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### Revision History

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OVERVIEW OF THE TRACE EVIDENCE TRAINING PROGRAM

1 Introduction
This training program is designed to train Forensic Scientists assigned to the discipline of trace evidence with the Texas Department of Public Safety Crime Laboratory. Trainees will learn to properly process, preserve, identify and/or compare trace evidence with the suggested techniques and procedures outlined in this training program.

Upon successful completion of this training program, a trace evidence examiner will be able to competently analyze trace evidence and accurately report case results in written form, and effectively present their findings as an expert witness.

2 Requirements
An examiner/analyst shall meet the degree and coursework requirements listed in the job description.

3 Purpose
The trace evidence training manual is designed to provide the trainee with sufficient background, laboratory skills, education, competency, and supervised hands-on experience to adequately perform independent casework with minimal supervision. The Texas DPS training time can vary depending on sub-disciplines. Trainees having prior experience in trace evidence analysis procedures may be evaluated to determine the amount of time necessary for training.

4 Program Format
The training program is divided into several units, each consisting of a set of modules. The modules consist of discussions and demonstrations with the trainer, practical exercises, practical exam(s), and written exercises. The modules may be dependent or independent on other modules within the unit and the prerequisite modules/units will be noted.

Evidence Collection and Preservation Unit will introduce the trainee to the proper techniques to collect, preserve and macroscopically examine physical evidence.

The Instrumental Analysis and General Microscopy Modules, and the Evidence Collection and Preservation Unit are prerequisites to the sub-discipline units.

Physical Comparison Unit will introduce the trainee to physical match comparisons, physical properties and cut/tear examinations of fabric and other materials.

Paint Unit will introduce the trainee to analysis and comparison of automotive paint, architectural paint and other categories of paint.

Glass Unit will introduce the trainee to the analysis and comparison of various sources of glass.

Lamp Filament Unit will introduce the trainee to the examination of incandescent lamp filaments to determine if they are functional or on/off.

Impression Evidence Unit will introduce the trainee to the detection, recovery, examination and comparison of footwear, tire track and fabric impressions.

Hair Unit will introduce the trainee to the examination of hair including animal/human determination, somatic origin, racial characteristics and, macroscopic and microscopic comparisons.
Fiber Unit will introduce the trainee to the analysis and comparison of fibers, threads, textiles, ropes and cordage.

Gunshot Primer Residue Unit will introduce the trainee to the detection and analysis of gunshot primer residue.

Pressure Sensitive Tape Unit will introduce the trainee to the analysis and comparison of pressure sensitive tape. **Prerequisites for this Unit are successful completion of the Fiber Unit and the Paint Unit**

Analysis of Unknowns Unit will introduce the trainee to the analysis, comparison and identification of various substances.

5 Safety

Safety precautions outlined in the Texas DPS Safety Manual will be followed at all times during the training program. Any specific safety considerations will be designated within the modules.

6 Assignment of Trainer

Meetings between the trainee, the trainer, and/or supervisor should be held periodically in order to evaluate the trainee’s progress, plan future study and practical assignments, and address any deficiencies which may require additional training.

7 Trainee Responsibilities

The trainee will be required to keep a training notebook. The training program covers much information that requires the trainee to keep up with reading assignments on a self-study basis. The trainee is responsible for informing his/her trainer or supervisor when problems arise at any time during the training period.

8 Training Notebook

During the training program, the trainee is responsible for keeping records in a notebook of his/her training, practice testing, and progress. Completion of modules and/or practical exercises will be recorded, dated, and approved by the trainer on the respective training record.

A. The following is a list of items maintained in the training notebook:

1. Training record (Training Checklist)
2. List of reading literature completed
3. List of in-house training videos and lectures attended
4. Practical exercises
5. Practical exams
6. Written exercises
7. Competency tests and results
8. Validation test results or special project assignments with summary reports as applicable
9. Written exams
10. List of cases reviewed
11. Courtroom testimony attended and observations/evaluations

9 Module and Unit Assessment

A. Each Unit consists of several training modules. Each module is assessed upon the completion of the associated readings, practical exercises, practical exams and written exercises. Once all module requirements in the Unit have been satisfied the trainee will need to complete a comprehensive written exam and, at least, two competency exams in order to pass the unit.

B. A competency exam can include mock casework, re-analysis of previously worked cases, and proficiency tests so long as the exam would encompass the majority of skills taught in the unit.

9.2 Training Unit

The Training Unit requirements will conclude with examiner approval to conduct supervised casework when the following are met:

A. All required reading assignments are completed.
B. All practical exercises are successfully completed.
C. All practical exams are successfully completed.
D. All written assignments are successfully completed.
E. A comprehensive written exam at the end of each unit is successfully completed. The criteria for passing is a grade of 75% or higher.
F. All competency exams are correctly analyzed.
G. The training notebook and other training records documenting completion of training requirements are reviewed by the trainer.
H. The trainer(s) recommend that the trainee be approved for supervised casework.

9.3 Evaluation of Training

The trainee will complete an evaluation of the module content and the trainer. The trainee and trainer will complete a checklist and seek Work Authorization for supervised casework (LAB-309).

10 Supervised Casework

Supervised casework requirements will conclude with independent examiner approval when the following are met:

A. Supervised casework consisting of successful completion of at least 3 cases per unit which may include mock casework as needed. Evidence encountered in supervised casework that was used to produce a probative conclusion will be verified and documented by the trainer or an experienced analyst. The experienced analyst/trainer must initial all relevant pages/results in the examination documentation indicating that they concurred with the examination/results.

B. Trainer or designee is consulted at each step of the analysis procedure prior to trainee proceeding with that step.

C. Trainee maintains a record of supervised casework (LAB-307).
D. The trainer(s) recommend that the examiner be approved for independent casework to the quality manager using the Work Authorization (LAB-309).

11 Courtroom Testimony

Courtroom testimony requirements will be satisfied when the trainee has completed the following. Completion ideally should occur before the trainee’s first trial or first year of training:

A. The trainee will observe or discuss with a trainer at least 5 examples of testimony covering relevant sub-disciplines. The examples of testimony can include past or current trials. In order to maximize the benefit to the trainee, the testimonies should include prosecution and defense questioning.

B. The trainee will present in a mock trial, one supervised case or mock case. The case will be chosen by the trainer and should allow for prosecution and defense questioning.
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INSTRUMENTAL ANALYSIS OVERVIEW

Duration Two to three weeks

Purpose Familiarize the trainee with the theory, capabilities and limitations of the analytical instruments used in trace evidence analysis.

1 Objectives

1.1 Theoretical

Instrumental analysis of physical evidence is an integral part of the modern forensic laboratory. A fundamental understanding of the theory, capabilities, and limitations of the different types of instruments available is critical to determining appropriate analytical methods and communicating results to peers as well as juries.

1.2 Practical

Following the completion of this module, the trainee will be able to:

1. Understand the theory behind each of the instruments used in trace evidence analysis,
2. Understand the capabilities of each of the instruments used in trace evidence analysis,
3. Understand the limitations of the each of the instruments used in trace evidence analysis, and
4. Explain in lay terms the operation of each instrument.

2 Lesson Plan

2.1 Instructional Outline

1. The trainee will be taught the theory, capabilities, and limitations for the following instruments used in trace evidence analysis
   a) Infrared Spectroscopy
   b) Microspectrometry
   c) Gas Chromatography
   d) GRIM
   e) Mass Spectrometry
   f) SEM/EDS
   g) X-Ray Fluorescence
   h) X-Ray Diffraction

2.2 Required Readings


2.3 Practical Exercises

The trainee will observe an experienced analyst(s) prepare samples, operate the instruments available in their laboratory, and interpret data.

2.4 Practical Examination

None

2.5 Written Exercises

The trainee will provide written responses to the following questions:

1. Describe in lay terms how the GC/MS works.
2. Explain what Fourier Transform is and what instrument uses it.
3. What is Beer’s Law?
4. What are the limitations of the SEM?
5. What types of evidence is X-ray Diffraction used for?
6. What type of analysis could you use to identify and analyze the following: sugar, paint, unknown white powder, fibers, and a piece of metal?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Preparer

Brad Mullins
Trace Advisory Board Chair

Date: 01/18/2012

Concurrence

Diana D. Salas
Quality Assurance

Date: 03/19/2012

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GENERAL MICROSCOPY

Duration: One week

Purpose: Introduce the trainee to the basic concepts and applications of polarized light microscopy.

1 Objectives

1.1 Theoretical

Microscopy is a powerful tool for the forensic scientist. A fundamental understanding of the types of microscopes available, the theory behind their operation, and their capabilities and limitations is essential for the trace evidence examiner.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Describe the functions of compound microscopes in general, and stereomicroscopes, polarized light microscopes, and comparison microscopes specifically,
2. Perform modified Köhler illumination
3. Use the Michel-Levy birefringence chart to determine birefringence,
4. Measure refractive indices of one- and two-refractive index materials, and
5. Take photomicrographs.

2 Lesson Plan

2.1 Instructional Outline

1. Review of properties of electromagnetic radiation; un-polarized and polarized light
2. Discuss Snell’s Law, refraction, refractive index, optics of lenses
3. Discuss aberrations and correcting aberrations
4. Review microscope parts and function
5. Abbe’s Law of Resolution, resolving power, numerical aperture
6. Demonstrate focal planes, Köhler illumination, contrast vs. resolution
7. Micrometry
8. Discuss crystal systems, isotropy, anisotropy
9. Polarized light microscopy
10. Michel-Levy chart
11. Demonstrate sample preparation, mounting media
12. Comparison microscope
13. Photomicrography
2.2 Required Readings


2.3 Further Reading


2.4 Practical Exercises

1. The trainee will demonstrate and explain how to properly obtain Köhler illumination and demonstrate conjugate focal planes.

2. The trainee will calibrate an ocular micrometer for various objectives.

3. The trainee will be given samples in which they will have to prepare and mount the samples in various ways.

4. The trainee will be given a set of samples in which they will have to measure their refractive index and determine their optic sign.

5. The trainee will be given a set of samples in which they will have to determine the amount of birefringence using the Michel-Levy chart.

2.5 Practical Examination

The trainer will give the trainee a set of unknown samples. The trainee will have to determine the unknown’s optical properties (refractive indices, optic sign, birefringence).

2.6 Written Exercises

The trainee will provide written answers to the following questions:

1. What are the advantages of Köhler illumination?

2. What is the function of the polarizer?

3. What does the sub-stage diaphragm control? What is effected by changing the sub-stage diaphragm?

4. What is refraction?

5. What is the difference between isotropic, uniaxial, and biaxial substances?
3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Preparer

Brad Mullins  
Trace Advisory Board Chair  
Date: 01/18/2012

Concurrence

Diana D. Salas  
Quality Assurance  
Date: 03/19/2012

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| 02        | 12/19/2008     | Minor revision – Section 1.2  
Revision of formatting |
| 03        | 04/17/2012     | Minor revision – Section 2.1 and 2.5  
Advisory Board |
FLUORESCENCE MICROSCOPY

Duration
One week

Purpose
Familiarize the trainee with the function and use of the fluorescence microscope.

