Technical Procedure for the Examination of Tapes and Adhesives

1.0 Purpose – This technical procedure shall be followed for the examination of tapes and adhesives.

2.0 Scope – This procedure applies to the analysis of tapes and adhesives within the Trace Unit. If the tape sample contains fiber reinforcement, the case shall be assigned to a Forensic Scientist trained in fiber analysis. Physical match analyses involving tape shall be conducted by a Forensic Scientist trained in tape physical match examinations.

3.0 Definitions – N/A

4.0 Equipment, Materials, and Reagents

4.1 Equipment

- Stereomicroscope
- Polarizing light microscope
- Comparison microscope
- FT-IR
- SEM/EDS
- Pyrolysis-GC-MS
- Microspectrophotometer
- UV light

4.2 Materials

- Forceps
- Scalpel or razor blade
- Ruler or calipers
- KBr discs and holder
- SEM adhesive lifts
- Heat gun
- Glass or transparency sheets
- Joliff cards
- Filler fibers

4.3 Reagents

- Hexane
- Methanol
- Xylene
- Liquid nitrogen

5.0 Procedure

5.1 Analytical Approach

5.1.1 General Guidelines

5.1.1.1 The Forensic Scientist approaches a tape 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 Forensic Scientists 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 Review the request for analysis.

5.1.3 Open the evidence container and describe the evidence present.

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

5.1.5 Using a stereomicroscope, perform a preliminary examination. Record the size, shape, colors and condition (stains, damage, cut or torn ends, 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.

5.1.6 Using either a physical (e.g., heating, freezing) or chemical (e.g., hexane, methanol) separation method, detach tape folded onto itself. Lay the tape out and flatten on glass or a clear plastic sheet.

5.1.7 A physical match examination shall be conducted if necessary. (See the Trace Unit Technical Procedure for Physical Match Examinations.)

5.1.8 If no physical match is found, remove a sample for analysis. Cut from the center of the item, leaving the original ends undamaged.

5.1.9 Determine the type of tape (duct, electrical, packing, etc.).

5.1.10 Document the construction of the sample and break down the sample into its major components.

5.1.10.1 For analysis of the backing, see **5.2**.

5.1.10.2 For analysis of the adhesive, see **5.3**.

5.1.10.3 For analysis of the scrim, see **5.4**.

5.1.11 In addition to the standard analysis, look for points that may relate a questioned item to a specific known item. These may include, but are not limited to, the following: damage, stains or other foreign matter that continues over both items, and manufacturer's flaws.

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

5.1.13 If questioned and known tape samples are found to be consistent with each other and a fabric scrim is present, 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 shall complete a verification review in FA.

5.2 Analysis of the Backing

5.2.1 While the tape is still intact, measure the width of the tape backing.

5.2.2 If the tape is transparent, examine using a polarized light microscope (PLM) under crossed-polars and record observations of the physical and optical characteristics.

5.2.3 Clean off the adhesive and remove the scrim (if present).

5.2.4 Describe the texture of the backing, and determine the manufacturing process.

5.2.5 Cross-section the backing to determine the number of layers. In addition, record the color and/or visual appearance of each layer.

5.2.6 The following Trace Unit procedures may be used to analyze the tape backing, as appropriate based on the Forensic Scientist's training and experience:

- Technical Procedure for Infrared Spectroscopy.
- Technical Procedure for Scanning Electron Microscope/Energy Dispersive X-Ray System (SEM/EDX) for non-GSR Casework.
- Technical Procedure for Microspectrophotometry.

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

5.3 Analysis of the Adhesive

5.3.1 While the tape is still intact, compare the color of the adhesive.

5.3.2 Remove a sample of the adhesive using forceps or a razor blade.

5.3.3 The following Trace Unit procedures may be used to analyze the adhesive, as appropriate based on the Forensic Scientist's training and experience:

- Technical Procedure for Infrared Spectroscopy.
- Technical Procedure for Scanning Electron Microscope/Energy Dispersive X-Ray System (SEM/EDX) for non-GSR Casework.
- Technical Procedure for Pyrolysis – Gas Chromatography-Mass Spectrometry.

