



Standard Guide for Forensic Examination of Fibers¹

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1. Scope

1.1 This guide is an introduction to the examination of textile fibers in forensic casework. It is intended to assist individuals who conduct fiber analyses in their evaluation, selection, and application of tests that can be of value to their examinations. The goal is to provide a consistent approach to fiber analysis. Detailed descriptions of procedures for many of the techniques are addressed in separate documents (Guides E2224, E2225, E2227, and E2228). This standard is not intended as a detailed process description or rigid scheme for the analysis and comparison of fibers, but as a guide to the strengths and limitations of each analytical technique.

1.2 *This standard is intended for use by competent forensic science practitioners with the requisite formal education, discipline-specific training (see Practice E2917), and demonstrated proficiency to perform forensic casework.*

1.3 *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.*

1.4 *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

D123 Terminology Relating to Textiles

D7641 Guide for Textile Fibers

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 by a Forensic Service Provider

E1732 Terminology Relating to Forensic Science

E2224 Guide for Forensic Analysis of Fibers by Infrared Spectroscopy

E2225 Guide for Forensic Examination of Fabrics and Cordage

E2227 Guide for Forensic Examination of Dyes in Textile Fibers by Thin-Layer Chromatography

E2228 Guide for Microscopical Examination of Textile Fibers

E2917 Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs

E3406 Guide for Microspectrophotometry in Forensic Fiber Analysis

2.2 Other Documents:

ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories³

OSAC 2022-N-0018 Standard Practice for a Forensic Fiber Training Program⁴

OSAC 2022-S-0029 Standard Guide for Interpretation and Reporting in Forensic Comparisons of Trace Materials⁴

3. Terminology

3.1 *Definitions*—For additional terms commonly employed for fiber examinations, see Terminology E1732 and Guide E2228. For additional terms relating to textiles, see Terminology D123 and Guide D7641.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *exclusionary difference, n*—a difference in one or more characteristics between compared items that is sufficient to determine that the compared items did not originate from the same source, are not the same source, or do not share the same composition or classification. **E1732**

3.2.2 *generic class, n*—as used with textile fibers, a grouping having similar chemical compositions or specific chemical characteristics. **E1732**

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

³ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

⁴ Available from Organization of Scientific Area Committees for Forensic Science (OSAC), 100 Bureau Dr., MS 6020, Gaithersburg, Maryland 20899, US, <http://www.nist.gov/osac>.

3.2.2.1 *Discussion*—A generic name applies to all members of a group and is not protected by trademark registration. Generic names for manufactured fibers include, for example, rayon, nylon, and polyester. Generic names used in the United States for manufactured fibers were established as part of the Textile Fiber Products Identification Act enacted by Congress in 1954.

3.2.3 *inorganic fibers, n*—a class of fibers of natural mineral origin (for example, chrysotile asbestos) and man-made mineral origin (for example, fiberglass). **E2228**

3.2.4 *manufactured fiber, n*—a class name for various genera of fibers (including filaments) produced from fiber forming substances which can be (1) polymers synthesized from chemical compounds [synthetic fibers], (2) modified or transformed natural polymers [regenerated fibers], and (3) minerals, for example, glasses. **(1)⁵**

3.2.4.1 *Discussion*—Acrylic, nylon, polyester, olefin, urethane, and polyvinyl are examples of fiber synthesized from chemical compounds. Cellulose based fibers, such as acetate and rayons, and alginate fibers are examples of modified or transformed polymers. **E1732**

3.2.5 *natural fibers, n*—a class name for various genera of fibers (including filaments) of: (1) animal (for example, silk, wool); (2) mineral (for example, asbestos); or (3) vegetable (for example, cotton, flax, jute, ramie) origin.

3.2.6 *synthetic fibers, n*—a class of manufactured polymeric fibers, which are synthesized from chemical compounds (for example, nylon and polyester). **E1732**

3.2.7 *target fibers, n*—questioned fibers selected for further examination based on their resemblance to the known sample.

3.2.8 *technical review, n*—a qualified second party's evaluation of reports, notes, data, and other documentation to ensure there is appropriate and sufficient support for the actions, results, conclusions, opinions, and interpretations.

3.2.9 *verification, n*—provision of objective evidence that a given item fulfills specified requirements. **ISO/IEC 17025 (2017)**

3.2.9.1 *Discussion*—The process through which the analyses of a forensic science practitioner (FSP) are compared by a second, independent FSP so that the findings of the first FSP are corroborated or can be corrected in situations where there is a disagreement.

3.2.9.2 *Discussion*—Verifications can be open or blind. Blind verifications are more robust than open verifications.

4. Summary of Guide

4.1 The basic activities involved in a fiber examination include case assessment, the search for and collection of fibers, preparation of the sample(s) for analysis, analysis using appropriate techniques, and evaluation of results.

4.2 The analysis of evidentiary fiber samples includes the examination of physical characteristics, including color, optical

properties, spectral properties, and chemical composition. The techniques described in this guide provide complementary information and are selected and employed in an order that considers sample preservation and the amount of discriminating information that can be obtained.

5. Significance and Use

5.1 Fibers are frequently encountered in casework, whether it be through the evidentiary item itself (for example, clothing, rope), or through the processing and collection of fibers from evidentiary items. Fibers can be exchanged between individuals, between individuals and objects, and between objects.

5.2 Fibers are subjected to a variety of manufacturing processes in order to produce textile materials for application in a wide range of industries (for example, automotive, clothing, home furnishing). Factors such as end use, current trends, and availability influence the type, color, and frequency of fibers incorporated into textiles.

5.3 Fibers exhibit a wide range of physical characteristics, including color, optical properties, spectral properties, and chemical compositions due to the manufacturing process, end use, and exposure to post-manufacturing changes (for example, exposure to various environmental conditions, chemicals, etc.). These characteristics and properties are observed, analyzed, and compared during a fiber examination.

6. Case Assessment

6.1 The samples to be analyzed are determined in the case assessment phase. Sample size, sample variability, sample condition, environmental effects, evidential value (for example, are the persons of interest known to have contact prior to incident?), and collection and packaging techniques are all taken into account. The FSP chooses the analytical techniques, sample preparation schemes, testing sequences, and degree of sample alteration and consumption that are suitable to the specific case.

6.2 Fiber examination involves the observation and interpretation of data; therefore, opportunities for bias exist **(2-4)**. Measures to address the effects of potential bias can include:

6.2.1 Receiving adequate training to conduct fiber examinations (refer to OSAC 2022-N-0018), including cognitive bias and methods that can mitigate or help avoid the effects of biasing information and procedures.

6.2.2 Avoiding task-irrelevant information (for example, suspect's confession or investigator's opinions) **(5, 6)**.

6.2.2.1 Information initially deemed task-irrelevant could be needed to streamline casework **(7)**. For example, when both parties live in the environment where the alleged incident took place, the decision could be made to not perform a fiber analysis, as any fiber associations found could not be directly attributed to the incident in question.

6.2.2.2 If task-irrelevant information is used, how the FSP uses that information in their decision-making process is documented.

6.2.3 As practicable, evaluating and documenting questioned fibers prior to known fiber samples during the examination process.

⁵ The boldface numbers in parentheses refer to a list of references at the end of this standard.