1 Objectives

1.1 Theoretical

Photoluminescence is the phenomenon in which a substance will absorb light at a specific wavelength and subsequently emit light at a different wavelength. Fluorescence, a specific form of photoluminescence, occurs when a substance is irradiated with light at a certain wavelength and then emits a light at a longer wavelength with less energy, than that of the excitation wavelength. Once the irradiating light is removed the substance will stop emitting light.

Certain dyes and optical brighteners possess a molecular structure, typically a conjugated double bond system, which is predisposed to fluoresce at certain wavelengths. These dyes and optical brighteners can be imparted to fibers during the manufacturing process or during after market applications.

1.2 Practical

Upon completion of this module the trainee will have the practical skills needed to

1. Determine the overall fluorescence of fibers, and
2. Determine the depth of penetration of fluorescence under various wavelengths of light.

2 Lesson Plan

2.1 Instructional Outline

1. Theory
   a) Stokes shift
   b) Particle nature of light
   c) Orbital energies

2. Barrier/Excitation filters
   a) Use and construction of barrier/excitation filters
   b) Different barrier/excitation filters

3. Dyes and optical brighteners
   a) Molecular composition of dyes and optical brighteners
   b) The dying process
   c) Effects on fluorescence

4. Mounting media
   a) Effect of mounting media

Effective Date: 04/25/2019
Issued by: QA Coordinator
b) Choosing an appropriate mounting media

5. Operation of the fluorescence microscope
   a) Setup
   b) Alignment

6. Discuss and demonstrate observable properties of different fibers
   a) Effect on fluorescence due to wavelength
   b) Depth of dye penetration

7. Demonstrate and discuss proper documentation of observable properties
   a) Presence or absence of fluorescence
   b) Intensity of fluorescence
   c) Color of fluorescence under various wavelengths
   d) Excitation wavelength producing the maximum fluorescence

2.2 Required Readings


2.3 Practical Exercises

1. The trainee will mount a set of fibers in 3 different mounting media and observe their fluorescence properly recording their characteristics.
2. The trainee will cross-section each of the fibers from the set and mount the cross-sections in the best mounting media and record their characteristics including the depth of penetration.

2.4 Practical Examination

The trainee will be given known fibers and a set of question fibers. The trainee will have to determine if any of the fibers could have a common origin based on their fluorescent properties.

2.5 Written Exercises

The trainee will provide written answers to the following questions:

1. What is the Stokes shift?
2. What is the function of the Excitation / Barrier filter?
3. What characteristics can be observed using fluorescence microscopy?
4. What affects the depth of penetration observed when viewing fiber cross-sections?
5. Describe the particle nature of light?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist and sign-off sheet. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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PHYSICAL COMPARISON CUT-TEAR

Duration One week

Purpose Familiarize the trainee with the examination of products to determine cut/tear

1 Objectives

1.1 Theoretical

Many items (textiles, window screens, upholstery, etc.) may become damaged as a result of a violent assault. The damage resulting from a tear can, at times, be distinguished from the damage caused by a cut.

1.2 Practical

Upon completion of this module, the trainee will be able to:

A. Examine an item for defects
B. Form an opinion about the cause of the damage arising from a cut or a tear
C. Report conclusions and opinions,
D. Perform technical and administrative reviews, and
E. Provide expert testimony that appropriately conveys the significance of the analysis.

2 Lesson Plan

2.1 Instructional Outline

A. General cut, tear, and puncture characteristics
   1. Textile type (knitted, woven, etc.), wire security screen, tape (electrical and duct), paper
   2. Force
   3. Direction
   4. Implement used
   5. Other variables
B. Visual and stereoscopic exams
C. Test cuts and tears
D. Documentation
   1. Notes
   2. Photography
E. Interpretation, limitations, and significance
F. Discuss report writing

G. Discuss technical and administrative reviews
   Pertinent documentation and necessary components of a completed case folder

H. Discuss court testimony

2.2 Required Readings


2.3 Practical Exercises

A. The trainee will examine several items and perform test cuts, tears, and punctures.
   1. The items should include, at a minimum, various clothing items (woven and knitted) and window screening.
   2. The characteristics of the test cuts, tears, and punctures should be documented and compared.
   3. The test cuts and tears should be made using various implements, with varying amounts of force, and in different directions relative to the weave.

B. Report writing
   1. The trainee will review reports written by experienced examiners.
   2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.
C. Technical and administrative reviews

1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.

2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

D. Court testimony

When possible, the trainee should observe actual testimony by an experienced cut/tear examiner.

2.4 Practical Examination

A. The trainee will be given a set of at least 5 items with cuts/tears and will determine the nature of the damage present. All observations and conclusions should be documented.

B. The trainee will prepare mock case reports based on the conclusions of the cut/tear exams.

2.5 Written Exercises

1. What are the general characteristics that are observed in items that have been cut?

2. What are the general characteristics that are observed in items that have been torn?

3. Describe circumstances in which the determination of a cut vs. tear can be complicated.

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples given should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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PHYSICAL COMPARISON

Duration: One week
Purpose: Familiarize the trainee with the comparison of objects based upon class and randomly acquired characteristics

1 Objectives
1.1 Theoretical

The physical comparison of items involves the comparison of the class characteristics and the randomly acquired characteristics of the items. Class characteristics are those characteristics shared by a finite number of items while randomly acquired characteristics are characteristics unique to one particular object.

Physical match comparisons, also known as jigsaw fit comparisons, are performed in an attempt to uniquely associate a piece of material with an item from which it is thought to have originated, based upon randomly acquired characteristics.

1.2 Practical

Upon completion of this module, the trainee will be able to:

A. Compare objects based upon class and randomly acquired characteristics.
B. Report conclusions and opinions,
C. Perform technical and administrative reviews, and
D. Provide expert testimony that appropriately conveys the significance of the physical comparison/match.

2 Lesson Plan
2.1 Instructional Outline

A. Class characteristics vs. randomly acquired characteristics
B. Physical comparisons
   1. Visual/stereoscopic exam
   2. Documentation
   3. Photography
   4. Significance
C. Physical matches
   1. Visual/stereoscopic exam
   2. Documentation
   3. Photography
   4. Significance
D. Discuss report writing
E. Discuss technical and administrative reviews
   Pertinent documentation and necessary components of a completed case folder
F. Discuss court testimony.

2.2 Required Readings


2.3 Practical Exercises

A. The trainee will prepare a number of practice physical comparisons using different techniques (ex. cutting with scissors and a scalpel, ripping, breaking) and using different materials such as duct tape, cloth, plastic, and paint. Note how each technique affects the different materials.

B. The trainee will perform a physical match comparison on these same items, demonstrating proper documentation.

C. Report writing
   1. The trainee will review reports written by experienced examiners.
   2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.

D. Technical and administrative reviews
   1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.
   2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

E. Court testimony
   When possible, the trainee should observe actual testimony by an experienced hair examiner.
2.4 Practical Examination

A. The trainee will be given at least 2 sets of broken material. The types of material selected will be typical of what is seen in actual casework. The trainee will be responsible for conducting a physical comparison examination as well as properly documenting any physical matches that might be found.

B. Successful completion of the practical exam will occur when all physical matches have been properly identified, documented, and reported.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What is a class characteristic?
2. What is a randomly acquired characteristic?
3. What materials are suitable for physical comparison examination?
4. List the requirements for documenting a physical match.
5. What is the significance of a physical match?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
## Revision History

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EVIDENCE COLLECTION AND PRESERVATION

Duration One to Two weeks
Purpose The trainee will become familiar with various techniques used to collect and preserve transfer evidence such as hair, fibers, paint and glass.

1 Objectives

1.1 Theoretical
The Locard Exchange Principle states that whenever two objects come into contact, a transfer of material will take place. This transferred material can be used to associate objects, people and/or locations. Material transferred during the commission of a crime must be collected and preserved to allow for its analysis, assessment of its significance and admission into court as evidence.

1.2 Practical
Upon completion of this module, the trainee will be able to:

A. Properly document evidence packaging and the original condition of an item of evidence,
B. Evaluate an item to determine the appropriate techniques needed to collect and preserve the various types of trace evidence that may be present,
C. Apply these techniques while maintaining the integrity of the evidence and prevent any loss or contamination,
D. Report conclusions, and
E. Perform technical and administrative reviews

2 Lesson Plan

2.1 Instructional Outline
A. Packaging documentation
   1. Condition of seal
   2. Package description
B. Item documentation
   1. Written
      a) Physical condition including any damage or stains
      b) Any identifying information, such as tag information on a garment
      c) Drawing a sketch
   2. Photographic
      a) Overall condition
      b) Areas of interest, such as stains or smears
C. Introduction to recovery techniques including demonstration and case record documentation - each technique will be demonstrated by an experienced examiner
   1. Picking
   2. Tape lifting
   3. Scraping
   4. Combing
   5. Clipping
   6. Vacuum sweeping

D. Discussion of recovery techniques
   1. When to use each technique
   2. How to prevent loss and/or contamination for each technique
   3. Advantages and disadvantages of each technique
   4. Proper documentation

E. Stereoscopic exam of recovered evidence
   1. Setting up the stereoscope
   2. Screening examinations of recovered evidence
   3. Documentation of stereoscopic findings (hairs, fibers, paint, etc.)

F. The trainer and trainee will discuss collection of standards (for various types of evidence including but not limited to: fiber standards, hair standards, and paint standards)
   1. When to collect a standard
   2. How to collect a standard
   3. Proper documentation

G. Discuss report writing

H. Discuss technical and administrative reviews
   Pertinent documentation and necessary components of a completed case folder

I. Discuss court testimony

2.2 Required Readings:


2.3 Practical Exercises

A. The trainee will practice the individual recovery techniques on different items of evidence. The trainee must demonstrate proper documentation, application of technique, and proper attention to loss and contamination potential.

B. The trainee will practice recovery of standards on different items of evidence. The trainee must demonstrate proper documentation, application of technique, and proper attention to loss and contamination potential.

C. The trainee will stereoscopically examine and document recovered trace evidence on a series of tape lifts and at least one petri dish of scrapings. The tape lifts and petri dish(s) should be typical of those encountered in routine casework and allow for the detection of evidence discussed previously. The trainer will determine if the trainee has adequately examined and documented the recovered trace evidence.

