

Applications Note

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

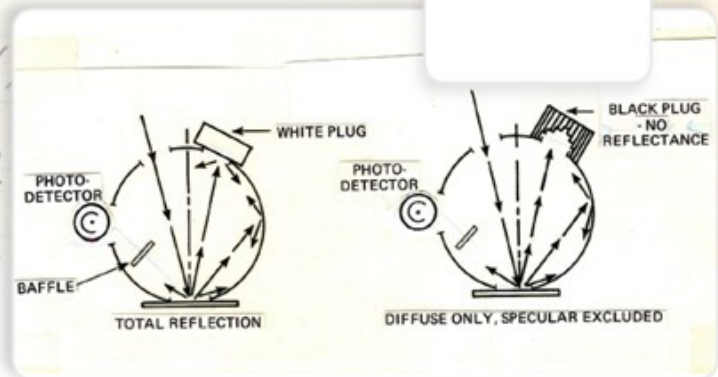
$$n\lambda = 2t + \frac{\lambda}{2}$$

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

substituting

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

AN 1081



Types of Instrument Standards

Standards can be categorized as Calibration, Performance and Diagnostic types.

Abstract

HunterLab instruments are shipped with standards that are used to standardize the instruments and check performance. There are many different types of standards involved with the testing and calibration of each instrument. These types of standards are described within.

Standards for Instrument Calibration

Ideal Reference Standards: Ideal reference standards do not really exist in nature, but are used to represent the top or bottom of a scale. Examples of ideal reference standards include the perfect reflecting diffuser and the perfect transmitting diffuser. The perfect reflecting diffuser diffusely reflects 100% of the light that hits its surface, with no absorption or transmittance. The reflectance value of a perfect reflecting diffuser is 100% across the visible spectrum. The perfect transmitting diffuser likewise diffusely transmits all the light that hits its surface and has a transmittance value of 100% across the visible spectrum.

Primary Standards: Primary standards are actual physical standards established and maintained by a governing body (such as the U.S. National Institute for Standards and Technology [NIST] or the National Physical Laboratory of England). The values of these standards are assigned in a standards laboratory and are those on which all other standard values are based. NIST usually uses magnesium oxide, barium sulfate, or halon (all white substances) as standards to approximate the imaginary perfect reflecting diffuser (see ASTM E259). NIST also has Standard Reference Material (SRM) neutral density filters for transmittance measurements.

Transfer Standards: Transfer standards are standards that are calibrated in terms of an accepted primary standard. For example, HunterLab maintains sets of transfer or “master” standards that are used in the calibration of all HunterLab instruments and standards. These standards are periodically sent to NIST for checking versus NIST’s primary standards.

Instrument “Working” Standards: Working standards are specific to a particular instrument and are used routinely for instrument calibration. The white tiles used in standardization of all HunterLab colorimeters and spectrophotometers are working standards. The X, Y, and Z values of these standards have been assigned based on HunterLab's Transfer Standards. HunterLab's transfer standard values have been assigned based on NIST's primary standards. Therefore, all working standards that HunterLab sells are “traceable” directly to NIST standards. Certificates of Traceability stating this relationship are available from HunterLab on request.

Re-verification of working standards is recommended whenever there is reason to believe that the surface of the standard has changed. When long-term control of absolute measurements is important, it may be desirable to have standards verified by HunterLab on a regular basis, generally once every two years.

Standards for Performance Testing

The green tiles provided with HunterLab spectrophotometers and the sets of colored tiles provided with colorimeters are examples of standards for routine testing of long-term repeatability. After the instrument is calibrated, these standards can be read and compared to factory-read values of the tiles to assess the current performance of the instrument. Such a test can indicate whether the instrument is still performing within specifications or needs maintenance.

Standards for Diagnostic Testing

Diagnostic standards are standards that are not normally checked, but may be used to help in diagnosis if an instrument problem is suspected. These standards would be used by HunterLab's Field Service Department and might include pairs of metameric standards or a series of metal mirrors. Holmium oxide or didymium filters might be used for checking wavelength accuracy of a spectrophotometer (see ASTM E275).

References

ASTM Method E259, "Standard Practice for Preparation of Pressed Powder White Reflectance Factor Transfer Standards for Hemispherical Geometry," American Society for Testing and Materials, 1993.

ASTM Method E275, "Standard Practice for Describing and Measuring Performance of Ultraviolet, Visible, and Near-Infrared Spectrophotometers," American Society for Testing and Materials, 1993.

ASTM Method E284, "Standard Terminology of Appearance," American Society for Testing and Materials, 1995.

ASTM Method E1164, "Standard Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation," American Society for Testing and Materials, 1994.

Billmeyer, Fred W., Jr. and Saltzman, Max, *Principles of Color Technology*, 2nd ed., New York: John Wiley & Sons, 1981.

Carter, Ellen C. and Billmeyer, Fred W., Jr., revised by Rich, Danny C., "ISCC Technical Report 86-1: Guide to Material Standards and Their Use in Color Measurement," Inter-Society Color Council, 1986.

Hunter, Richard S. and Harold, Richard W., *The Measurement of Appearance*, 2nd ed., New York: John Wiley & Sons, 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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