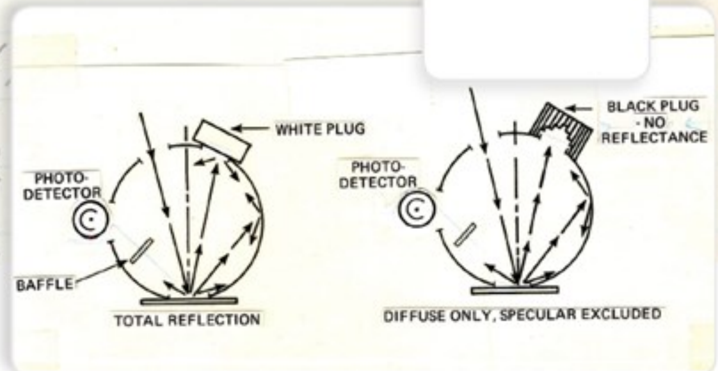
Applications Note

AN 1098



Instrument Geometries Part II: Diffuse/8°

Sphere instruments can be used to measure reflectance in RSIN and RSEX modes.

Abstract

In an instrument with a diffuse/8° geometry, the sample is illuminated diffusely (from all directions), and the viewer (detector) receives the reflected light at a location 8° from the normal to the sample surface. Diffuse/8° geometry is also known as "sphere" geometry because a white-lined diffuse-integrating sphere is used to project the light. Light is cast into the sphere and diffused by the sphere coating.

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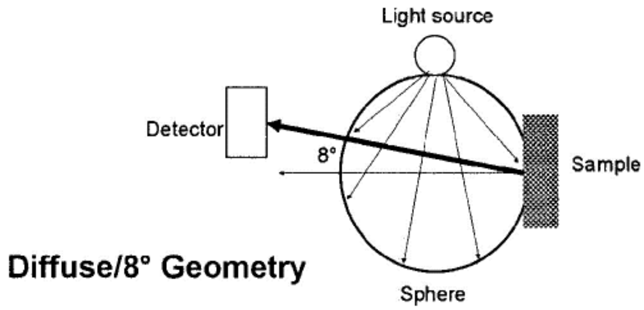
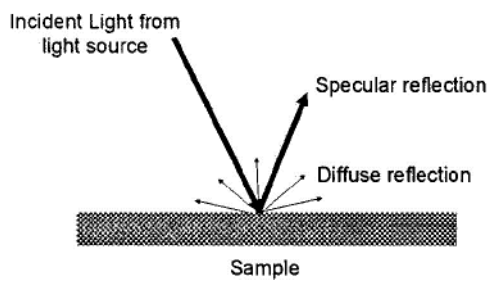
The following HunterLab instruments are built using this geometry: MiniScan EZ Diffuse, UltraScan PRO, and UltraScan VIS.



The 8° viewing variance from the normal allows some of the instruments (UltraScan PRO and UltraScan VIS) to measure reflectance in either specular-included or specular-excluded mode. The specular-included mode measures *total* reflectance, including diffuse reflectance (color) and specular-reflectance (direct reflectance of the light beam in an equal, but opposite, direction; mirror-like reflection or highlight). These two types of reflection are illustrated below. The specular-excluded mode measures diffuse reflection only. The specular component is excluded by opening the section of the sphere from which light would ordinarily be specularly reflected from the sample to the detector. Note that specular -exclusion is not complete in sphere instruments, so different models may yield different results in specular-excluded mode. This difference is particularly noticeable for dark, glossy samples.



Sphere instruments used in the reflectance specular-included mode minimize the effect of differences in gloss, texture, and directionality. For example, if two equally pigmented samples, one glossy and one matte, were measured on a sphere instrument, the readings would indicate that they are roughly equivalent in pigment color, even if they do not appear to be the same visually.

Applications

- Color formulation.
- Measurements for which choice of reflectance mode is important.
- Transmittance measurements of translucent and transparent materials, and for haze measurements (Vista, UltraScan PRO, and UltraScan VIS only).
- Color of brightened bare metals by reflection with specular component included.
- Color matching to a standard of different surface texture.
- Color quality assurance of opaque specimens.

How the Numbers Look

In order to demonstrate that sphere instruments eliminate the effects of texture and gloss, readings of a single piece of plastic with a matte section and a glossy section were made. On visual assessment, the shiny part of the sample looked darker and more saturated that the matte section. Two measurements of each section were made using an UltraScan PRO in RSIN mode.

Plastic ID	L (D65/10°)	a (D65/10°)	b (D65/10°)
Glossy 1	30.67	22.49	7.69
Glossy 2	30.70	22.54	7.72
Matte 1	30.12	22.93	7.98
Matte 2	30.10	22.85	7.95
Range	0.60	0.44	0.29

These numbers agree with our knowledge that the two sections of the plastic contain equal amounts of pigment. The L, a, and b values are very comparable for the two sections.

In order to demonstrate the difference between specular-included mode and specular-excluded mode, a single glossy tile was measured on the same UltraScan VIS in both modes. Two measurements in each mode were made and an average calculated. The numbers obtained are indeed different.

RSIN ID	L (D65/10°)	a (D65/10°)	b (D65/10°)	RSEX ID	L (D65/10°)	a (D65/10°)	b (D65/10°)
Reading 1	48.98	-16.30	8.54	Reading 1	43.94	-17.94	9.38
Reading 2	48.98	-16.29	8.54	Reading 2	43.88	-17.90	9.39
Average	48.98	-16.30	8.54	Average	43.91	-17.92	9.39

References

Billmeyer, Fred W., Jr. and Saltzmann, Max, *Principles of Color Technology*, New York: John Wiley & Sons, Inc., 1981.

Hunter, Richard S. and Harold, Richard W., *The Measurement of Appearance*, New York: John Wiley & Sons, Inc., 1987.

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.

 11/2023

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