Training Outline for the Examination of Fibers, Cordage, and Fabrics

1.0 Purpose – This document provides an outline for training in the collection, preservation, and examination of fiber, cordage, and fabric evidence, including the requisite competency testing.

2.0 Scope – This training outline shall be followed by all trainees in the examination of fibers, cordage, and fabrics, regardless of experience level.

3.0 Module 1 – Introduction to Fibers and Textiles

3.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills in:

3.1.1 The history and use of fibers.

3.1.2 Fiber terminology.

3.1.3 Chemistry and manufacturing processes of fibers and dyes.

3.1.4 Classification schemes of fibers.

3.2 Reading Assignments

3.2.1 Houck, M., ed. *Identification of Textile Fibers*. Boca Raton: Woodhead Publishing Limited and CRC Press, 2009. (Chapters 1, 2, 4, 5, 6).

3.2.2 Robertson, J. and M. Grieve, ed(s). *Forensic Examination of Fibres.* 2nd ed. Taylor and Francis, 1999. (Chapters 1, 14).

3.2.3 Saferstein, R., ed. *The Forensic Science Handbook.* Volume 2. Englewood Cliffs, New Jersey: Prentice Hall, Inc. 1988. (Chapter 5).

3.2.4 SWGMAT. "Forensic Fiber Examination Guidelines." *Forensic Science Communications*, 1(1), 1999. (Chapter 1)

3.3 Exercises

3.3.1 Read the literature pertaining to this module.

3.4 Evaluation

3.4.1 Successfully complete a written examination covering the reading assignments.

4.0 Module 2 – Evidence Search and Preparation for Examination

4.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

4.1.1 Use and maintain a stereomicroscope properly.

4.1.2 Work with extremely small samples.

4.1.3 Recognize and recover fibers from debris, clothing, and tools.

4.1.4 Describe the proper way to collect, package and preserve fiber evidence.

4.1.5 Describe the proper control standards needed in a variety of different cases.

4.1.6 Describe how to prevent contamination and loss of evidence during search and recovery.

4.1.7 Understand the safety procedures for handling potentially biohazardous materials.

4.1.8 Mount fibers properly for microscopic examination.

4.1.9 Make cross sections of fiber samples.

4.2 Reading Assignments

4.2.1 Chewning, D.D., K.L. Deaver and A.M. Christensen. "Persistence of Fibers on Ski Masks During Transit and Processing." *Forensic Science Communications* 10.3 (2008).

4.2.2 State Crime Laboratory Evidence Guide.

4.2.3 Palenik, S. and Fitzsimons. "Fiber Cross-Sections: Part II." *Microscope* 38 (1990): 313-320.

4.2.4 Robertson, J. and M. Grieve, ed(s). *Forensic Examination of Fibres*. 2nd ed. Taylor and Francis, 1999. (Chapters 5.1 and 5.2).

4.2.5 Robertson, J. and D. Olaniyan. "Éffect of Garment Cleaning on the Recovery and Redistribution of Transferred Fibers." *Journal of Forensic Sciences* 31.1 (1986).

4.2.6 Roux, C., J. Chable and P. Margot. "Fibre Transfer Experiments Onto Car Seats." *Science and Justice* 36.3 (1996): 143-151.

4.2.7 SWGMAT. "Trace Evidence Quality Assurance Guidelines." *Forensic Science Communications* 2.1 (2000).

4.2.8 SWGMAT. "Trace Evidence Recovery Guidelines." *Forensic Science Communications* 1.3 (1999).

4.3 Exercises

4.3.1 Read the literature pertaining to this module.

4.3.2 The trainer shall demonstrate the proper use of the stereomicroscope and assist the trainee in properly setting up a stereomicroscope for his/her use.

4.3.3 Instruction from trainer in the areas of:

4.3.3.1 Proper methods for fiber evidence collection and packaging.

4.3.3.2 Procedures to prevent contamination and loss.

4.3.3.3 Selection of the appropriate detection, collection and preservation techniques for fibers and other trace evidence.

4.3.3.4 General laboratory protocols regarding evidence handling and health and safety hazards.

4.3.4 Process a variety of types of actual or mock evidence using different search techniques, to include:

4.3.4.1 Visual searching (with the aid of lighting techniques)

4.3.4.2 Scraping

4.3.4.3 Taping

4.3.5 Appropriately package the evidence collected above.

4.3.6 The trainer shall demonstrate the proper method to mount fibers. This shall include both permanent and semi-permanent slide creation.