D. Report writing

1. The trainee will review reports written by experienced examiners.

2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.

E. Technical and administrative reviews

1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.

2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

F. Court testimony

When possible, the trainee should observe actual testimony by an experienced examiner.

2.4 Practical Examination

A. The trainer will provide the trainee with at least 5 mock items of evidence. The trainee will determine the best way to document each item, determine what technique of evidence recovery and preservation should be used, apply that technique, recover standards if appropriate, and prevent any loss and/or contamination. The trainee will also stereoscopically examine, document, and report the recovered trace evidence where appropriate.

B. The trainee will document and report out unknown debris from various collections.
2.5 Written Examination

The trainee will provide a written response to the following questions:

1. What is the most efficient recovery technique used for trace evidence?
2. What is the least efficient recovery technique used for trace evidence?
3. What is the proper way to collect a fiber standard for comparison?
4. What potential trace evidence could exist on clothing from a hit and run victim?
5. Name at least two things you can do to prevent loss and/or contamination.
6. How would you process wet evidence?
7. What magnification is best for fiber screening?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The types of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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COLLECTION OF GUNSHOT PRIMER RESIDUE SAMPLES

Duration One week
Purpose Familiarize the trainee with the collection of gunshot primer residue samples from clothing and other inanimate surfaces.

1 Objectives
1.1 Theoretical

Gunshot primer residue is formed by the firing of a weapon. The residue is expelled from the barrel and other openings of the weapon. The residue, primarily as a gaseous cloud, expands and may deposit gunshot primer residue particles on nearby objects. The detection of gunshot primer residue particles may indicate an association between an inanimate surface and the firing of a weapon.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Understand GSR formation and deposition
2. Collect and preserve possible gunshot primer residue particles from clothing and other inanimate surfaces.

2 Lesson Plan
2.1 Instructional Outline

1. Introduction to gunshot primer residue
   a) Particle morphology and composition
   b) Formation and deposition of particles
   c) Items suitable for gunshot primer residue collection
   d) Significance and limitations of analysis procedure
   e) Other gunshot residue deposits

2. Preparations for collection
   a) SEM stubs
   b) Site preparation

3. Sample collection
   a) Control sample
   b) Clothing (See GSR Stubbing Guidelines)
   c) Other inanimate objects

4. Documentation of samples

2.2 Required Readings


2.3 Practical Exercises
1. The trainee will practice properly preparing the site for the collection of gunshot primer residue from clothing.
2. The trainee will practice collecting gunshot primer residue from an article of clothing and other inanimate objects.

2.4 Practical Examination
1. The trainee will explain and demonstrate the collection of gunshot primer residue by stubbing at least two articles of clothing.
2. The trainee will explain the collection of gunshot primer residue from other inanimate objects and if practicable demonstrate the collection of gunshot primer residue from an inanimate object.

2.5 Written Exercises
The trainee will provide a written response to the following questions:
1. What types of objects are not appropriate for the collection of GSR samples?
2. Why is it important to collect a control sample?
3. What are the considerations/limitations for sample collection?
4. How are gunshot primer residue particles formed and deposited?

3 Conclusion
3.1 Assessment
The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The types of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation
The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer at the completion of the unit.
GSR STUBBING GUIDELINES

These are minimum requirements. More stubs may be collected at the analyst’s discretion or as the case dictates. Analyst should consider collecting additional stubs if garment can easily be worn inside out (i.e. undershirt)

1. Long-sleeve shirts
   a) Right sleeve
   b) Left sleeve
   c) Front
   d) Back
   e) Inside shirttail
   f) Each pocket (separate stub for each)

2. Short-sleeve shirts
   a) a) Front
   b) b) Back
   c) c) Inside shirttail
   d) d) Each pocket (separate stub for each)

3. Pant and shorts
   a) Front (down to knees)
   b) Back (down to knees)
   c) Inside waistband
   d) Each pocket (separate stub for each except coin pocket, this can be stubbed with corresponding pocket)
   e) Belt can be stubbed with front and back if it is through the belt loops

4. Jackets and hoodies
   a) Right sleeve
   b) Left sleeve
   c) Front
   d) Back
   e) Hood (this can be stubbed with back or separated out)
   f) Each pocket (separate stub for each)
### Preparer

*Justin Parker*  
Trace Evidence Advisory Board Chair  
Date: 11/15/2016

### Concurrence

*Valerie Turner*  
Quality Assurance Specialist  
Date: 11/10/2016

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INTRODUCTION TO GLASS EVIDENCE

Duration One week

Purpose Familiarize the trainee with the basic concepts and theoretical knowledge of glass products and the forensic examination and comparison of glass.

1 Objectives

1.1 Theoretical

Glass can be encountered as evidence at a variety of scenes. Analysis of the glass may be used to demonstrate the possible source, the direction of force from which the glass broke, or to provide investigative information as to the possible uses of a particular type of glass. Analysis techniques include examinations of both physical and chemical properties. A basic understanding of glass, its manufacturing processes, and available analysis techniques is required to begin forensic examination and comparison of glass evidence.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Understand the characteristics of glass,
2. Understand the principles of glass manufacture and applications,
3. Understand the available analysis techniques, and
4. Understand the process of glass evidence transfer and persistence.

2 Lesson Plan

2.1 Instructional Outline

1. Definition of glass and its characteristics
2. Composition
3. Glass types, manufacturing processes, and end uses
   a) tempered glass
   b) float glass
   c) soda-lime-silica glass
   d) laminated glass
   e) glass fibers
   f) other
4. Overview of analysis techniques
   a) visual
   b) microscopic
   c) density
   d) refractive index
   e) elemental analysis
5. Collection of known samples
   a) crime scene
   b) laboratory setting

6. Transfer and persistence

2.2 Required Readings


Almirall JR. Glass Exam and Comparison, Presentation, California Criminalistics Institute, 1997.


2.3 Practical Exercises

None

2.4 Practical Examination

None

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What type of glass would you typically find in a wine bottle? windshield? window pane?
2. Describe how float glass is made and how it can be identified.

3. A burglary suspect breaks a window to gain entrance into a house. Two hours later the suspect is caught. Describe likely places where the broken glass may have transferred on his person.

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
### Preparer

John Witkowski  
Trace Evidence Advisory Board Chair  
Date: 01/16/2015

### Concurrence

Katherine G. Sanchez  
Quality Assurance Specialist  
Date: 01/22/2015

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INITIAL EVALUATION GLASS EVIDENCE

Duration   One to two weeks
Purpose   Familiarize the trainee with the examination and comparison of the physical properties of glass evidence

1  Objectives

1.1  Theoretical

Glass has certain physical properties such as color, thickness and fluorescence that can be quickly and easily observed. These properties of the questioned and known glass from a case are documented and compared. A meaningful difference in these physical properties between the questioned and known glass samples would eliminate the need for any further analysis.

Direction of force or physical match comparisons are other common examinations that may be requested of submitted glass evidence. These characteristics can also be observed prior to any instrumental analysis.

1.2  Practical

Upon completion of this module, the trainee will be able to:

1. Identify glass based on physical characteristics and/or microscopic examinations,
2. Document and compare physical characteristics of glass,
3. Determine direction of force of glass fragments, and
4. Determine the presence of physical matches in glass evidence.

2  Lesson plan

2.1  Instructional Outline

1. Initial examination and identification techniques
   a) recovery
   b) cleaning
   c) stereoscope
   d) polarized light microscope

2. Color evaluation

3. Thickness measurements

4. UV reactions

5. Fracture processes and characteristics
   a) fracture shapes
   b) concoidal fractures
   c) hackle marks
   d) direction of force indicators
e) radial and concentric cracks
f) sequence of cracks
g) center frost lines

6. Physical match
7. Documentation and use of the “Glass Examination” worksheet

2.2 Required Readings

Trace Evidence Standard Operating Procedure. Glass Initial Examination and Overview. Texas Department of Public Safety Crime Laboratory.


2.3 Practical Exercises

1. The trainee will be provided samples of various glass and non-glass material of the type that may be encountered in casework (i.e. plastic, quartz, salt) to demonstrate how to identify glass from non-glass items.

2. The trainee will examine various types of glass and will document color, thickness, UV reactions, edge characteristics, and microscopic characteristics using the “Glass Examination” worksheet.

2.4 Practical Examination

The trainee will examine a set of question and known glass samples and will perform a comparison of those samples based on color, thickness, UV reactions, edge characteristics, and microscopic characteristics. This sample set should include some non-glass samples as encountered in casework.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What are some common characteristics of glass that help distinguish it from other types of trace evidence?

2. What are the limitations of a color comparison in glass fragments?

3. Explain how the sequence of cracks can be determined on a pane of glass?

4. What type of glass “dices” when it fractures?
3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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DETERMINATION OF GLASS REFRACTIVE INDEX

Duration One to two weeks

Purpose Familiarize the trainee with the operation of the GRIM3 instrument and the determination of the refractive index of glass

1 Objectives

1.1 Theoretical

The refractive index of glass is used to discriminate between glass samples of different origin. Glass particles from the same source will have the same refractive index, while glass particles from different sources may have a different refractive index. Refractive index can vary across a distance in a single item. The refractive index of even very small glass particles can be accurately determined by a semi-automated microscopy technique using the GRIM3 instrument.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Explain the property of refractive index
2. Measure the refractive index of glass fragments

2 Lesson Plan

2.1 Instructional Outline

1. Refractive Index
   a) definition
   b) measurement techniques
   c) variation in glass samples

2. GRIM instrument
   a) theory
   b) operation
   c) calibration
   d) QC procedures
   e) refractive index oil choice
   f) sample preparation
   g) measurements and edge counts
   h) interpretation

2.2 Required Readings

Trace Evidence Standard Operating Procedures. Glass Refractive Index Determination. Texas Department of Public Safety Crime Laboratory


Koons RD, and Buscaglia J. Distribution of Refractive Index Values in Sheet Glasses. For Sci Comm. 2001. 3(1).


Locke Scientific, Reference Glasses and Silicone Oils for Refractive Index Determination.


2.3 Practical Exercises

1. The trainee will measure the refractive index of a set of glass samples using the GRIM3 instrument. The samples should necessitate the use of various oils for the measurements.

2. The trainee will measure the refractive index of various locations of a single glass sample in order to assess variation within the sample.
2.4 Practical Examination
The trainee will examine a set of question and known glass samples and will perform a comparison of those samples based on refractive index measurements.

2.5 Written Exercises
The trainee will provide a written response to the following questions:

1. What are edge counts and why are they important?
2. What are the limitations of refractive index comparisons?
3. What is the match point or match temperature?
4. What are tramlines?

