

Applications Note

AN 1096

$\Delta = 2t + \frac{\lambda}{2}$ (must equal a whole number of λ for a bright fringe or

$$n\lambda = 2t + \frac{\lambda}{2}$$

$$t = \frac{n\lambda - \frac{\lambda}{2}}{2} = \frac{\lambda}{2} \left(n - \frac{1}{2} \right)$$

substituting

$$D^2 = 2s \left[\frac{\lambda}{2} \left(n - \frac{1}{2} \right) \right]$$



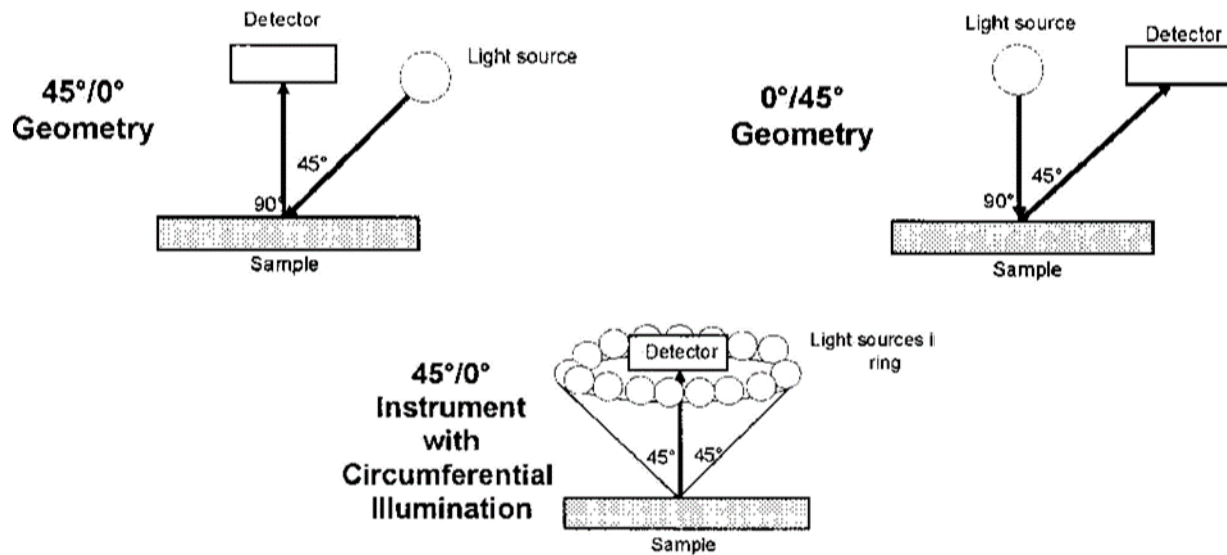
Instrument Geometries and Color Measurement Part 1: 45°/0° and 0°/45°

45°/0° and 0°/45° instruments . . . measure appearance of samples, which includes a color component and a geometric component (gloss and texture).

Abstract

In a description of instrument geometry, the first number is the angle or method of illumination and the second number is the angle or method of viewing. These are both relative to the perpendicular to the surface of the sample being measured. In an instrument with a 45°/0° geometry, the illumination (light source) shines on the sample at an angle 45° from the perpendicular to the sample surface. The viewer (detector) receives the reflected light at a location 0° from (in line with) the perpendicular to the sample. 45°/0° and 0°/45° are reciprocal geometries and yield equivalent measurements.

The following instruments are built using this geometry: ColorFlex 45/0, MiniScan EZ 45/0, and Agera. These instruments can have either circumferential illumination or detection. Circumferential instruments illuminate the sample using many lights in a ring around the sample, 45° from it. See the diagrams below. Measurements using the two types of instruments are slightly different, since circumferential illumination reduces the effects of sample directionality (by providing even lighting across the sample surface). HunterLab ColorFlex EZ 45/0, and MiniScan EZ 45/0 instruments use circumferential illumination. The Agera 0°/45° has circumferential *viewing*.



45°/0° and 0°/45° instruments measure in reflectance-specular-excluded mode only. They optimally measure *appearance* of samples, which includes a color component and a geometric component (gloss and texture). For instance, when a shiny specimen is viewed, it may appear darker and more saturated in color than a matte sample, even if the samples are equally pigmented. A 45°/0° or 0°/45° instrument yields values indicating that the shiny sample *is* darker and more saturated.

Applications

- These instruments "see" color in the same way the eye does and are preferable for applications where this feature is important.
- Measurements for which reflectance-specular excluded mode is preferred.
- For measuring differences in *appearance* of samples, including the effects of color, gloss, and texture.
- 45°/0° and 0°/45° instruments are generally preferred for measuring fluorescent samples and translucent samples by reflection.
- Opaque specimens.
- Color formulation. You should perform color formulation using samples and standards on the same substrate.
- Quality assurance/quality control.

How the Numbers Look

In order to demonstrate that 45°/0° and 0°/45° instruments measure how specimens appear, including the contributions of color and geometry, readings of shiny (silky) and matte cloth of the same color were made. On visual assessment, the shiny fabric looked darker and more saturated than the matte fabric. Two measurements of each fabric were made using an Agera.

Fabric ID	L (D65/10°)	a (D65/10°)	b (D65/10°)
Shiny 1	83.92	10.63	10.98
Shiny 2	84.25	10.45	10.98
Matte 1	85.32	8.74	9.79
Matte 2	85.28	8.86	9.99
Range	1.40	1.89	1.19

These numbers agree with the visual assessment. The shiny samples appear darker and have lower (closer to black) L values. Both a and b are larger (more saturated) for the shiny fabric.

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.

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