4.3.7 Mount a minimum of 10 fibers from each of the following fiber classes (save these slides for use in future blocks):

- Acetate
- Acrylic
- Aramid
- Modacrylic
- Nylon
- Olefin
- Polyester
- Rayon
- Triacetate

4.3.8 Mount a minimum of 2 fibers (if available) from each of the following fiber classes (save these slides for use in future blocks):

- Azlon
- Glass
- Metallic
- Nytril
- PLA
- Rubber
- Saran
- Spandex

- Vinal
- Vinyon
- Bicomponent / Biconstituent

4.3.9 The trainee shall be given 10 carpet samples. The trainee shall mount the different types of fibers in preparation for microscopic examination.

4.3.10 The trainer shall demonstrate several methods of cross-sectioning a range of fiber samples such as yarns, tufts, and single fibers. The cross-sectioning methods shall include the use of:

4.3.10.1 Joliff cards

4.3.10.2 Norland optical adhesive

4.3.10.3 Polyethylene sheets

4.3.11 The trainee shall make cross sections of several samples from the fiber library and the carpet samples utilizing a variety of cross-sectioning techniques.

4.3.12 The trainee shall perform casework under senior fiber analysts. This shall involve in-depth participation including note taking, collection of fibers and mounting of fibers.

4.4 Evaluation

4.4.1 The trainee shall demonstrate the different collection and packaging techniques.

4.4.2 The trainer shall provide a debris sample with a known number of fibers. The trainee shall search the debris and report the number of fibers recovered.

4.4.3 Given two scenarios, the trainee shall describe the appropriate control samples to collect.

4.4.4 The trainer and trainee shall review and discuss the pertinent points of the reading assignments.

5.0 Module 3 – Polarized Light Microscopy

5.1 **Objectives**: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

5.1.1 Explain the theory of polarized light microscopy.

5.1.2 Use and maintain a polarized light microscope properly.

5.1.3 Explain and demonstrate Köhler illumination.

5.1.4 Understand and determine the optical properties of fibers.

5.1.5 Classify synthetic fibers into generic classes based on optical properties.

5.2 Reading Assignments

5.2.1 Abramowitz M. *Microscope: Basics and Beyond*. Lake Success, NY: Olympus Corporation, 1985.

5.2.2 ASTM Standard E2228, 2002, "Standard Guide for Microscopic Examination of Textile Fibers." ASTM International, West Conshohocken, PA, 2002.

5.2.3 Houck, M., ed. *Identification of Textile Fibers*. Boca Raton: Woodhead Publishing Limited and CRC Press, 2009. (Chapter 7).

5.2.4 McCrone, W.C., et al. *Polarized Light Microscopy*. Chicago: McCrone Research Institute, 1999. (Chapters 1-5).

5.2.5 Microscopy of Hair and Fibers Training Course Materials. FBI, March 2004 (PLM section).

5.2.6 Saferstein, R., ed. *The Forensic Science Handbook.* Volume 1. Englewood Cliffs, New Jersey: Prentice Hall, Inc. 1982. (Chapter 9)

5.2.7 Robertson, J. and M. Grieve, ed(s), *Forensic Examination of Fibres*. 2nd ed. Taylor and Francis, 1999. (Chapter 7).

5.2.8 SWGMAT, "Forensic Fiber Examination Guidelines." *Forensic Science Communications*, 1(1), 1999. (Chapter 2)

5.3 Exercises

5.3.1 Read the literature pertaining to this module.

5.3.2 The trainer shall demonstrate the proper way to set up Köhler illumination, as well as explain its benefits in regards to fiber examinations.

5.3.3 Using all of the fibers (including carpet fibers) mounted in Module 2, determine the optical and physical properties of each sample. This shall include relative refractive index, birefringence, optic sign, diameter, optical cross sectional shape, delustrant characteristics, and any other unique characteristics of the fiber.

