
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 Unit, including clothing and other stitched items. Fabric examinations shall be conducted by a Forensic Scientist trained in fiber analysis. Physical match analyses involving fabric shall be conducted by a Forensic Scientist trained in fabric physical match examinations.

3.0 Definitions – N/A

4.0 Equipment, Materials, and Reagents

4.1 Equipment

- Stereomicroscope
- UV light
- Camera
- Alternate light source

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 available tests are destructive. When sample size is limited, destructive testing, if necessary, shall be performed only 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** 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. If a questioned and known item will be brought into direct contact, visible debris shall be removed and secured for possible further examination.
- 5.1.3** If the entire sample will be deconstructed or destroyed during analysis, photographs shall be taken prior to analysis.
- 5.1.4** In fabric analysis, several overall types of examination may occur.
 - 5.1.4.1** A physical match examination shall be conducted if necessary. See the Trace Unit [Technical Procedure for Physical Match Examinations](#).
 - 5.1.4.2** Comparison of two intact items to determine if they could have been made by the same manufacturer (class characteristics or common manufacturing characteristics) (see **5.2**).
 - 5.1.4.3** Comparison of two items to determine if a questioned item could have originated from the known item (comparison of question and known pieces) (see **5.2**).
 - 5.1.4.4** Examination of charred and burned fabrics (see **5.3**).
 - 5.1.4.5** Examination of cut and torn fabrics (see **5.4**).
 - 5.1.4.6** Examination of fabric impressions (see **5.5**).
- 5.1.5** 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 Unit [Technical Procedure for Examination of Cordage](#).
- 5.1.6** 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 Unit [Technical Procedure for Examination of Fibers](#).

Once all visual, microscopic, chemical and instrumental examinations have been completed and compared, the Forensic Scientist shall issue a report stating his or her findings.

- 5.1.7** If questioned and known fabric samples have been found to be consistent with each other, a second qualified Forensic Scientist shall verify that the fibers are microscopically consistent. The Forensic Scientist performing the verification shall initial the microscope slides involved and complete a verification review in FA.

5.2 Overall Examination of Fabric

- 5.2.1** When comparing garments or other items, note any points of similarity between the items (class or manufacturing characteristics).
- 5.2.2** Determine the number/type of fabrics present in each item. Remove samples, along with any stitching threads or yarns.
- 5.2.3** Describe the general fabric type as woven, knit, or nonwoven and document the construction.
- 5.2.4** Document the fabric design. Note any color patterns (individual colored yarns, colors printed on fabrics, etc.) 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 another item. 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 link a questioned item to a specific known item (individual characteristics). This includes, but is not limited to, the following: damage, stains or other foreign matter that continues over both items, manufacturer's flaws, mended areas or added accessories.

5.3 Examination of Charred and Burned Fabric

- 5.3.1** Taking care to handle the sample carefully and examining the areas of least damage, determine as many of the fabric characteristics as possible, as described in **5.2**.
- 5.3.2** Using ultraviolet and/or infrared lighting techniques, attempt to restore or visualize any writing or printing (e.g., labels, laundry markings).

5.4 Examination of Cut or Torn Fabrics

- 5.4.1** Look for characteristic indicators of a material being cut or torn. Test cuts/tears may be made.

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.

5.5 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 a damaged area 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 These statements shall be used when 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 This statement is used when no analysis is performed due to the results of the nuclear DNA analysis.

5.6.5.2.1 Example: Based on the results of DNA analysis, the above listed evidence is being returned unanalyzed. 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 unanalyzed.

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 unanalyzed.

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 a questioned 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
10/18/2013	2	Added issuing authority to header; grammar
09/05/2014	3	<p>Updated header to Physical Evidence Section – Trace Unit, issuing authority to Physical Evidence Section Forensic Scientist Manager.</p> <p>Updated all references in procedure from Trace Evidence Section to Trace Unit.</p> <p>Changed unworked to unanalyzed throughout document</p> <p>4.1 – added ALS</p> <p>5.1.2 – combined previous version 5.1.4.1 and 5.1.5; added direct contact statement</p> <p>5.1.4 – changed two to several</p> <p>5.1.4.1 – reworded from previous version 5.1.4</p> <p>5.1.4.2 – combined previous version 5.1.2.1 and 5.1.2.2 and added additional information</p> <p>5.1.4.3, 5.1.4.4, 5.1.4.5 – split apart previous version 5.1.6</p> <p>Removed: previous version 5.1.4.2, 5.2.7, 5.3.1.1, 5.3.1.2, 5.3.1.3, 5.3.2, 5.4.3</p> <p>5.1.7 – clarified the verification review required for fibers</p> <p>5.2.1 – reworded</p> <p>5.2.2 – combined previous version 5.2.2 and 5.2.3</p> <p>5.2.3 – removed pattern, or and added etc.</p> <p>5.2.5 – changed relate to link</p> <p>5.3.1 - combined previous version 5.3.1 and 5.3.1.2</p> <p>5.4.1 – combined previous version 5.4.1 and 5.4.2</p> <p>5.6.2.2.1 – changed area of separation to damaged area</p> <p>5.6.5.1, 5.6.5.2 – added intro statement</p> <p>6.0 – added questioned</p>
03/20/2015	4	<p>2.0 – Edited Scope to include physical match</p> <p>Removed “fiber-trained Forensic Scientists” from 5.1.1.2.2</p> <p>Reworded 5.1.4.1, edited title of Physical Match technical procedure</p> <p>Separated 5.1.4.2 into two separate examinations</p> <p>Added 5.2.1</p> <p>5.2.5 – changed “other” to “another” and removed “stitched” and “class characteristics”</p>