Technical Procedure for the Examination of Cordage

1.0 Purpose – This technical procedure shall be followed for the examination of cordage samples, to include yarns, ropes and carpets.

2.0 Scope – This procedure applies to the analysis of yarns, carpets, ropes and cordage samples within the Trace Evidence Section. 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
- Camera

4.2 Materials

- Forceps
- Ruler or calipers

4.3 Reagents

- N/A

5.0 Procedure

5.1 Analytical Approach

5.1.1 General Guidelines

5.1.1.1 The Forensic Scientist shall approach a cordage 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, concludes 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 and 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

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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 In cordage 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 constructed 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. Areas for possible physical matches include plastic ends, fabric/paper cores, long and short yarns, etc. 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. Any 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 analyzing each item.

5.1.5 Using a stereomicroscope, perform a preliminary examination. Record the size, shape, colors and condition (stains, fraying, damage, cut or torn ends, etc.) of both the known and questioned items.

5.1.6 Perform a detailed examination of the cordage according to **5.2**. If the item in question is a portion of carpet, proceed to **5.3**.

5.1.7 Once the cordage 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.

5.1.8 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 are found to be consistent with each other, a second qualified Forensic Scientist shall verify the fiber association. This Forensic Scientist performing the verification shall initial the microscope slides involved and complete a verification review in FA.

5.2 Examination of Cordage

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5.2.1 Measure the length and diameter of the sample.

5.2.2 Look for points that may relate a questioned item to a specific known item. This may include, but is not limited to, the following: damage, stains or other foreign matter that continues over both items; and manufacturer's flaws.

5.2.3 Document the construction of the sample and classify as twisted, braided, or plastic.

5.2.3.1 **Twisted cordage** (including yarns and carpet)

5.2.3.1.1 Determine the overall number of plies and their direction of twist

5.2.3.1.2 Measure the length of the repeating unit and the number of crowns per unit length.

5.2.3.1.3 Break down each ply until the final unit is a single yarn composed of fibers or filaments. Record the twist direction in each step.

5.2.3.2 **Braided cordage**

5.2.3.2.1 Determine the number of braids in both the S and Z direction.

5.2.3.2.2 Describe the weave pattern.

5.2.3.2.3 Measure the length of the repeating unit and the number of braids per unit length.

5.2.3.2.4 Measure the thickness of each braid and determine the direction of twist.

5.2.3.2.5 Break down each ply until the final unit is a single yarn composed of fibers or filaments. Record the twist direction in each step.

5.2.3.3 **Plastic cordage**

5.2.3.3.1 Examine the plastic sheath's ends for markings suitable for a physical match or toolmark examination.

5.2.3.3.2 Measure the thickness of the sheath and record its color and/or composition.

5.2.4 Remove a sample for analysis, taping off and labeling the cut ends. Leave all knots intact, and cut from the center of the item, leaving the original ends undamaged.

5.2.5 Record whether a coating has been used. Collect a sample for analysis.

5.2.6 If a core is present, analyze the size, color, twist and coating for each type. Collect a sample for analysis.

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5.2.7 If a tracer is present, analyze the size, color, twist and location for each type. Collect a sample for analysis.

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

5.2.9 Once the cordage 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.

5.3 Examination of Carpet

5.3.1 For intact carpet samples, classify the type of carpet present in the sample (loop, cut-pile, etc.) if possible.

5.3.2 For carpet tufts, examine the yarns as detailed in **5.2.3.1**.

5.3.3 If present, examine the layer structure and construction of any backing materials in accordance with the Trace Evidence Section Technical Procedure for Examination of Fabric.

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

5.3.5 Once the carpet 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.

5.4 Guidelines for Cordage Examination Result and Conclusion Statements

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

5.4.2 Positive

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

5.4.2.1.1 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.

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

5.4.3 Inconclusive

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

5.4.3.1.1 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.

5.4.3.1.2 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.

5.4.4 Negative

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

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

5.4.4.1.2 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.

5.4.5 No Analysis

5.4.5.1 No analysis is performed.

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

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

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

5.4.5.2.1 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.

5.5 Standards and Controls – N/A

5.6 Calibrations – N/A

5.7 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.

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5.8 Sampling and Sample Selection

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

5.8.2 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.

5.8.3 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.

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

5.8.5 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.

5.9 Calculations – N/A

5.10 Uncertainty of Measurement – N/A

6.0 Limitations - Ropes, cordage, yarns and carpet are manufactured materials. 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 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

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

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

8.2 Books

Joseph, M.L. *Introductory Textile Science.* USA: CBS College Publishing, 1981.

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

8.3 Journal Articles

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Wiggins, K.G. "Recognition, Identification and Comparison of Rope and Twine." *Science and Justice* 35.1 (1996): 53-58.

9.0 Records – N/A

10.0 Attachments – N/A

Revision History		
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09/17/2012	1	Original ISO Document
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