5.3.4 Using Cargille liquids, determine the refractive index of 5 different fiber samples from the fiber library.

5.4 Evaluation

5.4.1 The trainer and the trainee shall review and discuss the pertinent points of the required reading and exercises.

5.4.2 The trainee shall demonstrate how to set up Köhler illumination properly.

5.4.3 Successfully complete a written microscopy test.

5.4.4 The trainee shall be given a set of a minimum of 8 unknown fibers. The trainee shall determine the physical and optical properties of each fiber and correctly identify the fibers according to generic class.

5.4.5 The trainee shall be given a set of a minimum of 5 different fibers from the same generic class to examine and identify differentiating characteristics.

6.0 Module 4 - Comparison and Fluorescence Microscopy

6.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

6.1.1 Explain how the comparison microscope and optical bridge work.

6.1.2 Use and maintain a comparison microscope and fluorescence attachments properly.

6.1.3 Explain the principles of fluorescence microscopy.

6.1.4 Explain the difference between the fluorescence cubes.

6.1.5 Discern and describe fluorescence colors.

6.1.6 Interpret the significance of the fluorescence observed during comparison.

6.1.7 Understand the factors which may or may not affect fluorescence.

6.1.8 Use the comparison microscope to compare fibers side-by-side.

6.2 Reading Assignments

6.2.1 Becker E. *Fluorescence Microscopy: Principles, Instruments, and Applications*. Leitz Brochure Code-No. 923 038.

6.2.2 Microscopy of Hair and Fibers Training Course Materials. FBI, March 2004 (Fiber comparison and fluorescence sections).

6.3 Exercises

6.3.1 Read the literature pertaining to this module.

6.3.2 Using all of the fibers (including carpet fibers) mounted in Module 2, determine the fluorescent properties of each sample.

6.3.3 The trainee shall be provided with several practice Q & K fiber samples for comparison.

6.4 Evaluation

6.4.1 The trainer and the trainee shall review and discuss the pertinent points of the required reading and exercises.

6.4.2 The trainee shall correctly associate a minimum of 5 unknown samples with their corresponding known samples.

7.0 Module 5 – Fourier Transform Infrared Spectroscopy (FT-IR)

7.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

7.1.1 Explain the theory of FT-IR analysis.

7.1.2 Explain the limitations of the FT-IR.

7.1.3 Properly operate and maintain the section FT-IRs and their accessories.

7.1.4 Prepare fiber samples for FT-IR analysis using a variety of techniques.

7.1.5 Obtain consistent spectral data from samples, run spectral library searches, and interpret the spectra.

7.1.6 Correctly identify the generic class of a fiber by its spectrum.

7.2 Reading Assignments

7.2.1 ASTM Standard E2224, 2002, "Standard Guide for Forensic Analysis of Fibers by Infrared Spectroscopy." ASTM International, West Conshohocken, PA, 2002.

7.2.2 Houck, M., ed. *Identification of Textile Fibers*. (Chapter 8). Boca Raton: Woodhead Publishing Limited and CRC Press, 2009.

7.2.3 Humecki, H., ed. *Practical Guide to Infrared Microspectroscopy*. New York: Marcel Dekker, 1995. (Chapter 7: Forensic Examination of Synthetic Textile Fibers by Microscopic Infrared Spectrometry)

7.2.4 Microscopy of Hair and Fibers Training Course Materials, FBI, March 2004. (FT-IR section).

7.2.5 Robertson, J. and M. Grieve, ed(s). *Forensic Examination of Fibres, 2nd ed.* Taylor and Francis, 1999. (Chapter 8).

7.2.6 Saferstein, R., ed. *The Forensic Science Handbook.* Volume 1. (Chapters 3, 4) Englewood Cliffs, New Jersey: Prentice Hall, Inc. 1982.

7.2.7 SWGMAT, "Forensic Fiber Examination Guidelines." *Forensic Science Communications* 1.1 (1999). (Chapter 6)

7.3 Exercises

7.3.1 Read the literature pertaining to this module.

7.3.2 The trainer shall demonstrate the basic operations of the FT-IR.

7.3.3 The trainer shall demonstrate different ways to prepare fibers for FT-IR analysis.

7.3.4 Using a single fiber sample, acquire 10 spectra to demonstrate the ability to acquire consistent spectra from a single source.

7.3.5 Using different techniques, prepare 3 fibers from each of the generic fiber classes found in the synthetic fiber reference file for IR analysis and obtain spectra for each.

