

Technical Procedure for the Examination of Fabric

1.0 Purpose – This technical procedure shall be followed for the examination of fabric, including fabric damage, cut versus torn determination and fabric impressions.

2.0 Scope – This procedure applies to the analysis of fabric samples within the Trace Evidence Section, including clothing and other stitched items. Examinations shall be conducted by a fiber-trained Forensic Scientist.

3.0 Definitions – N/A

4.0 Equipment, Materials, and Reagents

4.1 Equipment

- Stereomicroscope
- UV light
- Camera

4.2 Materials

- Forceps
- Probes
- Scalpel
- Razor blades
- Glass slides and cover slips
- Ruler

4.3 Reagents

- Nail polish, evaporated to approximately 50 % concentration
- Xylene Substitute
- Casting media such as Mikrosil

5.0 Procedure

5.1 Analytical Approach

5.1.1 General Guidelines

5.1.1.1 The Forensic Scientist shall approach a fabric comparison by attempting to show that the samples are different. The failure to detect any significant differences, after exhausting the methodology available to the Forensic Scientist, results in the conclusion that the known and questioned items could have a common origin.

5.1.1.2 Unless specified otherwise, the same methods of analysis shall be conducted on both the questioned and known samples. The same descriptions, measurements,

observations and/or instrumental analyses shall be taken and compared side-by-side as the examination progresses.

5.1.1.2.1 The order of the examination is based on the quantity, quality, type of the evidence and the Forensic Scientist's training and experience.

5.1.1.2.2 Some of the tests available to fiber-trained Forensic Scientists are destructive. When sample size is limited, destructive testing, if necessary, shall only be performed after all non-destructive testing is complete.

5.1.1.3 All results shall be based on the Forensic Scientist's knowledge and experience and the case being examined. Results shall be in agreement with the technical reviewer.

5.1.2 In fabric analysis, two overall types of examination may occur.

5.1.2.1 Analysis of a questioned item to determine if it originated from the known item.

5.1.2.2 Analysis comparing two samples to determine if they could have been made by the same manufacturer.

5.1.3 If the entire sample will be deconstructed during analysis, photographs shall be taken prior to analysis.

5.1.4 A physical match examination shall be conducted if necessary based on the Forensic Scientist's training and experience. See the Trace Evidence Section [Technical Procedure for Physical Match Analysis](#).

5.1.4.1 The questioned and known evidence shall not be brought into direct contact until a preliminary examination of both items has been completed. Debris shall be removed and secured for possible further examination.

5.1.4.2 If no physical match is possible, or a physical match cannot be made, the Forensic Scientist shall continue describing the overall fabric construction for each item.

5.1.5 Using a stereomicroscope, perform a preliminary examination. Note the size, shape, and condition (stains, patterns, cut/torn/damaged edges, etc.) of both the known and questioned items.

5.1.6 Perform a detailed examination of the item as explained in 5.2. If the item is a charred/burned fabric, go to 5.3. If a cut/torn determination has been requested, go to 5.4. If the item involves fabric impressions, go to 5.5.

5.1.7 Once the fabric analysis is complete, the fabric shall be broken down into its component yarns. Yarns shall be analyzed and compared following the Trace Evidence Section [Technical Procedure for Examination of Cordage](#)

5.1.8 Once the yarn analysis and comparison is complete, the yarns shall be broken down into their component fibers. Fibers shall be analyzed and compared following the Trace Evidence Section [Technical Procedure for Examination of Fibers](#).

5.1.9 Once all visual, microscopical, chemical and instrumental examinations have been completed, the Forensic Scientist shall issue a report stating his or her findings. If questioned and known samples have been found to be consistent with each other, a second qualified forensic scientist shall verify the fiber association. This Forensic Scientist shall initial the microscope slides involved and complete a verification review in FA.

5.2 Overall Examination of Fabric

5.2.1 Determine the number of fabrics present in the item and remove samples of each type along with any stitching threads or yarns.

5.2.2 Determine whether an item is homemade or factory manufactured and describe the general fabric type as woven, knit or nonwoven.

5.2.3 Document the specific type of fabric and its construction.

5.2.4 Document the fabric's design and pattern. Note any color patterns (individual colored yarns or colors printed on fabrics) and construction patterns (different types or sizes of yarn, cut versus uncut pile yarns, etc.)

5.2.5 Note any points which may relate a questioned piece of fabric with a type of garment or other stitched item (class characteristics). This includes, but is not limited to: edges, seams, stitching, linings, trim, labels or attachments (buttons, hooks, snaps, etc.).

