



Standard Guide for Microscopic Examination of Textile Fibers¹

This standard is issued under the fixed designation E 2228; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This section describes guidelines for microscopical examinations employed in forensic fiber characterization, identification, and comparison. Several types of light microscopes are used including stereobinocular, polarized light, comparison, fluorescence and interference. In certain instances, the scanning electron microscope may yield additional information. Select which test(s) or techniques to use based upon the nature and extent of the fiber evidence.

2. Referenced Documents

2.1 ASTM Standards:

D 276 Test Methods for Identification of Fibers in Textiles²

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *anisotropic*—a characteristic of an object, which has optical properties that differ according to the direction in which light travels through the object when viewed in polarized light.

3.1.2 *barrier filter*—a filter used in fluorescence microscopy that suppresses unnecessary excitation light that has not been absorbed by the fiber and selectively transmits only light of greater wavelengths than the cut-off wavelength.

3.1.3 *Becke line*—the bright halo near the boundary of a fiber that moves with respect to that boundary as the fiber is moved through best focus when the fiber is mounted in a medium that differs from its refractive index.

3.1.4 *Becke line method*—a method for determining the refractive index of a fiber relative to its mountant by noting the direction in which the Becke line moves when the focus is changed. The Becke line will always move toward the higher refractive index medium (fiber or mountant when the focal distance is increased and when the focal distance is decreased away from the objective and will move toward the lower refractive index medium when the sample is moved toward the objective.

3.1.5 *birefringence*—the numerical difference in refractive indices for a fiber, given by the formula: $n_{\parallel} - n_{\perp}$. Birefrin-

gence can be calculated by determining the retardation (r) and thickness (T) at a particular point in a fiber and by using the formula: $B = r \text{ (nm)}/1000T \text{ (}\mu\text{m)}$.

3.1.6 *comparison microscope*—a system of two microscopes positioned side-by-side and connected via an optical bridge in which two specimens may be examined simultaneously in either transmitted or reflected light.

3.1.7 *compensator*—any variety of optical devices that can be placed in the light path of a polarizing microscope to introduce fixed or variable retardation comparable with that exhibited by the fiber. The retardation and sign of elongation of the fiber may then be determined. Compensators may employ a fixed mineral plate of constant or varying thickness or a mineral plate that may be rotated, or have its thickness varied by tilting to alter the thickness presented to the optical path (and retardation introduced) by a set amount.

3.1.8 *compensator, full wave (or red plate)*—a compensator usually a plate of gypsum, selenite or quartz, which introduces a fixed retardation between 530 to 550 nm (approximately the retardation of the first order red color on the Michel-Levy chart).

3.1.9 *compensator, quarter wave*—a compensator, usually with a mica plate, which introduces a fixed retardation between 125 to 150 nm.

3.1.10 *compensator, quartz wedge*—a wedge, cut from quartz, having continuously variable retardation extending over several orders of interference colors (usually 3 to 7).

3.1.11 *compensator, Sénarmont*—a quarter-wave plate inserted above the specimen in the parallel “0” position with a calibrated rotating analyzer. Measures low retardation and requires the use of monochromatic light.

3.1.12 *compensator, tilting (Berek)*—a compensator typically containing a plate of calcite or quartz, which can be tilted by means of a calibrated drum to introduce variable retardation up to about ten orders.

3.1.13 *cortex*—the main structural component of hair consisting of elongated and fusiform (spindle-shaped) cells. The cortex may contain pigment grains, air spaces called cortical fusi, and structures called ovoid bodies.

3.1.14 *crimp*—the waviness of a fiber.

3.1.15 *crossover marks*—oblique flattened areas along silk fibers caused by the overlapping of extruded silk fibers before

¹ This guide is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.01 on Criminalistics. Current edition approved August 10, 2002. Published October 2002.

² *Annual Book of ASTM Standards*, Vol 07.01.