7.3.6 Prepare and obtain spectra of several of the fibers from the carpet samples.

7.4 Evaluation

7.4.1 The trainee shall be given a minimum of 10 fibers for which they shall obtain IR spectra and then from the spectra, correctly determine the generic fiber class.

7.4.2 Successfully complete a written test covering the reading assignments and exercises.

8.0 Module 6 – Microspectrophotometry (MSP)

8.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

8.1.1 Explain the theory of MSP.

8.1.2 Understand colorimetry (i.e. color intensity, hue, Munsell).

8.1.3 Operate and maintain the microspectrophotometer (MSP) and its accessories properly.

8.1.4 Prepare samples for MSP analysis.

8.1.5 Obtain transmittance spectra of fibers.

8.1.6 Discuss the effect of fiber structure and composition on the reproducibility of the results.

8.2 Reading Assignments

8.2.1 Billmeyer, F.W. Jr. and M. Saltzman. *Principles of Color Technology*. 2nd Ed. New York: John Wiley and Sons, 1981. (Chap. 1-3)

8.2.2 Grieve, M., J. Dunlop and P. Haddock. "An Investigation of Known Blue, Red, and Black Dyes Used in the Coloration of Cotton Fibers." *Journal of Forensic Sciences* 35.2 (1990): 301-315.

8.2.3 Houck M., ed. *Identification of Textile Fibers.* (Chapter 9). Boca Raton: Woodhead Publishing Limited and CRC Press, 2009.

8.2.4 Robertson, J. and M. Grieve, ed(s). *Forensic Examination of Fibres*. 2nd ed. Taylor & Francis, Inc., Philadelphia, PA, 1999. (Chapter 10)

8.2.5 Saferstein, Richard, ed. *Forensic Science Handbook*. Volume 1. 2nd edition, 2002, Chapter 6, pp. 354-364, 367-376.

8.2.6 SWGMAT, "Forensic Fiber Examination Guidelines." *Forensic Science Communications* 1.1 (1999). (Chapter 3)

8.3 Exercises

8.3.1 Read the literature pertaining to this module.

8.3.2 The trainer shall demonstrate the basic operations of the MSP.

8.3.3 The trainer shall demonstrate how to prepare samples for MSP analysis.

8.3.4 The trainee shall obtain spectra from a variety of fibers of different colors. Discuss how thickness and cross-sectional shape affects the resulting spectra.

8.3.5 The trainee shall obtain spectra on 10 different samples of roughly the same color, so as to observe the differences.

8.4 Evaluation

8.4.1 Successfully complete a written test covering the reading assignments and exercises.

9.0 Module 7 – Dye Analysis by Thin Layer Chromatography (TLC)

9.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

9.1.1 Identify those situations in which TLC analysis is appropriate.

9.1.2 Understand the physical and chemical principles of TLC.

9.1.3 Select optimum extraction and eluent systems.

9.1.4 Extract dyes from a variety of samples.

9.1.5 Record and compare TLC plates for colors, fluorescence, position and intensity of bands.

9.2 Reading Assignments

9.2.1 ASTM Standard E227, 2002, "Standard Guide for Forensic Examination of Non-Reactive Dyes in Textile Fibers by Thin-Layer Chromatography." ASTM International, West Conshohocken, PA, 2002.

9.2.2 Houck, M.M. ed. *Identification of Textile Fibers.* Boca Raton: CRC Press, 2009.

9.2.3 Robertson, J. and M. Grieve, ed(s). *Forensic Examination of Fibres.* 2nd ed. Philadelphia: Taylor & Francis, Inc., 1999. (Chapter 11)

9.2.4 SWGMAT. "Forensic Fiber Examination Guidelines." *Forensic Science Communications* 1.1 (1999). (Chapter 4)

9.3 Exercises

9.3.1 Read the literature pertaining to this module.

9.3.2 Extract dyes from 30 fabric and/or carpet samples (including nylon, polyester, acrylic, olefin, and cotton).

9.3.3 Run dye extracts in several eluent systems to determine the best system for each of the fibers tested.

9.3.4 Extract dyes from 10 different dark colored yarns or fabrics from the same color family (e.g., black, navy blue). Run the dye extracts in the same eluent system and then compare the results.