3 Conclusion
3.1 Assessment
The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation
The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Preparer

John Witkowski
Trace Evidence Advisory Board Chair

Date: 01/16/2015

Concurrence

Katherine G. Sanchez
Quality Assurance Specialist

Date: 01/22/2015

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INTERPRETATION OF GLASS EVIDENCE

Duration: One week

Purpose: Familiarize the trainee with the factors that affect interpretation of the significance of glass evidence.

1 Objectives

1.1 Theoretical

Glass can be encountered as evidence at a variety of scenes. Its ultimate evidentiary value is dependent on factors and circumstances surrounding the case and the commonness of the particular glass fragments. The forensic scientist must be able to provide expert testimony concerning the significance of an association based upon glass evidence.

1.2 Practical

Upon completion of this module, the trainee will be able to:

A. Understand the factors affecting the significance of glass evidence,
B. Report conclusions and opinions,
C. Perform technical and administrative reviews, and
D. Provide expert testimony that appropriately conveys the significance of glass evidence.

2 Lesson Plan

2.1 Instructional Outline

A. Discuss the interpretation, significance, and limitations of glass comparisons and associations
   1. Variations in physical and chemical characteristics within individual samples
   2. Variation within the glass population
   3. Effects of sample size
   4. Quantity and distribution of recovered glass
   5. Persistence of glass transfers

B. Discuss report wording

C. Discuss technical and administrative reviews
   Pertinent documentation and necessary components of a completed case folder

D. Discuss court testimony

2.2 Required Readings


2.3 Practical Exercises

A. Report writing
   1. The trainee will review reports written by experienced examiners.
   2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.

B. Technical and administrative reviews
   1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.
   2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

C. Court testimony
   When possible, the trainee should observe actual testimony by an experienced glass examiner.

2.4 Practical Examination

None
2.5 Written Exercises

The trainee will provide a written response to the following question:

What factors can affect the significance of a glass association and how?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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GLASS ANALYSIS BY X-RAY FLUORESCENCE

Duration: One to two weeks

Purpose: Familiarize the trainee with the elemental analysis and comparisons of glass samples using x-ray fluorescence instrumentation.

1 Objectives

1.1 Theoretical

The elemental composition of glass can be determined through the use of x-ray fluorescence (XRF) analysis. Once the elemental composition has been determined a comparison between glass samples can be performed using a semi-quantitative technique that compares spectral shape and elemental peak intensity ratios.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Operate x-ray fluorescence instrumentation for elemental analysis of glass,
2. Perform semi-quantitative comparison of glass samples using XRF data.

2 Lesson plan

2.1 Instructional Outline

1. Discuss elemental composition of various glass types
2. XRF theory
3. Instrument familiarization
4. Instrument operation
   a) Operating parameters
   b) Calibration
   c) QC procedures
   d) Sample preparation
   e) Element identification
   f) Spectral comparisons (overlays)
   g) Elemental ratio analysis
5. Limitations
   a) Element range
   b) Concentration
   c) Sample size
6. Interpretation
2.2 Required Readings

Trace Evidence Standard Operating Procedures. Glass Analysis by X-Ray Fluorescence. Texas Department of Public Safety Crime Laboratory.


2.3 Practical Exercises

1. The trainee will be provided various glass samples to prepare for XRF analysis to include full thickness pieces. These samples will be analyzed using XRF and the elemental composition identified.

2. The trainee will be given a sample set of glass samples to analyze via XRF. These samples will then be compared using spectral overlays and elemental ratio comparisons.

2.4 Practical Examination

The trainee will examine a set of question and known glass samples and will perform a comparison of those samples based on XRF analysis.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What are some major elements encountered in glass samples?
2. What are some minor and/or trace elements encountered in glass samples?
3. Why are cerbium, erbium, or arsenic containing compounds sometimes added to glass samples?
4. What element can be used to classify glass as to float or container glass?
5. Why is iron sometimes added to glass?
6. What are the limitations and benefits of XRF analysis over other elemental analysis techniques?
3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Training Manual
Trace Evidence
Subject: Glass Analysis by X-Ray Fluorescence

Preparer

\underline{John Witkowski} \\
Trace Evidence Advisory Board Chair

Date: 01/16/2015

Concurrence

\underline{Katherine G. Sanchez} \\
Quality Assurance Specialist

Date: 01/22/2015

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INTRODUCTION TO FILAMENT EVIDENCE

Duration: One week

Purpose: Familiarize the trainee with the basic concepts and theoretical knowledge of vehicle lamps and the forensic examination of filaments.

1 Objectives

1.1 Theoretical

Forensic filament examinations are used primarily for automotive lamps involved in traffic accidents to determine if the lamps were on or off. Information derived through a forensic filament examination can be helpful in corroborating witness testimony and/or developing useful information for the investigation. Analysis of the filament and the bulb may yield information as to whether the bulbs were on or off when the damage occurred. A basic understanding of vehicle lamps and their components as well as the manufacturing processes is required to begin forensic examinations of filament evidence.

1.2 Practical

Upon completion of this module, the trainee will understand:

1. Characteristics of tungsten filaments
2. Principles of lamp/coil manufacture and applications
3. Collection of filament evidence

2 Lesson Plan

2.1 Instructional Outline

1. Tungsten filament characteristics
   a) Physical properties (melting point, tensile strength, coefficient of linear expansion)
   b) Oxidation states
   c) Incandescence process
   d) Halogen cycle
   e) Water cycle
2. Coil manufacturing processes
   a) Retractable mandrel process
   b) Continuous coil process
3. Lamp construction
   a) B style bulbs
   b) C style bulbs
   c) Other bulb styles
   d) Posts and supports
   e) Getter
f) **Bases**

4. Discuss specific automotive bulbs and locations in vehicles
5. Collection of evidence samples
   a) *Crime scene*
   b) *Laboratory setting*

### 2.2 Required Readings

- Trace Evidence Standard Operating Procedure. Lamp Filament Examinations. Texas Department of Public Safety Crime Laboratory.

### 2.3 Practical Exercises

The trainee will examine multiple styles of vehicle bulbs noting the different components that are present. These bulbs should include, but not be limited to, vacuum bulbs, halogen bulbs, posts with getter, and various coil constructions and placements.

### 2.4 Practical Examination

None

### 2.5 Written Exercises

The trainee will provide the answers to the following questions:

1. What substance is the filament of an automobile headlight made of and why?
2. Should lamps be turned on or off at the scene of an accident to see if they function? Why or why not?

### 3 Conclusion

#### 3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

#### 3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Preparer

Brad Mullins
Trace Advisory Board Chair
Date: 01/18/2012

Concurrence

Diana D. Salas
Quality Assurance
Date: 03/19/2012

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LAMP FILAMENT EXAMINATION

Duration One to Two weeks

Purpose Familiarize the trainee with the forensic examination of filament evidence

1 Objectives

1.1 Theoretical

The physical properties of incandescent tungsten lamp filaments differ from their cold properties, which will affect how the filament will behave when it encounters a shock force, such as in a traffic accident. The resultant condition of the filament can be used to assess whether or not the filament was incandescent at the time it was damaged.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Examine a filament and form an opinion as to its on/off status at the time of damage to the filament.

2 Lesson Plan

2.1 Instructional Outline

1. Normal use lamp characteristics
   a) Coil shape and spacing
   b) Color
   c) Mechanical distortions
   d) Squirm
   e) Age sag
   f) Pitting

2. Damage characteristics
   a) Cold break
   b) Hot shock or thermal shock
   c) Broken glass envelope
   d) Oxidation
   e) Melted glass
   f) Missing filaments
   g) Burnouts
   h) Water exposure
   i) Glass etching

3. Lamp examinations
   a) Continuity tests with ohm meter
   b) Stereoscopic examinations and photography
2.2 Required Readings

Trace Evidence Standard Operating Procedure. Lamp Filament Examinations. Texas Department of Public Safety Crime Laboratory.


Lamp Filaments-A Method of Determining Whether Lights were “On” or “Off”. Camps, ed. Grahwohl's Legal Medicine, 2nd edition. 1968, pp. 235-238.


Lavabre R, and Baudoin P. Examination of Lightbulb Filaments After a Car Crash: Difficulties in Interpreting the Results. J For Sci. 46(1), pp. 147.

2.3 Practical Exercises

1. The trainee will demonstrate that they can break the bulbs of lamps and expose the bare filaments without damaging the filaments. At least one sealed-lamp and one B-type lamp should be used.

2. The trainee will correctly identify at least one example of each of the following: age-sag, pitting, tungsten deposition, various oxidation states (blackening and secondary colors), oxide dust/deposits, hot shock distortion, angular breaks and a normal functioning burnout.

3. The trainee will bring lamps of various types to incandescence and determine how much comparative force is needed to produce significant distortion. At least one “peanut” lamp, one B-type lamp and one halogen lamp should be examined.

4. The trainee will demonstrate the proper way to operate an ohmmeter on at least one sealed-lamp, one B-type lamp and one halogen lamp (preferably still mounted in a housing unit as well as loose.)

2.4 Practical Examination

The trainee will examine various style bulbs and determine if the bulbs were on or off. The trainee will document their observations using the “Lamp Examination” form.
2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What is meant by the term age sag, and what characteristics differentiate age sag from distortion caused by an impact?
2. What is the purpose of performing a conductivity test on the filaments in a light?
3. What causes the "coloration" (green, purple, blue etc.) sometimes observed on a filament where the glass has been broken?
4. How would you interpret a lamp if the bulb is broken and the filament is stretched out, but no apparent oxidation is present?
5. How would you interpret the absence of distortion in an unbroken bulb?
6. How would you interpret the presence of an angular break in the filament if the bulb is unbroken?
7. How would you interpret a lamp where the bulb is broken and the filament is bright with angular fractures?
8. How would you interpret a lamp where the bulb is broken, filament A is tinted with no distortion, filament B is stretched out, blackened and broken with melted ends?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Training Manual
Trace Evidence
Subject: Lamp Filament Examination

Preparer

Brad Mullins ........................................ Date: 01/18/2012
Trace Advisory Board Chair

Concurrence

Diana D. Salas ........................................ Date: 03/19/2012
Quality Assurance

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INTERPRETATION OF FILAMENT EVIDENCE

Duration  One week

Purpose  Familiarize the trainee with the factors that affect interpretation of the significance of filament evidence.

1  Objectives

1.1  Theoretical

The forensic filament examiner must be able to provide expert testimony concerning the significance and limitations of forensic filament examinations and convey that information to a jury in a manner that can be understood.

1.2  Practical

Upon completion of this module, the trainee will be able to:

A. Understand the limitations and significance of filament examinations,
B. Report conclusions and opinions,
C. Perform technical and administrative reviews, and
D. Provide expert testimony that appropriately conveys the significance of filament examinations.

