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Standard Guide for Forensic Physical Fit Examination[1]

This standard is issued under the fixed designation E3392; 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 guide covers the forensic physical fit examinations for the macroscopical and microscopical examinations of broken, torn, or separated materials for the purpose of determining whether or not they were once joined together to form a single object. This guide is intended as an overview of the process for the physical fit examination of these materials and to assist individuals in the evaluation and documentation of their physical comparisons.

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 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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.*

1.5 *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]

C1256 Practice for Interpreting Glass Fracture Surface Features

E1459 Guide for Physical Evidence Labeling and Related Documentation

E1492 Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory

E1610 Guide for Forensic Paint Analysis and Comparison

E1732 Terminology Relating to Forensic Science

E2225 Guide for Forensic Examination of Fabrics and Cordage

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

E3260 Guide for Forensic Examination and Comparison of Pressure Sensitive Tapes

2.2 *Other Documents:*

ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories[3]

OSAC 2022-S-0029 Standard Guide for Interpretation and Reporting in Forensic Comparisons of Trace Materials[4]

3. Terminology

3.1 *Definitions*—For additional terms commonly employed for general forensic examinations see Terminology E1732, and for fractography see Practice C1256.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *arrest lines, n*—a sharp line on the fracture surface defining the crack front shape of an arrested or momentarily-hesitated crack. **(1)**[5]

3.2.2 *fractography, n*—the means and methods for characterizing fractured specimens or compounds. **(1)**

3.2.3 *individual characteristics, n*—the attribute(s) that establish(es) a single source.

3.2.3.1 *Discussion*—Other terms used include random accidental characteristics, randomly acquired characteristics, and distinguishing characteristics.

3.2.4 *physical fit, n*—an association based upon the realignment of two or more items that demonstrate they were once joined together to form a single object.

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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.

[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 National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

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

3.2.4.1 *Discussion*—The term match (for example, physical match, fracture match) is not recommended to be used as it can be misleading to the layperson.

3.2.5 *scarp, n*—subtle curved line on a fracture surface caused by interaction of a propagating crack and a liquid or a reactive environment. **(1)**

3.2.6 *taphonomy, n*—the study of the processes affecting remains after death. **(OSAC Lexicon)**

3.2.7 *technical review, n*—a qualified second party's evaluation of reports, notes, data, and other documentation to determine there is appropriate and sufficient support for the actions, results, conclusions, opinions, and interpretations. **(OSAC Preferred Term – Lexicon)**

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

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

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

4. Summary of Guide

4.1 Physical fit examination is the process of evaluating two or more items to form an opinion about whether they were once joined together. It is based on the premise that separation events (for example, breaks, cuts, tears) are not reproducible, in whole or in part, because of the combination of applied forces, construction features, and material properties that can impart individual characteristics.

4.2 Physical fit examinations can involve the assessment or reassembly of multiple pieces prior to the comparison of a questioned sample to a possible known source.

4.3 Separation occurs in a variety of ways (for example, broken, cut, torn). Separated materials that possess irregular edges and individual characteristics on their complementary surfaces can be realigned to demonstrate they were at one time a single object. The physical fit can be viewed in two or three dimensions.

4.4 The absence of edge detail or material loss does not always rule out the possibility of a physical fit. A physical fit could result when physical features align across the separation boundary (for example, striations, wood grain, printing).

4.5 Different types of materials exhibit various types of individual characteristics based on their construction, chemical structure, and physical properties. The recognition and distinction between class and individual characteristics for different types of materials allows the use of the same general procedures for the physical fit examinations of all materials.

4.6 This guide contains a general procedure to perform physical fit examinations as well as a summary of considerations and limitations for an examiner to evaluate when conducting these examinations.

5. Significance and Use

5.1 This guide can assist the examiner in selecting and organizing a general analytical scheme for the evaluation and documentation of physical comparisons of materials for a potential physical fit. The type and size of material influences the exact steps and equipment needed to assess the physical fit. Evaluation, documentation, and interpretation are all important parts of a physical fit examination.

5.2 This guide addresses special considerations for physical fit analysis for glass, skeletal material, polymers, tapes and textiles.

5.3 Foundations of physical fit examination in forensic science are described in the literature, including studies on the fractography of different materials and the use of physical fit examinations in forensic casework **(1-12)**.

5.4 It is not the intention of this guide to present comprehensive theories regarding the mechanism of fractures, tearing, cutting, or other methods of separation. This information is available from training courses and reference materials such as Practice C1256 and others **(3-7, 13)**.

6. Quality Assurance Considerations

6.1 A quality assurance program is used to assess and verify that analytical testing procedures and reporting of results is monitored by means that include, but are not limited to, proficiency tests and technical audits. General quality assurance guidelines are available in ISO/IEC 17025.

7. Apparatus and Materials

7.1 Different equipment is used depending on the material being examined and the case specifics.

7.2 General list of common materials utilized:

7.2.1 Camera.

7.2.2 Microscopes (for example, stereomicroscope, comparison microscope).

7.2.3 Magnifier.

7.2.4 Polarizing filters.

7.2.5 Light box.

7.2.6 Oblique lighting.

7.2.7 Alternate light source(s).

7.2.8 Clay.

7.2.9 Casting material.

7.2.10 Plastic sheets.

7.2.11 Scanners.

7.2.12 Solvents.

7.2.13 Ruler.

7.2.14 Micrometer.

7.2.15 Sample handling tools (for example, probe, forceps).

7.2.16 Packaging and documentation materials (for example, labels, markers).

7.2.17 Tape.

8. Sample Handling

8.1 The general handling and tracking of samples should meet or exceed the requirements of Practice E1492 and Guide E1459.