9.4 Evaluation

9.4.1 Successfully complete a written test covering the reading assignments and exercises.

10.0 Module 8 - Solubility of Synthetic Fibers

10.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

10.1.1 Identify those situations in which solubility testing is appropriate and select appropriate tests.

10.1.2 Prepare microchemical test reagents properly.

10.1.3 Describe the solubility of fibers correctly when subjected to different chemicals and reagents.

10.1.4 Use solubility testing to determine the generic class of a fiber.

10.1.5 Recognize solvent reactions indicative of bi-component/bi-constituent fiber compositions

10.2 Reading Assignments

10.2.1 Grieve, M.C. and L.R. Cabiness. "The Recognition and Identification of Modified Acrylic Fibers." *Forensic Science International* 29 (1985): 129-146.

10.2.2 Hall, D.M. *Practical Fiber Identification*. 2nd Ed. Auburn, AL: Auburn University, 1982.

10.2.3 The Textile Institute. *Identification of Textile Materials*. 7th Ed. Portsmouth: Eyre & Spottiswoode Limited, 1975. (Sections pertaining to Solubility)

10.3 Exercises

10.3.1 Read the literature pertaining to this module.

10.3.2 The trainee shall perform solubility tests on known fiber samples from the fiber library and record all observations.

10.3.3 The trainee shall perform solubility tests on bicomponent and biconstituent fibers and observe the reactions indicative of these types of fibers.

10.4 Evaluation

10.4.1 The trainer and the trainee shall review and discuss the pertinent points of the required reading and exercises.

10.4.2 The trainee shall be provided with a minimum of 5 Q and K fiber samples. The trainee shall perform solubility tests and then correctly determine whether or not they are of the same generic class.

11.0 Module 9 – Pyrolysis-GC-MS

11.1 **Objectives**: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

11.1.1 Explain the theory of pyrolysis-GC-MS analysis.

11.1.2 Prepare samples for pyrolysis-GC-MS analysis.

11.1.3 Interpret the resulting chromatograms.

11.2 Reading Assignments

11.2.1 SWGMAT. "Forensic Fiber Examination Guidelines." *Forensic Science Communications* 1.1 (1999). (Chapter 5)

11.2.2 Wampler, T.P., ed. *Applied Pyrolysis Handbook*. Boca Raton: CRC Press, 2007.

11.2.3 Pyrolysis Application Notes. CDS Analytical, Inc. www.cdsanalytical.com.

11.3 Exercises

11.3.1 Read the literature pertaining to this module.

11.3.2 The trainee shall prepare 5 samples for pyrolysis-GC-MS analysis.

11.3.3 The trainee shall observe a pyrolysis-GC-MS operator analyze a minimum of one fiber sample and discuss the process of running samples and interpretation of the resulting chromatograms.

11.4 Evaluation

11.4.1 Successfully complete a written test covering the reading assignments and exercises.

12.0 Module 10 – Identification of Natural Fibers

12.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

12.1.1 Understand the history, use, and origin of natural fibers.

12.1.2 Use polarized light microscopy to identify plant tissue and cellular structural features that allow for the classification of the fibers as vegetable, and as bast (stem), leaf, or seed fibers and discern unique features, such as spiral elements and crystals.

12.1.3 Identify common animal fibers used in textile materials.

12.2 Reading Assignments

12.2.1 Caitling, D.M. and J.E. Grayson. *Identification of Vegetable Fibres*. New York: Chapman and Hall, 1982.

12.2.2 Houck, M., ed. *Identification of Textile Fibers*. Boca Raton: Woodhead Publishing Limited and CRC Press, 2009. (Chapter 3).

12.2.3 Deedrick, Douglas W. and Sandra L. Koch. "Microscopy of Hair Part II: A Practical Guide and Manual for Animal Hairs." *Forensic Science Communications* 6.3 (2004).

12.2.4 The Textile Institute. *Identification of Textile Materials*. 7th Ed. Portsmouth: Eyre & Spottiswoode Limited, 1975. (Chap. 2.1, 5.9, 5.12, 5.13)

12.2.5 Microscopy of Hair and Fibers Training Course Materials, FBI, March 2004. (Animal hairs and natural fibers sections).

12.2.6 Valaskovic, GA. "Polarized light in multiple birefringent domains: a study of the Herzog effect." *The Microscope* 39 (1991): 269-286.

