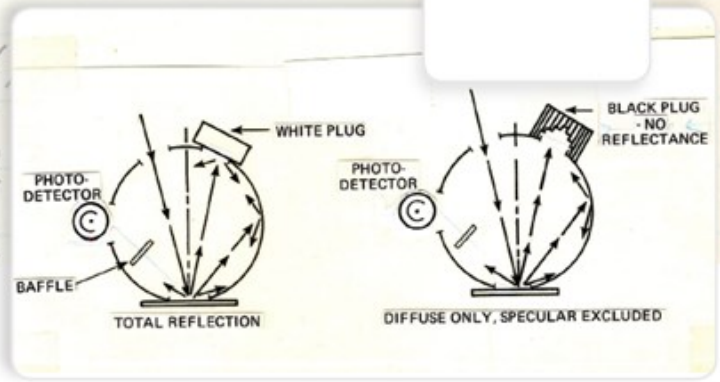
Applications Note

AN 1087



Measuring Translucent Liquids Using the Ring and Disk Set

The ring and disk technique is used to simulate an opaque sample for the purpose of measurement consistency.

Abstract

The ring and disk accessories can be used for measuring translucent liquids on a HunterLab 45°/0° instrument such as the ColorFlex EZ, Agera, or MiniScan EZ 4500. The purpose of the ring and disk set is to control the liquid characteristics and extra light interactions (diffusion and transmittance) associated with translucent liquid samples, thus making these samples appear more like the opaque samples the sensor was designed to measure.

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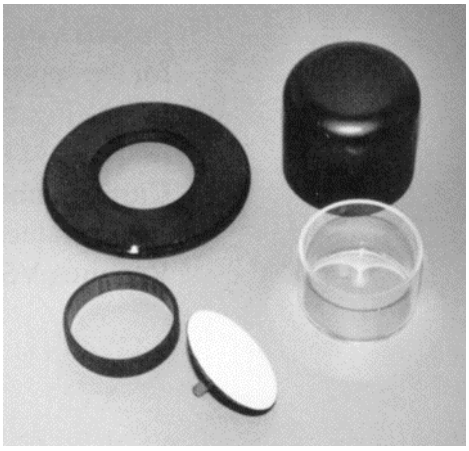
The Ring to Fix Path Length

When the ring and disk set is used to measure a liquid, the black plastic ring is first placed in the sample cup to fix the internal path length of light through the liquid sample at 10 mm while excluding outside light that can cause measurement interference. The liquid is poured into the cup until the level of liquid is higher than the top of the black ring.

To show the effect of path length on a sample measurement, three measurements of orange juice were made on an Agera. For the first measurement, approximately 1 cm of liquid was placed in the sample cup. For the second measurement, approximately 2 cm of liquid was placed in the sample cup. For the third measurement, the sample cup was filled all the way to the top. The sample cup was placed at the sample port and covered with the opaque cover for measurement. The results are shown below. The three measurements are quite different. With the cup filled to the top, the liquid appears lighter (higher L*) and more saturated (larger a* and b*) to the instrument than does only one or two cm of orange juice. A fixed path length is necessary for consistent results when measuring liquids.



Height of Liquid	L* (D65/10°)	a* (D65/10°)	b* (D65/10°)
1 cm	62.50	2.89	50.72
2 cm	63.46	4.44	52.53
Filled to top	63.61	4.85	52.89

The Disk to Provide a White Background

The white ceramic disk is lowered into the liquid until it sits on top of the ring. This disk provides a white background to direct light that has traveled through the liquid back to the detector.

To illustrate the difference between providing a white background and not doing so, two measurements of orange juice were made on an Agera. For the first measurement, the black ring was inserted in the sample cup and the cup was filled with juice just to the top of the ring. The cup was then placed at the sample port, covered with the opaque cover, and measured. For the second measurement, the cup was filled with juice to just above the level of the ring, the white disk was placed on top of the ring, and then the cup was read at the sample port covered with the opaque cover. The results are shown below. The sample read without the white disk appears darker (lower L*) and less saturated (lower a* and b*). A consistent white background is recommended for measurement of translucent liquids.

White Disk Used?	L* (D65/10°)	a* (D65/10°)	b* (D65/10°)
No	62.19	2.95	50.22
Yes	64.75	6.20	54.56

The Opaque Cover to Eliminate Ambient Light

A black sample cup cover is then placed over the sample cup to prevent any ambient light from outside the instrument from leaking into the detector.

In order to show the difference between covering the sample cup and not covering the sample cup, two measurements of orange juice were made on the Agera. For both measurements, the plastic ring was placed in the sample cup and liquid was poured to a level above the ring. The white disk was then placed on top of the ring. For one measurement, the sample cup was covered with the opaque cover at the sample port, and for the second measurement the opaque cover was not used. The results are shown below. Ambient light was not a major problem in this instance, although the b* value was slightly affected. Use of an opaque light cover to eliminate ambient light is recommended, particularly for measurement of near-clear liquids.