5.2.6 Look for points that may relate a questioned item to a specific known item (individual characteristics). This includes, but is not limited to: damage, stains or other foreign matter that continues over both items, manufacturer's flaws, mended areas or added accessories.

5.2.7 Compare all of the above-listed color, construction and compositional characteristics of the known and questioned items.

5.3 Examination of Charred and Burned Fabric

5.3.1 Taking care to handle the sample carefully, determine as many of the following fabric or garment characteristics as possible:

5.3.1.1 Weave or knit pattern and yarn construction.

5.3.1.2 Original color and composition by checking points of least damage (yarns crossings, inner position of seams, etc.).

5.3.1.3 Portions of seams, hems, pockets, tags, snaps, zippers, buttons, rivets, etc.

5.3.1.4 Using ultraviolet and/or infrared lighting techniques, attempt to restore or visualize any writing or printing (e.g., labels, laundry markings).

5.3.2 Compare to a known sample if available and issue a report. If no known sample is available, issue a report describing the findings.

5.4 Examination of Cut or Torn Fabrics

5.4.1 Look for characteristic indicators of a material being cut or torn.

5.4.1.1 Cutting indicators

- No preferred direction of damage or rapid changes in direction. This may also include discontinuities typical of scissor-cut stoppages.
- Clean, relatively featureless edges with an ability to fiber end or pattern match.
- Presence of a significant planar array.

5.4.1.2 Tearing indicators

- Damage follows a clearly-preferred direction (usually parallel to the warp/fill or courses/wales).
- Fabric exhibits associated stretching or distortion.
- Fabric exhibits noticeable curling along the severance line.
- Edges are devoid of planar array.

5.4.2 Using an undamaged area of the garment, make test cuts/tears as necessary.

5.4.3 Issue a report detailing the findings.

5.5 Examination of Fabric Impressions

5.5.1 Examination may involve the questioned item bearing the actual impression, a lift of an impression or a cast of an impression.

5.5.2 All impressions shall be photographed before proceeding with analysis.

5.5.3 Examine the questioned impression.

5.5.3.1 Remove any embedded or adhering fibers or yarns that may be analyzed separately.

5.5.3.2 Determine the type of fabric that left the impression and describe the fabric pattern and construction.

5.5.3.3 If impressions may have originated from a garment, look for indications of seams, stitching, zippers, buttons, etc.

5.5.3.4 Look for signs of fabric damage or mended areas that may relate the impression to a specific item.

5.5.4 Examine the known item believed to have made the questioned impression.

5.5.4.1 Start by looking for damaged, soiled, or stained areas on the item.

5.5.4.2 Attempt to isolate patterns found in the questioned specimen.

5.5.5 Prepare a variety of test impressions of the known item using a method appropriate to the material at hand. This may include, but is not limited to, the use of ink, modeling clay, epoxy, casting material (e.g., mikrosil) or photographic overlays.

5.5.6 Compare the known and questioned impressions by comparing as many fabric construction characteristics as possible.

5.6 Guidelines for Fabric Analysis Result and Conclusion Statements

5.6.1 The reports shall read as follows. The wording of the results shall accurately describe the evidence at hand.

5.6.2 Positive

5.6.2.1 Fabric Analysis

5.6.2.1.1 This statement shall be used when the questioned and known samples are consistent in color, construction and composition.

5.6.2.1.1.1 Example: Item A was found to be consistent in color, construction and composition with Item B. Therefore, Item A could have originated from [the same source as] Item B.

5.6.2.1.2 Qualifying statements shall be added to the report where appropriate, based on the Forensic Scientist's training and experience (e.g., limited testing performed).

5.6.2.2 Cut/Torn Determination

5.6.2.2.1 Example: Examination of Item A revealed an area of separation that is consistent with cutting/tearing the fabric.

5.6.2.3 Fabric Impressions

5.6.2.3.1 Example: Examination of Item A revealed a fabric impression that is consistent in construction with the fabric in Item B. Therefore, Item B could have formed the impression found in/on Item A.

5.6.3 Inconclusive

5.6.3.1 These statements shall be used when, based on the acquired data, no conclusion could be reached.

5.6.3.1.1 Example: Item A was found to be consistent in __ to Item B; however, slight differences were noted in _____. Therefore no conclusion could be reached as to whether or not Item A could have originated from [the same source as] Item B.