2  Lesson Plan

2.1  Instructional Outline

A. Discuss the significance of filament examinations
B. Discuss the limitations of filament examinations
C. Discuss report wording
D. Discuss technical and administrative reviews
   Pertinent documentation and necessary components of a completed case folder
E. Discuss court testimony

2.2  Required Readings

Trace Evidence Standard Operating Procedure. Lamp Filament Examinations. Texas Department of Public Safety Crime Laboratory.


2.3  Practical Exercises

A. Report writing
   1. The trainee will review reports written by experienced examiners.
   2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.
B. Technical and administrative reviews

1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.

2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

C. Court testimony

When possible, the trainee should observe actual testimony by an experienced filament examiner.

2.4 Practical Examination

None

2.5 Written Exercises

The trainee will provide a written response to the following question:

What are some limitations of filament examinations?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
## Revision History

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INTRODUCTION TO HAIR

Duration One to Two weeks
Purpose Familiarize the trainee with forensic hair examination and comparison

1 Objectives

1.1 Theoretical

Hair evidence can be found in almost any criminal offense. The ability to properly identify and characterize hair can be useful in providing investigative leads, eliminating hairs from possible contributors and in the comparison to known source(s). The information in this module will help the examiner understand the many features utilized in forensic hair examination and the valuable information that can be gained from such exams.

1.2 Practical

Upon completion of this module, the trainee will be able to

1. Discuss the development of forensic examination and comparison of hair evidence
2. Discuss the techniques used to examine and compare hair evidence

2 Lesson Plan

2.1 Instructional Outline

1. History and development of forensic examination and comparisons of hair evidence and the current state of hair evidence
2. The structure and chemical composition of human hair
3. Growth cycle and root stages of human hair
4. Wig hair
5. Transfer and persistence
6. Hair examinations and comparisons
7. Hair conclusions

2.2 Required Readings


Hicks JW. Microscopy of Hair, Federal Bureau of Investigation, 1977.


2.3 Practical Exercises
None

2.4 Practical Examination
None

2.5 Written Exercises
The trainee will provide a written response to the following questions:

1. Describe the structure and chemical composition of human hair.
2. Discuss the growth cycle of hair and the root stages.
3. On average, how many hairs does a person shed in a day?

3 Conclusion

3.1 Assessment
The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation
The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Trace Evidence

Subject: Introduction to Hair

Preparer

Sandy Parent
Trace Advisory Board Chair

Date: 11/20/2008

Concurrence

Zoë M. Smith
Quality Assurance

Date: 11/20/2008

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MACROSCOPIC EXAMINATION AND COMPARISONS OF HUMAN HAIR

Duration  One to two weeks
Purpose  Familiarize the trainee with the macroscopic examination of human hair.

1 Objectives

1.1 Theoretical

Hair identification and comparison, to a limited degree, can be accomplished by visual or macroscopic techniques. An understanding of the class characteristics of hair along with the use of low-powered microscopy can enable an examiner to assess the need for microscopic comparison.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Visually or macroscopically examine/compare hair samples.

2 Lesson Plan

2.1 Instructional Outline

A. Macroscopic characteristics of

1. Human
   a) Head hair
   b) Pubic hair
   c) Body hair

2. Animal

B. Visual and macroscopic differences of human hairs from common animal hairs and fibers

1. Diameter
2. Color (shade, uniformity and banding)
3. Luster
4. Length
5. Cross-sectional shape

C. Macroscopic characteristics of roots

1. Anagen
2. Catagen
3. Telogen
4. Presence of tissue

D. Required documentation for a macroscopic comparison

1. Length
2. Root
3. Color
4. Configuration

E. Criteria for an association and the limitations of a macroscopic association

F. Factors that may affect a macroscopic hair comparison
   1. Length
   2. Time lapse
   3. Sample size

2.2 Required Readings
Trace Evidence Standard Operating Procedure. Macroscopic Examination of Hair. Texas Department of Public Safety Crime Laboratory.


2.3 Practical Exercises
1. The trainee will macroscopically examine and document human hairs, animal hairs and fibers.
2. The trainee will examine and document the macroscopic characteristics of head hair, pubic hair and body hair.
3. The trainee will collect 10 hairs in different growth cycles (pulling and combing) and document the presence or absence of a root and tissue.
4. The trainee will determine the criteria of an association by comparing one hair designated as the question hair to the known hair of the same individual.

2.4 Practical Examination
1. The trainee will determine if question material is human hair, animal hair or fibers based on the macroscopic characteristics.
2. The trainee will determine somatic origin and the presence/absence of a root of an unknown set of hairs based on the macroscopic characteristics.
3. The trainee will compare question hair samples to known hair samples to determine if they are visually similar or dissimilar to one another. Document any conclusions using appropriate reporting statements.

2.5 Written Exercise
The trainee will provide a written response to the following questions:
1. What are macroscopic characteristics of human hair, animal hair and fibers?
2. What are the required characteristics to document for a macroscopic hair comparison?
3. What are some factors that may affect a macroscopic hair comparison?
3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
## Preparer

*Justin Parker*  
Trace Evidence Advisory Board Chair  
Date: 11/15/2016

## Concurrence

*Valerie Turner*  
Quality Assurance Specialist  
Date: 11/10/2016

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Advisory Board |
| 03        | 01/11/2017     | Minor Revision Section 2  
Advisory Board 9/27/2016 |
EXAMINATION OF ANIMAL HAIR

**Duration** One to two weeks

**Purpose** Familiarize the trainee with the characteristics used in the determination of genus or species of animal hair.

1 **Objectives**

1.1 **Theoretical**

The examination and identification of animal hairs can be important in many criminal offenses. An animal hair recovered from a victim or an item of evidence can provide investigative lead information for a potential suspect, corroborate a victim's statement, or provide a basis for further investigation. Animal hairs are typically not followed by a microscopic comparison and may be examined for possible genus or species identification.

1.2 **Practical**

Upon completion of this module, the trainee will be able to

1. Identify the most common animal hairs,
2. Apply the techniques used to characterize and identify hairs as animal, and
3. Identify the characteristics of hairs that determine various animal genera or species.

2 **Lesson Plan**

2.1 **Instructional Outline**

1. Microscopic characteristics of various known animal guard and fur hair.
   a) roots
   b) medulla
   c) pigmentation
   d) scales
   e) other pertinent characteristics

2. Different microscopic characteristics between animal and human hairs:
   a) medullary pattern
   b) scales
   c) roots
   d) tips
   e) color and banding
   f) shape
   g) diameter

3. Scale casting method:
   a) suitable medium (e.g., Permount, nail polish, Norland adhesive, Polaroid film coater, etc.)
4. Animal hair examination:
   a) conclusions
   b) limitations of hair comparisons
   c) report writing.

2.2 Required Readings

Trace Evidence Standard Operating Procedure. Species Determination of Hair. Texas Department of Public Safety Crime Laboratory.

Hicks JW. Microscopy of Hair, Federal Bureau of Investigation, 1977.


Material Safety Data Sheets for the following chemicals: Xylene, Permout, Polaroid film coater, Acetone, Fingernail polish (clear).


2.3 Practical Exercises

1. The trainee will perform the scale casting technique on a minimum of five (5) animal hairs

2. The trainee will microscopically examine a minimum of ten (10) animal hairs including dog, cat, rabbit, cow, horse and deer and document the microscopic characteristics.

2.4 Practical Examination

1. The trainee will be given a minimum of 10 hairs to determine microscopically if the hairs are human or animal. The trainee will document the microscopic characteristics to support their conclusion.

2. The trainee will be given a set of unknown common animal hairs to microscopically determine the family of animal and document relevant microscopic characteristics.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. List three characteristics that are different between animal hair and human hair?

2. Describe the medulla of an animal.

3. Does the hair of lower animals exhibit radical color changes within short distances? If yes, what is it called?

4. What is necessary for accurate identification of animal hair specimens?

5. How are hairs of deer family and antelope distinguished?

6. How are hairs of domestic animals distinguished?

7. How is a scale cast performed?
8. What are the limitations of animal hair comparisons?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Preparer

Devin Crago-Stasicha
Trace Advisory Board Chair

Date: 07/23/2010

Concurrence

Zoë M. Smith
Quality Assurance

Date: 07/23/2010

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MICROSCOPIC CHARACTERISTICS OF HUMAN HAIR

1. Objectives

1.1 Theoretical

The identification of somatic and racial characteristics of evidentiary hairs is important. The somatic origin of human hair may be classified as head, pubic, and body hairs, which includes limb (arm or leg), facial, chest, axillary (underarm) or other (eyebrow, eyelash, trunk). A human hair may have certain characteristics indicative of Caucasian, Mongoloid or Negroid race. The somatic origin and racial characteristics of a hair recovered from a victim or an item of evidence can provide investigative lead information for a potential suspect, corroborate a victim’s statement, or provide a basis for further investigation. Additionally, identification of the growth stage of evidentiary hairs may provide valuable information. Hair roots in the anagen and catagen stages are indicative of being forcibly removed and have the potential of providing nuclear DNA results, whereas roots in the telogen stage indicate the hair is ready to be shed and most often contain little nuclear DNA.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Identify probative microscopic hair characteristics,
2. Classify hair according to somatic and racial characteristics, and
3. Determine the growth stage of hairs.

2. Lesson Plan

2.1 Instructional Outline

1. Method of mounting with an appropriate medium and proper documentation of the hairs slide.
2. Microscopic observations including:
   a) type of root growth stages
   b) medulla
   c) pigmentation
   d) cortical fusi
   e) ovoid bodies
   f) cuticle
   g) damage areas
   h) demarcation lines
   i) postmortem banding
   j) characteristics of diseases
   k) characteristics of artificial treatment
3. Microscopic observations of Caucasian, Negroid, and Mongoloid hairs and discuss the differences between them with the trainee.

4. Cross-section of Caucasian, Negroid, and Mongoloid head hairs and discuss the differences with the trainee.

5. Difference between head hair, pubic hair, and body hair.

6. Procedures for demounting hairs that are going to be DNA tested from slides using the following methods:
   a) liquid nitrogen method
   b) xylene method

7. Suitability for DNA analysis
   a) nuclear DNA
   b) mitochondrial DNA testing

2.2 Required Readings


Hicks JW. Microscopy of Hair, Federal Bureau of Investigation, 1977.


2.3 Practical Exercises

1. The trainee will demonstrate to the trainer the method of mounting with permount, making proper documentation on hair slide and demounting hairs.

2. The trainee will mount Caucasian, Negroid, and Mongoloid head hair and pubic hair and examine and document the following microscopic characteristics:
   a) roots
   b) medulla
   c) pigmentation
   d) cortical fusi
   e) ovoid bodies
   f) cuticle
   g) other pertinent characteristics

3. The trainee will mount body hair including chest, beard/mustache, underarm hairs, eyebrow, eyelash, and trunk hair and examine and document relevant microscopic characteristics.