12.3 Exercises

12.3.1 Read the literature pertaining to this module.

12.3.2 After a demonstration by the trainer, macerate or manually separate several natural fibers in preparation for mounting.

12.3.3 The trainee shall prepare longitudinal mounts of the different natural fibers and examine the fiber's physical and optical properties using the PLM. Properties include cell walls, lumen, spiral elements, pits, dislocations, cytoplasmic remnants, crystals, and resins.

12.3.4 The trainee shall prepare cross sections of the different natural fibers.

12.3.5 The trainer shall demonstrate the dry twist test. The trainee shall perform the dry twist test on the different natural fibers.

12.3.6 The trainer shall demonstrate the Herzog test. The trainee shall perform the Herzog test on the different natural fibers.

12.3.7 The trainee shall ash samples of the different natural fibers and examine the remains for crystals.

12.3.8 If the trainee is not a qualified hair analyst, the trainee shall mount and examine samples of the common animal hairs used in textiles.

12.4 Evaluation

12.4.1 The trainer and the trainee shall review and discuss the pertinent points of the required reading and exercises.

12.4.2 The trainer shall issue the trainee a set of 10 unknown natural plant fibers. The trainee shall determine the physical and optical properties of each fiber and correctly identify the fibers.

12.4.3 The trainer shall issue the trainee a set of 5 unknown animal hairs. The trainee shall determine the physical and optical properties of each fiber and correctly identify the fibers.

13.0 Module 11 – Fabric Analysis

13.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

13.1.1 Determine the twist of a yarn.

13.1.2 Describe the weave and knit patterns of a fabric.

13.1.3 Describe the construction of carpet.

13.1.4 Determine the physical and microscopic properties of the following types of damage:

- Cut (sharp vs. dull blade)
- Tear
- Burn
- Seam separation and normal wear

13.1.5 Locate, identify, and compare a fabric impression to a known fabric sample.

13.1.6 Determine the physical and microscopic properties of a fabric physical match.

13.2 Reading Assignments

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

13.2.2 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.

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

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

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

13.2.6 Robertson, J. and M. Grieve, ed(s). *Forensic Examination of Fibres.* 2nd ed. Philadelphia: Taylor & Francis, Inc., 1999. (Chapters 2, 4)

13.2.7 Saferstein, Richard, ed., *Forensic Science Handbook.* Volume 2. 2nd edition. 2005. Chapter 6.

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

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

13.2.10 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.

13.2.11 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.

13.2.12 Taupin, J.M. and C. Cwiklik. *Scientific Protocols for Forensic Examination of Clothing.* Boca Raton: CRC Press, 2010.

13.3 Exercises

13.3.1 Read the literature pertaining to this module.

13.3.2 The trainee shall determine the twist of several different yarns.

13.3.3 The trainee shall collect a number of different fabric samples and determine the composition and structural design of each, including identifying and diagramming/drawing the weave and knit patterns.

13.3.4 The trainee shall analyze the construction of the carpet samples received in Module 2.

13.3.5 The trainee shall collect a number of different fabric samples and expose portions of each sample to various types of damage, such as burning, smashing, tearing and cutting. The trainee shall then note the visual and microscopic characteristics of each type of damage.

13.3.6 The trainee shall work with charred fabric or molten polymeric material in attempting to identify and compare with known sources.

13.3.7 The trainee shall make test impressions with clay and cast material for comparative purposes.

13.3.8 The trainee shall complete section 4.0 of the Trace Unit Training Outline for Physical Match Examinations using fabric samples.

13.4 Evaluation

13.4.1 The trainer and the trainee shall review and discuss the pertinent points of the required reading and exercises.

13.4.2 The trainee shall be given 10 yarn samples from which to correctly determine the twist.

13.4.3 The trainee shall be given 6 samples of fabric and shall be required to perform a fabric analysis on each sample.

13.4.4 The trainee shall be given 6 samples of damaged fabric from which to correctly determine the type of damage present.

13.4.5 The trainee shall be given 3 questioned fabric impressions and known fabric samples to compare and correctly determine the source of the impressions.

