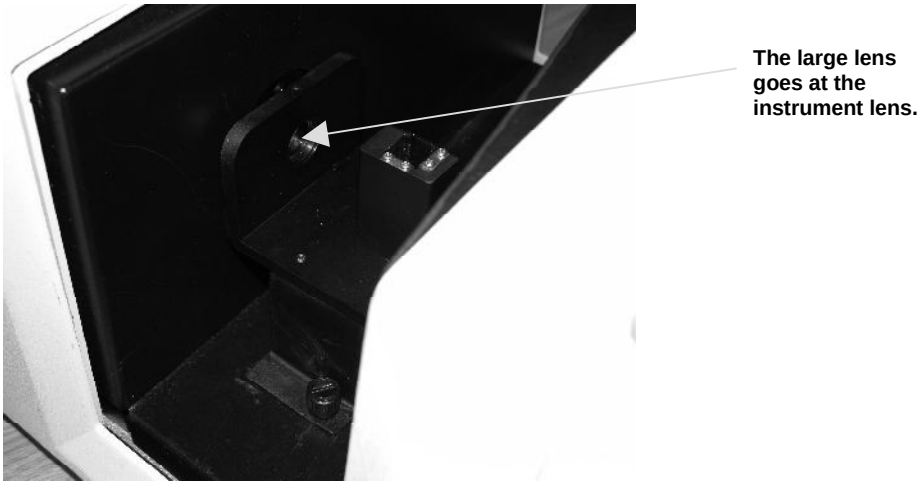
Path Length (mm)	Cell Type	Minimum Sample Volume for Measurement (mL)
10	Standard	4.0
10	Semi-Micro	0.4
20	Standard	8.0
20	Semi-Micro	0.8

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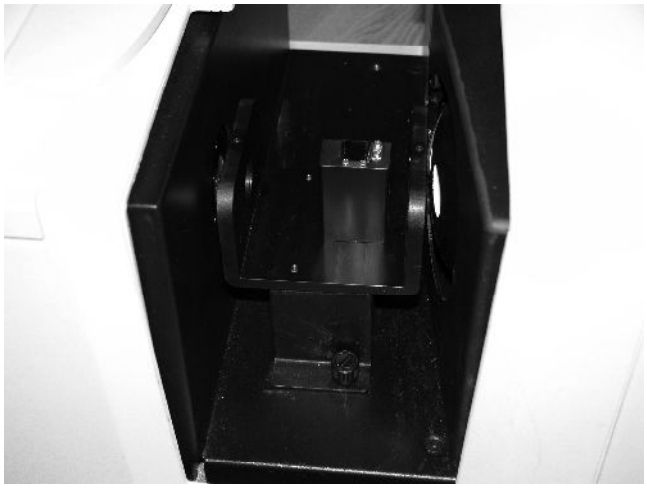
Complete the following steps to install and use the semi-micro cell holder.

1. Slide the semi-micro cell holder and optical assembly into the transmission compartment at the center, widest part of the transmission compartment with the large lens of the optical assembly toward the instrument lens and the small lens of the optical assembly toward the opening in the sphere.



2. Ensure that the holder is in a straight line between the instrument lens and the hole in the sphere. Depress and turn the captive thumbscrews clockwise into holes in the transmission compartment floor. If the holder is slightly off-line, reposition it so that the screws align properly in the holes on the floor of the transmission compartment.

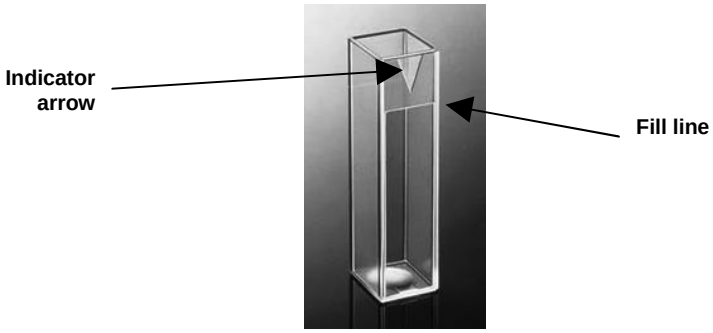
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3. Initiate standardization in TTRAN mode for the 1.000 inch (25.400 mm) area view, sliding the black card device between the cell holder and the hole in the sphere when prompted for the black card.



4. When prompted for the cell blank, fill the desired analytical cell with distilled water or another clear liquid you would like to use as your top of scale. Some cells will have a fill line. The liquid should at least reach this line.



5. Slide the transmission cell into the cell holder as far as it will go. If your cell has an indicator arrow, point it toward the hole in the instrument sphere.

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