4. The trainee will microscopically examine the growth cycles, (pulled and combed) and status of root sheath of a minimum of ten head hairs.
2.4 Practical Examination

1. Identify somatic origin of at least ten human hairs
2. Identify racial origin of at least ten head and pubic hairs

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. Name the main parts of the hair and describe how each can vary.
2. List at least three characteristics that distinguish animal hair from human hairs.
3. Describe the growth cycle of human scalp hair and how to identify each stage of growth.
4. Describe the racial characteristics observed in human scalp hair.
5. Why is selection of the proper mounting medium so important for microscopic hair examination?
6. What are the pigments which give hair its color?
7. Define “Hair”.
8. How does one distinguish head hair from pubic hair?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
**Preparer**

*Brad Mullins*
Trace Advisory Board Chair

Date: 01/18/2012

**Concurrence**

*Diana D. Salas*
Quality Assurance

Date: 03/19/2012

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MICROSCOPIC COMPARISON OF HUMAN HAIR

Duration Two to four weeks
Purpose Familiarize the trainee with the microscopic comparison of human hair.

1 Objectives
1.1 Theoretical
Hair comparisons are an important part of criminal offenses such as homicide and sexual assault. A hair recovered from a victim or an item of evidence that exhibits similar microscopic characteristics as the hair from a possible suspect indicates that suspect may be the source of the questioned hair.

Hair comparisons involve a subjective comparison of the microscopic characteristics found in a questioned hair to the microscopic characteristics exhibited by a representative sample of hair from an individual. It is essential that the analyst be knowledgeable and proficient in the use of the comparison microscope and in describing the varying morphology of hair. Upon the finding of an association of probative value based upon microscopic comparison, verified by a second experienced hair examiner, DNA testing of the questioned hair should be performed.

1.2 Practical
Upon completion of this module, the trainee will be able to:
A. Perform hair comparisons using a comparison microscope, and
B. Evaluate the evidentiary value and significance of such comparison.

2 Lesson Plan
2.1 Instructional Outline
A. Microscope set-up
   1. Proper procedure on how to set-up and operate the comparison microscope (Köhler illumination) to ensure that the light is optimized
   2. Color balance the light source and correct any defects in the system using two slides containing the same hair
B. Microscopic characteristics of human hairs used in comparison.
C. Suitability of hairs for microscopic comparison.
   1. Damage
   2. Length
   3. Color
   4. Fragments
D. Factors that affect a microscopic comparison and/or conclusions
   1. Improper Köhler illumination
   2. Insufficient representative sample
   3. Time lapse between transfer of Q hair to collection of K hair,
4. Known hair samples consisting of cut hairs
5. Known hair samples consisting of hairs from a hair brush
6. Known hair samples consisting of hairs less than ½ inch
7. Known hair samples consisting of hair that have been artificially colored soon after the date of offense

2.2 Required Readings

A. Trace Evidence Standard Operating Procedure. Human Hair Comparison. Texas Department of Public Safety Crime Laboratory.


2.3 Practical Exercises

A. The trainee will prepare slides to assist in balancing the illumination of the microscope using a brown, black or red hair. Two preparations from the same hair will be produced by cutting the hair in half and mounting each half on a slide. After both sides of the microscope have been set-up with Kohler illumination, the trainee will use these slides to assist in balancing the light source.

B. The trainee will collect hairs from at least 5 different known sources; at least 20 -25 hairs from different areas of the head and pubic region.

C. The trainee will mount a representative sample from the 5 different collected hair samples. The trainee will microscopically examine the known hair samples and document the microscopic characteristics as well as the variation within the known sample.

D. The trainee will mount one hair from each of the 5 different collected hair samples for a question hair. The trainee will compare this hair to its known source and to all other known mounted hairs to determine the criteria of an association or an exclusion.

2.4 Practical Examination

A. The trainee will be given a minimum of 5 sets of question and known hairs to determine if any of the question hairs could have originated from the known samples. These samples should consist of both head and pubic hairs from various racial origins.

B. The trainee will document the microscopic characteristics, the variation of the known sample and the conclusion of the comparison.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What are the different microscopic characteristics compared in a microscopic comparison?
2. Discuss the importance of a representative known hair sample
3. What types of hair are not suitable for a microscopic hair comparison and why?
4. What are the limitations of a microscopic hair comparison?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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INTERPRETATION OF HAIR EVIDENCE

Duration One week
Purpose Familiarize the trainee with the factors that affect interpretation of the significance of hair evidence.

1 Objectives
1.1 Theoretical
Hair evidence can be encountered in a wide variety of crimes and can provide strong corroborative information for placing an individual at a scene or in contact with another individual. Its ultimate evidentiary value is dependent on factors and circumstances surrounding the case and the type and characteristics of the hair. The forensic scientist must be able to provide accurate expert testimony concerning the significance of hair evidence.

1.2 Practical
Upon completion of this module, the trainee will be able to
   A. Understand and discuss the factors affecting the significance of hair evidence,
   B. Report conclusions and opinions,
   C. Perform technical and administrative reviews, and
   D. Provide expert testimony that appropriately conveys the significance of hair evidence.

2 Lesson Plan
2.1 Instructional Outline
A. Discuss the interpretation, significance, and limitations of hair examinations/comparisons and associations
   1. Variations within known samples
   2. Variation within the population
   3. Color, condition and characteristics of hair
   4. Quantity and location of recovered hair and the relationship between the individuals/scene
   5. Root stage
   6. Time lapse between transfer of Questioned hair and collection of Known hairs
B. Discuss why probative hair associations in casework must be verified by a second examiner.
C. Discuss why hair comparisons are not means of absolute personal identification
D. Discuss why a disclaimer “It is recognized that hair comparisons do not constitute a basis for absolute personal identification” should be part of a probative association
E. Discuss report wording on the following examples:

1. The hair from the questioned (Q) source exhibits the same microscopic characteristics as the hairs in a known (K) hair sample.

2. The hairs from the questioned source are microscopically dissimilar to the hairs in a known hair sample.

3. The questioned hairs exhibit both similarities and slight differences to hairs found in a known hair sample, and no conclusion can be reached whether they could have originated from the known source. It may be that, in the opinion of the examiner, the differences are not sufficient to eliminate the source of the known hairs as being a possible source of the questioned hairs. At the same time, the presence of these differences precludes an association being made between the questioned and known hairs.

F. Discuss technical and administrative reviews

Pertinent documentation and necessary components of a completed case folder

G. Discuss court testimony

2.2 Required Readings

A. Trace Evidence Standard Operating Procedure. Human Hair Comparison. Texas Department of Public Safety Crime Laboratory.


2.3 Practical Exercises

A. Report writing
   1. The trainee will review reports written by experienced examiners.
   2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.

B. Technical and administrative reviews
   1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.
   2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

C. Court testimony
   When possible, the trainee should observe actual testimony by an experienced hair examiner.

2.4 Practical Examination

None

2.5 Written Exercises

The trainee will provide a written response to the following question:

What factors can affect the significance of a hair association and how?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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INTRODUCTION TO PAINT AND POLYMER EVIDENCE

Duration: One to two weeks

Purpose: Familiarize the trainee with basic concepts of forensic paint and polymer examination and terminology, application, and composition.

1 Objectives

1.1 Theoretical

The trainee must have general knowledge about paints and polymers and the forensic examination of this type of evidence. This module will introduce the trainee to the classification of paint according to binder types, the classification of polymers including plastics and rubbers, the uses of the different classes of paint and polymers, and the tests used to compare these samples in a forensic laboratory.

1.2 Practical

Upon completion of this module, the trainee will be able to

1. Discuss the forensic examination and comparison of paint and polymer evidence.

2 Lesson Plan

2.1 Instructional Outline

1. Classification of different types of paints
   a) automobile
   b) architectural
   c) maintenance
   d) other end uses

2. Classification of generic polymers
   a) plastics
   b) rubber
   c) substrates
   d) other polymers

3. General aspects of paint/polymer examinations for
   a) color
   b) layer sequence
   c) chemical solubility and microchemical tests
   d) binder type
   e) polymer classification
   f) chemical composition

2.2 Required Readings
2.3 Practical Exercises

None

2.4 Practical Examination

None

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What are the most common types of automotive and architectural paints?
2. Describe the difference in the mode of formation (curing) between enamel and lacquer paint
3. Why are both FTIR and pyrolysis examinations made on paint samples?
4. What are some common substrates used for automotive parts?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Preparer

Brad Mullins  
Trace Advisory Board Chair  
Date: 01/18/2012

Concurrence

Diana D. Salas  
Quality Assurance  
Date: 03/19/2012

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INITIAL EVALUATION OF PAINT AND POLYMER EVIDENCE

Duration  One week
Purpose  Familiarize the trainee with the initial assessment of paint and polymer samples, including physical characteristics, layer sequence, solubility and micro-chemical testing

1 Objectives

1.1 Theoretical

The examination of paint and polymer evidence begins with a thorough macroscopic examination to assess the color, layer sequence, texture, and other physical characteristics. In order to detect all layers in a multi-layer system, the examination of a cross-section of the chip is required. Solubility and micro-chemical testing of questioned and known paint samples can be useful in the differentiation of visually similar paint samples, however, they are destructive tests and should be used only when sufficient paint sample is available. Solubility testing classifies paint samples as enamel or lacquer, and micro-chemical testing may easily distinguish paint samples of different composition.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Compare the physical characteristics of paint and polymer samples, and
2. Perform and interpret solvent and micro-chemical tests on paints.

2 Lesson Plan

2.1 Instructional Outline

1. Physical characteristics of paint and polymers (color, texture, effects, etc.).
2. Demonstrate cross-section of samples and examination of cross-sections.
3. Demonstrate solubility and micro-chemical tests of samples and interpretation of results.
4. Macroscopic and microscopic comparison of samples.

2.2 Required Readings

Trace Evidence Standard Operating Procedures. Paint Initial Examination and Overview. Texas Department Public Safety Crime Laboratory.


2.3 Practical Exercises

The trainer will provide known automotive and architectural paints, plastic, and rubber samples. The paints should include lacquer, enamel, nitrocellulose and latex paints with a variety of layer sequences. The trainee will describe (as applicable):

1. Color and effect
2. Texture
3. Layer sequence
4. Chemical properties

2.4 Practical Examination

1. The trainer will provide automotive and architectural paints, plastic, and rubber samples for the trainee to determine the:
   
   a) Color and effect
   b) Texture
   c) Layer sequence
   d) Chemical properties

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. How can it be determined if a paint is a lacquer paint?
2. What can be determined from a cross section of a paint chip?
3. What is “effect” in a paint?
4. Describe how to preliminarily identify rubber samples.