14.0 Module 12 - Cordage

14.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

14.1.1 Describe the construction of cordage samples.

14.1.2 Perform a thorough analysis of cordage samples.

14.1.3 Determine the physical and microscopic properties of a cordage physical match.

14.2 Reading Assignments

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

14.2.2 Robertson, J. and M. Grieve, ed(s). *Forensic Examination of Fibres.* 2nd ed. Philadelphia: Taylor & Francis, Inc., 1999. (Chapter 3)

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

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

14.3 Exercises

14.3.1 Read the literature pertaining to this module.

14.3.2 The trainee shall be given a variety of cordage samples to examine. These shall include twisted, braided and plastic cordages comprised of either synthetic or natural fibers.

14.3.3 The trainee shall perform a thorough analysis of the above-listed cordage samples, to include analysis of construction, fiber microscopy and instrumental analysis.

14.3.4 The trainee shall complete section 4.0 of the Trace Unit Training Outline for Physical Match Examinations using cordage samples.

14.4 Evaluation

14.4.1 The trainee shall be given 5 cordage samples and perform a complete cordage analysis on each sample.

15.0 Module 13 – Casework, Final Evaluation and Preparation for Court

15.1 Objectives: Through completion of this module, the trainee shall have developed and demonstrated the theoretical knowledge and/or practical skills to:

15.1.1 Document evidence condition, analytical methods used, and reasons for conclusions in the case file in a method understandable to fellow Forensic Scientists.

15.1.2 Write clear, concise Laboratory Reports consistent with Laboratory and Section guidelines.

15.1.3 Perform independent casework.

15.1.4 Demonstrate courtroom procedures.

15.1.5 Present the results of a fiber examination in court effectively.

15.1.6 Describe the legal and ethical obligations of an expert witness.

15.1.7 Describe the admissibility standards set by *Daubert* and *Frye*.

15.2 Reading Assignments

15.2.1 CVs or Statements of Qualifications of other Forensic Scientists.

15.2.2 *Daubert v. Merrill Dow Pharmaceuticals,* 509 U.S. 579 (1993).

15.2.3 *Frye v. United States,* 293 F. 1013 (DC Cir. 1923).

15.2.4 Feder, H.A. and M.M. Houck. *Succeeding as an Expert Witness,* 4th ed. Boca Raton: CRC Press, 2008.

15.2.5 Kogan, J.D. "On Being a Good Expert Witness in a Criminal Case." *Journal of Forensic Sciences* 23.1 (1978): 190-200.

15.2.6 Philipps, K.A. "The Nuts and Bolts of Testifying as a Forensic Scientist." *Journal of Forensic Sciences* 22.2 (1977): 457-463.

15.2.7 Ron Smith and Associates, Inc. "Courtroom Testimony Techniques: Success Instead of Survival." Collinsville, Mississippi.

15.2.8 Tanton, R.L. "Jury Preconceptions and Their Effect on Expert Scientific Testimony." *Journal of Forensic Sciences* 24.3 (1979): 681-691.

15.3 Exercises

15.3.1 Read the literature pertaining to this module.

15.3.2 The trainee shall perform work in actual cases under the direct supervision of the training officer. The following will be discussed and practiced with the trainee:

15.3.2.1 Proper procedures for taking notes and marking evidence.

15.3.2.2 Proper procedures for handling and analyzing known standards and unknown samples.

15.3.2.3 Proper procedures for sample selection.

15.3.2.4 Determining which examination(s) apply to each individual case.

15.3.2.5 Results analysis and report writing.

15.3.3 Observe pretrial conferences and/or courtroom testimony of qualified fiber examiners, if possible.

15.3.4 Prepare a series of qualifying questions and answers to those questions for use in a voir dire.

15.3.5 Prepare or update a CV or Statement of Qualifications reflective of experience in fiber examination.

15.4 Evaluation

15.4.1 The trainee shall be given 4 mock cases to analyze and prepare reports, as if they were actual cases.

15.4.2 Using the mock cases, the trainee shall successfully complete a moot court or roundtable discussion.

15.4.3 Successfully complete a final competency test covering all of the training materials.

16.0 Records

- Training file
- Training checklist

17.0 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
08/29/2014	3	Updated header to Physical Evidence Section – Trace Unit, issuing authority to Physical Evidence Section Forensic Scientist Manager.
03/20/2015	4	Edited 13.3.8 to refer to correct section of Physical Match training procedure. Added 14.1.3, 14.3.4.