Opaque Cover Used?	L* (D65/10°)	a* (D65/10°)	b* (D65/10°)
No	64.74	6.21	54.66
Yes	64.75	6.20	54.56

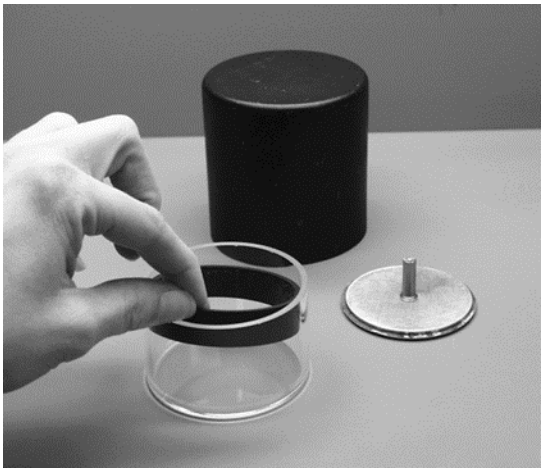
Since the liquid sample is measured through the bottom of a glass sample cup, HunterLab offers an excellent optical-quality quartz sample cup as part of the ring and disk set. This cup has a clear bottom and no color. There is also a special port insert available for most instruments which is counter-bored to center the glass cup correctly at the port for each reading. This port insert is not required, but is helpful if a large number of translucent liquid samples are being measured.

The HunterLab part numbers for the components of the translucent sample set are provided below for each HunterLab 45°/0° instrument.

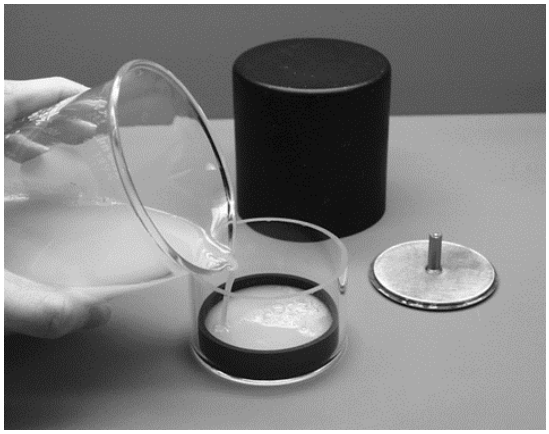
Instrument (s)	Component	Part Number
All	2.5-inch Sample Cup Opaque Cover Ring and Disk Set	04-7209-00 04-4000-00 02-4579-00
ColorFlex EZ	Port Insert for Sample Cup	04-6622-00
Agera	Port Insert for Sample Cup	A02-1010-316
MiniScan EZ 4500	Sample Cup Holder Benchtop Stand	D02-1009-952 D01-1007-434

Step-by-step instructions for using the ring and disk set are given below. The examples shown are using the Agera.

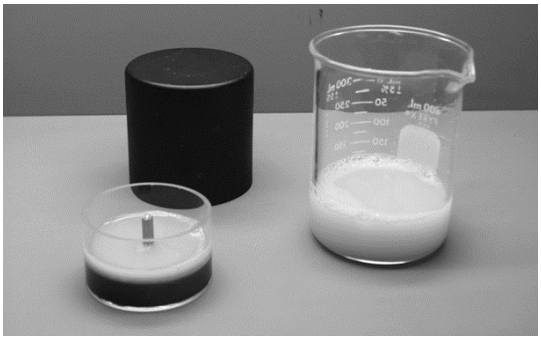
1. Orient the instrument so that the sample port is facing up. (Use of the benchtop stand is recommended for the MiniScan.) Replace the regular port insert with the special port insert for the sample cup.



2. Standardize the instrument with the special port insert in place.
3. Insert the 10-mm black ring into the cup so that it settles flat on the bottom of the cup.



4. Fill the cup with the translucent liquid sample until the liquid is above the level of the ring.



5. Float the white ceramic disk down through the liquid sample until it rests firmly on top of the black ring. Your goal is to have the sample appear smooth and opaque through the glass bottom of the sample cup.

6. Place the sample cup at the instrument port and cover it with the opaque cover.
7. Measure the sample and record the color values.
8. Pour the sample out of the sample cup, refill it, and measure again. Averaging of multiple readings with replacement of the liquid between readings is recommended.

About HunterLab

HunterLab is the technology leader in color measurement solutions, providing instruments, software, knowledge and service to a wide variety of industries.
With over 5 decades of experience in more than 65 countries, HunterLab applies our leading edge technology to your products helping you measure and communicate color simply and effectively.

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