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
# Initial Evaluation of Paint and Polymer Evidence

**Preparers**

*John Witkowski*  
Trace Evidence Advisory Board Chair  
Date: 01/16/2015

*Katherine G. Sanchez*  
Quality Assurance Specialist  
Date: 01/22/2015

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INFRARED SPECTROSCOPY CLASSIFICATION OF PAINTS AND POLYMERS

Duration Two weeks
Purpose Introduce the trainee with infrared microspectroscopy and binder classification of paint samples and general polymer classification.

1 Objectives
1.1 Theoretical
The paint binder type and polymer classification may be determined by comparison and interpretation of the infrared spectra obtained for the sample. The spectra of the various layers from the known and the questioned samples can be compared to determine if differences are present.

1.2 Practical
Upon completion of this module the trainee will be able to
1. Properly operate and maintain the FTIR spectrometer,
2. Obtain and compare the infrared spectra, and
3. Determine the binder or polymer classification of evidence samples.

2 Lesson Plan
2.1 Instructional Outline
1. Theory and application of FTIR spectroscopy related to the examination of paint and polymers.
2. Demonstrate preparation of paint/polymer samples and the use and maintenance of infrared spectrometer.
3. Paint binder and extender classification based on FTIR spectra.
4. General polymer classification based on FTIR spectra.
5. Comparison of FTIR spectra.

2.2 Required Readings
Trace Evidence Standard Operating Procedures. FTIR. Texas Department Public Safety Crime Laboratory.


2.3 Practical Exercises

The trainer will provide the trainee with automotive and architectural paints with known binder and extender composition and general polymer samples to determine the classification. The samples will include:

1. Acrylic paint
2. Alkyd and polyester paint
3. Epoxy paint
4. Lacquer paint
5. Latex paint
6. Rubber (including car parts such as tires, bumpers, and door guards)
7. Plastic

2.4 Practical Examination

1. The trainer will provide the trainee with automotive and architectural paints to determine the binder and extender classifications and to determine possible associations.
2. The trainer will provide the trainee with plastic and rubber samples to determine polymer classification and to determine possible associations.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What type of molecular energy is measured to generate a FTIR spectra?
2. How can binder type be determined from a FTIR spectra?
3. Name three binder types of architectural paint.
4. Is FTIR a valuable technique for rubber identification? Why?
5. Describe how to prepare a rubber sample for FTIR analysis.

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Training Manual

DRN: TE-TM-PNT-03

Subject: Infrared Spectroscopy Classification of Paints and Polymers

Preparer

John Witkowski
Trace Evidence Advisory Board Chair
Date: 01/16/2015

Concurrence

Katherine G. Sanchez
Quality Assurance Specialist
Date: 01/22/2015

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PYROLYSIS GAS CHROMATOGRAPHY MASS SPECTROMETRY OF PAINTS AND POLYMERS

Duration Two weeks
Purpose Introduce the trainee with pyrolysis gas chromatography mass spectrometry of paint and polymer samples.

1 Objectives
1.1 Theoretical
Pyrolysis Gas Chromatography Mass Spectrometry (PGCMS) of paint and polymer samples offers increased discrimination power over infrared microspectroscopy. It should be used whenever questioned and known samples are of sufficient size and quality to allow comparison.

1.2 Practical
Upon completion of this module the trainee will be able to:
1. Properly operate and maintain the pyrolysis gas chromatograph mass spectrometer,
2. Obtain and compare the pyrograms from paint and polymer samples, and
3. Identify components within the pyrograms via mass spectral data.

2 Lesson Plan
2.1 Instructional Outline
1. Theory and application of pyrolysis gas chromatography mass spectrometry related to the examination of paint and polymers.
2. Demonstrate preparation of samples and the use and maintenance of the pyrolysis gas chromatograph mass spectrometer.
3. Interpretation and comparison of pyrograms and identification of components via mass spectral data.

2.2 Required Readings
Trace Evidence Standard Operating Procedure TE-12-08. Texas Department of Public Safety Crime Laboratory.
Manufacturer’s operating manual for the Chemical Data System Pyroprobe.
2.3 Practical Exercises

1. The trainer will provide the trainee with automotive and architectural paints, plastics, and rubbers to obtain and compare pyrograms to determine possible associations. At least five paints with different binder types will be examined.

2. The trainee will demonstrate the ability to identify components within the pyrograms using mass spectra.

2.4 Practical Examination

1. The trainer will provide the trainee with automotive and architectural paints, plastics, and rubbers to obtain and compare pyrograms to determine possible associations.

2. The trainee will demonstrate the ability to identify components within the pyrograms using mass spectra.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What is the result of pyrolysis of a sample?

2. What makes pyrolysis a reproducible examination?

3. What may be determined if pyrolysis of individual layers is performed?

4. How can pyrolysis support the determinations of organic composition made with FTIR analysis?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
# Training Manual

**DRN:** TE-TM-PNT-04  
**Subject:** Pyrolysis GCMS of Paints and Polymers

---

## Preparer

*John Witkowski*  
Trace Evidence Advisory Board Chair  
Date: 01/16/2015

## Concurrence

*Katherine G. Sanchez*  
Quality Assurance Specialist  
Date: 01/22/2015

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Effective Date: 02/17/2015  
Issued by: QA Coordinator
PAINT DATA QUERY

Duration Two to three weeks

Purpose Introduce the trainee to the identification of possible sources of automotive paint by utilizing the Paint Data Query database and other searching tools.

1 Objectives

1.1 Theoretical

Using a database of automotive paints, it is possible to provide an investigative lead as to the make and model of automobile that may be the source of automotive paint recovered from the scene or victim.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Use the Munsell Color Coordinate System,
2. Search the Paint Data Query (PDQ) automotive paint database,
3. Search the PDQ spectral libraries, and
4. Use the refinish color collections.

2 Lesson Plan

2.1 Instructional Outline

1. Paint examinations
   a) OEM
   b) repaint systems
2. FTIR and spectral coding
   a) binders
   b) extenders
   c) substrates
3. Munsell Color Coordinate System books for primer coding
4. Paint Data Query
   a) PDQ participants and requirements
   b) database content and sample information
   c) PDQ software/appendix overview
   d) layer sequence descriptors and other coding
   e) searches and their significance
      i. Layer System Queries (LSQ)
      ii. Fill-in-the-Blank searches (FITB)
      iii. spectral library searches and software
   f) assembly plant lists
5. Refinish color collections
6. Choosing a search scheme
7. Significance of a hit list
   a) ranges
   b) limitations
   c) report wording

2.2 Required Readings
Trace Evidence Standard Operating Procedure, Paint Data Query Database, Texas Department of Public Safety Crime Laboratory.

2.3 Practical Exercises
1. The trainee will utilize PDQ to identify possible manufacturer, plant, and year range information on set of at least 5 paint samples. Specific vehicle information should also be identified.
2. The trainee will write sample reports for the paint sample set.

2.4 Practical Examination
The trainee will identify possible manufacturer, plant, vehicle, and year range information for a sample set of known paints.

2.5 Written Exercises
The trainee will provide a written response to the following questions:
1. What information is stored in PDQ database?
2. Describe a possible search scheme for an OEM 4 layer paint chip.

3 Conclusion
3.1 Assessment
The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation
The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Training Manual
Trace Evidence
Subject: Paint Data Query

**Preparer**

*Brad Mullins*  
Trace Advisory Board Chair  
Date: 01/18/2012

**Concurrence**

*Diana D. Salas*  
Quality Assurance  
Date: 03/19/2012

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INTERPRETATION OF PAINT AND POLYMER EVIDENCE

Duration  One Week
Purpose   Familiarize the trainee with the significance of paint and polymer evidence examinations.

1 Objectives
1.1 Theoretical

Paint as a protective and decorative coating is common on numerous items encountered in everyday activities. Plastics and rubbers are commonly encountered in automotive parts and other sources. The association of paint and polymer evidence results from the forensic analysis of the physical and chemical properties of the samples. The significance of the results of forensic analysis of paint and polymers is dependent not only on the physical and chemical properties but also manufacturing, application, transfer and environmental factors.

1.2 Practical

Upon completion of this module the trainee will be able to:
   A. Assess the significance of paint and polymer examinations,
   B. Report observations and opinions,
   C. Perform technical and administrative reviews, and
   D. Provide expert testimony that appropriately conveys the significance of associations and eliminations.

2 Lesson Plan
2.1 Instructional Outline
   A. Discuss the significance of associations for
      1. Automotive paint
         a) OEM
         b) Repaint systems
      2. Architectural paint
      3. Tool paint
      4. Maintenance paint
      5. Plastics and substrates
      6. Rubber
   B. Discuss report writing
   C. Discuss technical and administrative reviews
      Pertinent documentation and necessary components of a completed case folder
   D. Discuss court testimony
2.2 Required Readings


2.3 Practical Exercises

A. Report writing

1. The trainee will review reports written by experienced examiners.

2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.

B. Technical and administrative reviews

1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.

2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

C. Court testimony

When possible, the trainee should observe actual testimony by an experienced paint examiner.

2.4 Practical Examination

None

2.5 Written Exercises

The trainee will provide a written response to the following:

1. What testimony in court would be appropriate for an association of a multilayer OEM paint transfer between two vehicles?

2. What can be concluded from the detection of transfer paint, determined to be from a repaint system, on a victim’s clothes?

3. What factors can strengthen the significance of an association based on paint or polymer evidence?
3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of practical exercises and written exercises. The type of questions and samples given should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer at the completion of the unit.
### Revision History

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<td>04/25/2019</td>
<td>Revision – Sections 1 and 2</td>
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INTRODUCTION TO FIBER AND TEXTILE EVIDENCE

Duration  One week

Purpose  Familiarize the trainee with the basic concepts and theoretical knowledge of fibers and textile products along with fiber examinations and comparisons.

1 Objectives

1.1 Theoretical

Many objects in our environment are composed of fibers, the fundamental unit of a textile. In order to testify about fiber evidence as an expert, advanced knowledge of fibers is necessary.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Discuss the forensic examination and comparison of fiber and textile evidence.
2. Discuss the significance of fibers as associative evidence.