5.6.3.1.2 Example: Due to the nature/condition of Item A, no conclusion could be reached as to whether or not Item A could have originated from [the same source as] Item B.

5.6.4 Negative

5.6.4.1 These statements shall be used when one or more of the characteristics associated with the questioned and known samples are different.

5.6.4.1.1 Example: Item A is not consistent with Item B. Therefore, Item A could not have originated from [the same source as] Item B.

5.6.4.1.2 Example: Item A was found to have different manufacturing characteristics from Item B. Therefore, Item A could not have originated from [the same source as] Item B.

5.6.5 No Analysis

5.6.5.1 No analysis is performed

5.6.5.1.1 Example: The above listed evidence is being returned unanalyzed. If you have any questions, please contact the Forensic Scientist who issued this report.

5.6.5.1.2 Example: Due to the nature/condition of the evidence, no analysis could be performed.

5.6.5.2 No analysis is performed due to the results of the DNA analysis.

5.6.5.2.1 Example: Based on the results of DNA analysis, the above listed evidence is being returned unworked. If you have any questions, please contact the Forensic Scientist who issued this report.

5.7 Standards and Controls – N/A

5.8 Calibration – N/A

5.9 Maintenance – No maintenance is required in this procedure. However, the procedure does utilize instruments that require maintenance. See the individual technical procedures for the operations of those instruments.

5.10 Sampling and Sample Selection

5.10.1 No sampling is performed. When sample selection occurs, it shall be based on the Forensic Scientist's training and experience.

5.10.2 If at any point during the course of examination the items are found to be inconsistent with one another, analysis may be halted and a lab report must be issued stating a negative finding.

5.10.3 If a physical match can be made between two items, analysis may be halted and a lab report shall be issued stating a positive finding.

5.10.4 If no standards are submitted, the evidence may be returned to the agency unworked.

5.10.5 If DNA analysis is being performed on the evidence in the case, based on the results of the DNA analysis, the fiber evidence may be returned unworked.

5.11 Calculations – N/A

5.12 Uncertainty of Measurement – N/A

6.0 Limitations - Fabric and textile items are derived from a manufactured material. In general, it shall not be possible to identify an item as having come from a particular source to the exclusion of all others. One exception to this shall be in the case of a physical match.

7.0 Safety - Items may have blood or other body fluids present. Use protective equipment when dealing with items that may contain biohazard material.

8.0 References

8.1 ASTM / SWG Guidelines

ASTM Standard E2225, 2002, "Standard Guide for Forensic Examination of Fabrics and Cordage." ASTM International, West Conshohocken, PA, 2002.

SWGMA. "Forensic Fiber Examination Guidelines." *Forensic Science Communications* 1.1 (1999). Chapter 7.

8.2 Books

Hatch, K.L. *Textile Science*. New York: West Publishing Company, 1993.

Robertson, J. and M. Grieve, eds. *Forensic Examination of Fibres*. 2nd Ed. London: Taylor and Francis, 1999.

Taupin, J.M. and C. Cwiklik. *Scientific Protocols for Forensic Examination of Clothing*. Boca Raton: Taylor & Francis Group, 2011.

8.3 Journal Articles

Daly, D.J., M.A. Lee-Gorman and J. Ryan. "Distinguishing Between Damage to Clothing as a Result of Normal Wear and Tear of as a Result of Deliberate Damage: A Sexual Assault Case Study." *Journal of Forensic Sciences* 54.2 (2009): 400-403.

Monahan, D.L. and H.W.J. Harding. "Damage to Clothing – Cuts and Tears." *Journal of Forensic Sciences* 35.4 (1990): 901-912.

Taupin, J.M. "Clothing Damage Analysis and the Phenomenon of the False Sexual Assault." *Journal of Forensic Sciences* 45.3 (2000): 568-572.

Taupin, J.M. "Damage to a Wire Security Screen: Adapting the Principles of Clothing Damage Analysis." *Journal of Forensic Sciences* 43.4 (1998): 897-900.

Taupin, J.M. "Testing conflicting Scenarios – A Role for Simulation Experiments in Damage Analysis of Clothing." *Journal of Forensic Sciences* 43.4 (1998): 891-896.

8.4 Training Materials

Introduction to Hairs and Fibers (2007 Training Materials), FBI.

9.0 Records – N/A

10.0 Attachments – N/A

Revision History		
Effective Date	Version Number	Reason
09/17/2012	1	Original ISO Document