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

5.4 Analysis of the Scrim

5.4.1 If the sample is a fiber-reinforced tape, the fabric scrim shall be separated from the rest of the tape by soaking the sample in a solvent such as hexane or methanol.

5.4.2 The scrim construction shall be analyzed and compared following the Trace Unit Technical Procedure for the Examination of Fabric.

5.4.3 Once the construction analysis and comparison 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 the Examination of Cordage.

5.4.4 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 the Examination of Fibers.

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

5.5 Guidelines for Tape and Adhesive Analysis Result Statements

5.5.1 The reports shall read as listed below. The wording of the results shall accurately describe the evidence at hand.

5.5.2 Positive

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

5.5.2.1.1 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.

5.5.3 Inconclusive

5.5.3.1 These statements shall be used when, based on the analysis, no conclusion could be reached.

5.5.3.1.1 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.

5.5.3.1.2 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.

5.5.4 Negative

5.5.4.1 This statement shall be used when one or more of the characteristics associated with the questioned and known samples are different.

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

5.5.4.1.2 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.

5.5.5 No Analysis

5.5.5.1 No analysis is performed. The reason for no analysis shall be noted in the case notes.

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

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

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

5.6 Standards and Controls – N/A

5.7 Calibrations – This procedure does not require any calibrations or performance checks. However, it does utilize instruments that require performance checks. See the individual technical procedures for the operations of those instruments.

5.8 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.

5.9 Sampling and Sample Selection

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

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

5.9.3 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.

5.9.4 If no tape standards are submitted, the evidence may be returned to the agency unanalyzed.

5.9.5 If DNA analysis has been performed on the evidence in the case, based on the results of the DNA analysis, the fiber evidence may be returned unanalyzed.

5.10 Calculations – N/A

5.11 Uncertainty of Measurement – N/A

6.0 Limitations - Tape and adhesives are manufactured materials. 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 a physical match.

7.0 Safety

7.1 Burns may result from contact with hot items such as heat guns.

7.2 Wear protective clothing when using liquid nitrogen.

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

7.4 Care shall be exercised when using solvents.

8.0 References

8.1 ASTM / SWG Guidelines

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SWGMAT. "Guideline for Assessing Physical Characteristics in forensic Tape Examinations." online (December 14, 2010)

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8.2 Books

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8.3 Journal Articles

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Snodgrass, H. "Duct Tape Analysis as Trace Evidence." *Proceedings of the International Symposium on the Forensic Aspects of Trace Evidence* (June 1991): 69-73.

Teetsov, A.S. and M.L. Stellmack. "Hand-Sectioning and Identification of Pressure-Sensitive Tapes." *Modern Microscopy Journal* 30 (June 2004).

8.4 Training Materials

The Forensic Analysis of Pressure Sensitive Tapes (Training Materials). FBI, June 2005.

Smith, Jenny. Introduction to Forensic Examinations of Pressure Sensitive Tape (Training Materials). Southern Association of Forensic Scientists Meeting, Savannah, Georgia, May 5, 2003.

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
09/05/2014	3	Updated header to Physical Evidence Section – Trace Unit, issuing authority to Physical Evidence Section Forensic Scientist Manager. Updated all references in procedure from Trace Evidence Section to Trace Unit Changed unworked to unanalyzed throughout document 4.1 – added UV light, microspectrophotometer 4.3 – added liquid nitrogen 5.1.7 – previously 5.1.5 5.1.5, 5.1.8 – added additional information 5.1.12 – added results compared 5.1.13 - clarified the verification review required for fibers 6.0 – added questioned Added: 7.2
03/20/2015	4	2.0 – Edited Scope to include physical match of tape 5.1.7 – Removed "based on training and experience" and edited title of Physical Match technical procedure