



Standard Practice for Training in the Forensic Examination of Hair by Microscopy¹

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1. Scope

1.1 This practice covers training guidelines for use by forensic laboratory personnel responsible for training forensic examiners that will perform hair examinations, including microscopical comparisons of human hair.

1.2 Forensic hair examiners are trained in accordance with Practice E2917 and the discipline-specific guidelines (Guide E3316) and criteria within this practice.

1.3 This practice contains guidelines that include the tasks, goals, and objectives that allow the trainee to acquire the requisite knowledge, skills, and abilities to independently perform casework in the microscopical examination of hair.

1.4 This practice addresses the correlation between the analytical results of microscopical examinations and the potential for DNA analysis.

1.5 This practice addresses training for the microscopical examination of hairs and not the examination of chemical alterations (for example, hair dye) or trace materials on the surface of hairs (for example, hair care products).

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

¹ This practice is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.15 on Trace.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

E620 Practice for Reporting Opinions of Scientific or Technical Experts
E1459 Practice for Physical Evidence Labeling and Related Documentation
E1492 Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory
E1732 Terminology Relating to Forensic Science
E2917 Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs
E3316 Guide for Forensic Examination of Hair by Microscopy

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, refer to Terminology E1732.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *anagen, n*—the active growth phase of a hair follicle in the hair growth cycle.

3.2.1.1 *Discussion*—The root from a pulled anagen hair is elongated and is usually fully pigmented.

3.2.2 *ancestral group, n*—a biogeographic designation of human populations (for example, Asian, African, European) whose hair can share similar morphological and microscopic traits.

3.2.2.1 *Discussion*—The racial terms Caucasoid, Mongoloid, and Negroid should not be used as these terms are no longer acceptable in the field of anthropology (the field from which these designations originated).

3.2.3 *association, inclusion, n*—the result of a comparison between two hair samples in which the characteristics of the questioned hair are present in the known hair sample without any exclusionary differences and, therefore, the donor of the known sample can be included as a possible source of the questioned hair.

3.2.3.1 *Discussion*—A microscopical association of hair cannot identify the definitive source of a questioned hair to the exclusion of all others and the number of individuals who could be included as a possible donor of a specific hair is unknown and cannot be reliably estimated.

3.2.4 *buckling, n*—an abrupt change in the shape and orientation of a hair shaft with or without a slight twist.

3.2.5 *catagen, n*—the transitional phase of the hair follicle between the active growth phase (anagen) and the resting phase (telogen) in the hair growth cycle.

3.2.6 *classification, n*—the systematic arrangement of hairs into categories (for example, human, animal, somatic origin, ancestry) based on shared traits.

3.2.7 *cortex, n*—the primary anatomical region of a hair between the cuticle region and the medullary region composed of elongated and fusiform cells.

3.2.8 *cortical fusi, n*—small air spaces that form between the cortical cells in the hair shaft and, under transmitted light, appear as tiny, dark structures.

3.2.9 *cortical texture, n*—the relief or definition of the margins of the cortical cells when viewed using transmitted light microscopy.

3.2.10 *cross-sectional shape, n*—the shape of a hair shaft when cut at a right angle to its longitudinal axis.

3.2.10.1 *Discussion*—When viewed longitudinally with transmitted light, the apparent cross-sectional shape is determined by slowly focusing through the hair (optical cross-sectioning). When viewed longitudinally between crossed polars, the cross-sectional shape can be determined by observing the interference colors.

3.2.11 *cuticle, n*—the outermost region of a hair composed of layers of overlapping scales.

3.2.11.1 *Discussion*—The dimension of the cuticle as measured from its outer margin to the cortex is often described in relative terms (for example, thin, medium, thick).

3.2.12 *cuticle, cracked, n*—a cuticle with linear breaks that are perpendicular to the length of the shaft.

3.2.13 *cuticle, looped, n*—a feature in which the distal edges of the cuticular scales are curved away from or cupped toward the hair shaft.

3.2.14 *cuticle, serrated, n*—a cuticle in which the outer margin has a notched appearance like a saw blade.

3.2.15 *decompositional changes, n*—alteration in the root or the proximal end of a hair that can include discoloration, postmortem root banding, or a tapered or brush-like appearance, as well as fungal tunneling along the length of the shaft.

3.2.16 *distal end, n*—the end of the hair farthest away from the root.

3.2.17 *exclusion/elimination, n*—the result of a comparison between two hair samples in which exclusionary differences are observed in the characteristics of the questioned hair that are not present in the known hair sample, and therefore the donor of the known sample can be excluded as a possible source of the questioned hair.

3.2.17.1 *Discussion*—This result is reached in a comparative hair examination when exclusionary differences (for example, color, characteristics indicative of ancestry) are noted in the macroscopic or microscopic characteristics between the questioned and known hairs. In these circumstances, the source of the known hairs, as represented by the known sample, is eliminated as a possible source of the questioned hair.

3.2.18 *exclusion with limitations, n*—the result of a comparison between two hair samples in which the characteristics of the questioned hair differ from those present in the known hair sample, and therefore the donor of the known sample cannot be included as a possible source of the questioned hair.

3.2.18.1 *Discussion*—This result is reached in a comparative hair examination when differences are noted in the macroscopic or microscopic characteristics between the questioned and known hairs; however, the differences are insufficient for an absolute exclusion of a person as a possible source. This could be due to the natural variation that occurs in hairs as a biological specimen, the effect that time or environment can have upon a hair, or the reference sample does not capture the complete variation of the individual's hair.

3.2.19 *exclusionary difference, n*—a difference in a feature or property between compared items that is substantial enough to determine that they did not originate from the same source.

3.2.20 *fungal tunneling, n*—air pockets in a hair shaft caused by fungal growth.

3.2.21 *hair, n*—a fibrous outgrowth from the skin of mammals.

3.2.22 *hair follicle, n*—an invagination of the epidermis which contains the root of the hair.

3.2.23 *imbricate, n*—a term that describes a scale pattern in which the scales overlap and the edges have an irregular wavy pattern. This pattern is typical of human hair.

3.2.24 *inconclusive, n*—the result of a comparison between two hair samples in which similarities and differences were observed in the characteristics of the provided standard and the questioned hair to the extent that the known source of the standard could not be included or excluded as a possible source of the questioned hair.

3.2.25 *individualization, n*—a term indicating an individual can be discriminated to the exclusion of all other sources.

3.2.25.1 *Discussion*—Hairs cannot be individualized via microscopical hair comparison.

3.2.26 *inner cuticle margin, n*—the border between the cortex and the visible cuticle.

3.2.27 *keratin, n*—a class of sulfur-containing fibrous proteins that forms the foundation of outgrowth tissue from the epidermis, such as hair, nails, feathers, and horns.

3.2.28 *macroscopic, n*—a term that describes characteristics large enough to be perceived without magnification.

3.2.29 *medulla, n*—the core of the hair shaft that is composed of vacuoles and cells that can be air- or fluid-filled.

3.2.29.1 *Discussion*—The medulla (if present) occurs in a continuous, discontinuous, or fragmented pattern along the length of a hair and appears translucent or opaque.

3.2.30 *microscopic, n*—a term that describes characteristics too small to be resolved by the unaided eye, but large enough to be resolved with a microscope.

3.2.31 *microscopical, n*—concerning a microscope or the use of a microscope.