2 Lesson Plan

2.1 Instructional Outline

1. Textile Definitions
   a) Fiber
   b) Filament
   c) Staple fibers
   d) Yarn
   e) Warp
   f) Weft/Fill
   g) Dye
   h) Pigment

2. Types of fibers
   a) Man-made (Cellulosics)
   b) Synthetics including Bicomponent
   c) Natural

3. Manufacturing Process
   a) Melt spinning
   b) Wet spinning
   c) Dry spinning

4. Fiber Transfer and Persistence

5. Textile Labeling

6. Fiber examinations
7. Conclusions

2.2 Required Readings


2.3 Practical Exercises

None

2.4 Practical Examination

None

2.5 Written Exercise

The trainee will provide written answers to the following questions:

1. What is the difference between man-made and synthetic fibers?
2. Give a brief description of the chemical composition of the following generic fiber classes:
   a) Acetate, acrylic, polyester, nylon, rayon, olefin.
3. Give possible end uses to the following generic fiber classes;
   a) Acetate, acrylic, polyester, nylon, rayon, olefin.
4. Give a brief description for the following terms:
   a) Filament, yarn, stable, wet spinning, dry spinning, melt spinning
5. Describe the difference between a dye and a pigment.

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.
3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Training Manual
Trace Evidence
Subject: Introduction to Fiber and Textile Evidence

Preparer

Sandy Parent
Trace Advisory Board Chair
Date: 09/30/2008

Concurrence

Zoë M. Smith
Quality Assurance
Date: 09/30/2008

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Effective Date: 11/05/2008
Issued by: QA Coordinator
STEREOMICROSCOPIC EXAMINATION OF FIBERS, YARNS AND FABRIC

Duration: One week

Purpose: To familiarize the trainee with stereoscopic characteristics of fibers, thread, and fabrics as well as to identify target fibers

1 Objectives

1.1 Theoretical

Examination of fibers using the stereomicroscope will enable an analyst to examine various characteristics to determine which fibers if any will be selected for further comparison.

Yarns and fabric can also be examined using the stereoscope for basic construction.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Identify fibers as natural or synthetic,
2. Document stereoscopic characteristics of fibers,
3. Recognize and recover target fibers from the debris,
4. Describe the weave and knit patterns of fabric, and
5. Determine the characteristics of yarns.

2 Lesson Plan

2.1 Instructional Outline

1. Introduction to fabric construction
   a) Knits, non-woven and woven fabrics
   b) Documentation
2. Introduction to rope/cordage and yarns
   a) Documentation of characteristics – (ply, twist, crown, etc.)
   b) Relationship of yarns in fabric construction
3. Representative sampling and mounting of fibers from different known fabric types
   a) Selection criteria used
   b) Demonstration of fiber mounting methodology
4. Discuss and demonstrate observable characteristics of different fibers
   a) Color
   b) Relative Diameter
   c) Shape
   d) Man-made versus Natural
   e) Luster
f) **Crimp**

g) **Documentation**

5. Introduction to the criteria used to select target fibers for further comparison
   a) **Developing search image for questioned fibers**
   b) **Demonstrate the methods for removing and mounting fibers**
   c) **Documentation**

6. Demounting fibers

### 2.2 Required Readings

Trace Evidence Standard Operating Procedures. Fiber Initial Examination and Overview. Texas Department of Public Safety.

Trace Evidence Standard Operating Procedures. Comparison of Thread, Yarn, and Cordage. Texas Department of Public Safety.


### 2.3 Practical Exercises

1. The trainee will examine fabric of various construction and document construction characteristics (weave, knit, etc.).

2. The trainee will mount known fibers in an appropriate fashion for target fiber comparison.

3. The trainer will provide debris samples (tape-lifts, scrapings, etc.) with known fibers for the trainee to examine. The trainee will document observed characteristics of the fibers within the debris and select target fibers for further comparison.

4. The trainee will remove and mount above questioned fibers for further comparison.

5. The trainee will examine various types of cordage and document the characteristics of ropes and cordage.

### 2.4 Practical Examination

1. Identify and document the construction characteristics of an unknown piece of fabric. Mount known fibers for target fiber comparison.
2. Use the known fibers to screen debris samples (tapelifts, scrapings, etc.) and document observed characteristics of the fibers within the debris and select and mount target fibers for further comparison.

3. Identify and document characteristics of an unknown and known piece of cordage and compare to make the determination if further testing is warranted.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What characteristics can be observed from a macroscopic examination of fibers?
2. How can color be compared using the stereoscope?
3. What characteristics are considered for selecting fibers for further comparison?
4. What characteristics are considered to eliminate a fiber at this stage?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
**Preparer**

*Brad Mullins*  
Trace Advisory Board Chair  
Date: 01/18/2012

**Concurrence**

*Diana D. Salas*  
Quality Assurance  
Date: 03/19/2012

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POLARIZED LIGHT MICROSCOPIC EXAMINATION OF FIBERS

Duration: One to Two weeks

Purpose: Familiarize the trainee with the microscopic characteristics of manufactured and natural fibers.

1 Objectives

1.1 Theoretical

The polarized light microscope can be used to evaluate three basic optical properties of manufactured fibers: refractive index, birefringence, and sign of elongation. These optical properties are sometimes sufficient to identify the generic classification of man-made fibers as a preliminary step in the identification process. Other features that may be observed microscopically include cross-section shape, diameter, surface features, inclusions, internal structure and color.

Many fibers for commercial and domestic use are natural in origin and can be broadly classified as animal, vegetable, or mineral. Animal fibers of forensic interest are hairs (from textiles, pets, livestock, game animals, etc.) and silk. Vegetable fibers include cotton, linen, ramie, jute, etc. Classification of animal and vegetable fibers is usually accomplished based upon their microscopic appearance. Mineral fibers are rarely encountered in forensic casework. Glass fibers are occasionally encountered.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Classify man-made fibers into the most common generic classes based on optical properties.
2. Document other observed features of fibers.
3. Identify common animal and vegetable fibers.

2 Lesson Plan

2.1 Instructional Outline

1. Demonstrate mounting fibers
2. Discuss and demonstrate the optical properties of various known man-made fibers including:
   a) relative refractive indices,
   b) birefringence,
   c) sign of elongation,
   d) optical cross-section,
   e) diameter,
   f) surface features,
   g) inclusions,
   h) delustrant,
   i) internal structure,
3. Discuss advantages and disadvantages

2.2 Required Readings

Trace Evidence Standard Operating Procedure. Microscopic Examination of Fibers. Texas Department of Public Safety.


2.3 Practical Exercises

1. The trainer will provide samples of man-made fibers of a variety of shapes, sizes and delustrant from the most common generic classes for the trainee to mount. The man-made fibers will included:

   a) acetate
   b) triacetate
   c) acrylic
   d) modacrylic
   e) nylon 6 and nylon 6.6
   f) olefin,
   g) polyester
   h) rayon
   i) Lyocell
2. The trainee will examine and document the following properties:
   a) Delustrant
   b) Diameter
   c) Birefringence
   d) Sign of Elongation
   e) Refractive indices

3. Trainee will mount, examine and document the following natural fibers:
   a) Cotton
   b) Linen
   c) Wool
   d) Silk

2.4 Practical Examination

The trainee will examine, document and identify the generic class of a set of unknown fibers.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. Define polarized light.
2. How are interference colors produced?
3. Define refractive indices
4. Define birefringence.
5. Define extinction.
7. Define pleochroism/dichroism.
8. How and why are fibers delustered?
9. Can the generic class of a fiber be identified with PLM?
10. What are bi-component fibers? How are some of them manufactured?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Training Manual
Trace Evidence
Subject: Polarized Light Microscopic Examination of Fibers

Preparer

Brad Mullins
Trace Advisory Board Chair
Date: 01/18/2012

Concurrence

Diana D. Salas
Quality Assurance
Date: 03/19/2012

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COMPARISON MICROSCOPE

Duration One week
Purpose To compare the color and morphological features of fibers using the comparison microscope

1 Objectives

1.1 Theoretical
A comparison microscope is used to perform side by side comparisons of questioned fibers with those from a known source. A comparison microscope consists of two compound transmitted light microscopes connected with an optical bridge that enables both samples to be observed simultaneously in the same field of view. In order to gain optimal resolution, specimen contrast and color balance, it is essential that the optical conditions on both sides of microscope be properly balanced.

1.2 Practical
Upon completion of this module, the trainee will be able to
1. Properly illuminate a comparison microscope, and
2. Compare color and morphological features of fibers.

2 Lesson Plan

2.1 Instructional outline
1. Demonstrate
   a) how to set-up and operate the microscope,
   b) color balance the light source and correct any defects in the system using two slides containing the same fibers.
2. Discuss criteria used for comparison.
3. Discuss factors that affect comparison.
4. Discuss advantages and disadvantages.

2.2 Required Readings


Trace Evidence Standard Operating Procedures. Fiber Initial Examination and Overview. Texas Department of Public Safety.

2.3 Practical Exercise
1. The trainee will prepare slides to assist in balancing the illumination of the microscope using colored yarns that are uniformly dyed or pigmented and preferably delustered. Two identical preparations from the same source will be
produced by cutting the yarns in half and mounting the fibers on two slides. After both sides of the microscope have been set-up with Kohler illumination, the trainee will use these slides to assist in balancing the light source.

2. The trainee will make sets of slides consisting of two slides of the same sample to determine the criteria for a match and compare the samples on the comparison microscope. The samples should consist of fibers of various types, colors and morphological features.

2.4 Practical Examination
The trainee will be given a set of question and known fibers to determine if any of the question fibers could have originated from the known samples based on comparison scope.

2.5 Written Exercises
The trainee will provide a written response to the following questions:

1. What criteria can be used in a comparison?
2. What factors can affect comparison?
3. What are the advantages and disadvantages for the comparison microscope?

3 Conclusion

3.1 Assessment
The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation
The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Training Manual
Trace Evidence
Subject: Comparison Microscope

Preparer

Sandy Parent
Trace Advisory Board Chair

Date: 09/30/2008

Concurrence

Zoë M. Smith
Quality Assurance

Date: 09/30/2008

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Issued by: QA Coordinator
MANUFACTURED FIBERS – CROSS-SECTION

Duration  One week
Purpose  Familiarize the trainee with fiber cross-sectioning techniques and the type of information obtained from them.

1  Objectives
1.1  Theoretical

The examination and comparison of the cross-sectional shape of fibers is an imperative part of fiber examination. Often times, the cross-sectional shape of a fiber can be determined optically. However, other information, such as modification ratio, the spinning process used, the possible end-use, fiber quality, quality and method of dyeing, is obtained from examining the cross-section of a fiber.

1.2  Practical

Following the completion of this module, the trainee will be able to

1. Obtain cross-sections from single fibers, multiple fibers and fiber tufts
2. Determine the modification ratio of multi-lobed fibers
3. Observe microscopic characteristics of the fiber from its cross-section.

2  Lesson Plan
2.1  Instructional Outline

1. Discuss the significance of cross sections
   a)  Modification ratio
   b)  End use
   c)  Dye penetration
   d)  Sampling and variation within a sample
2. Techniques -single fibers, multiple fibers and fiber tufts
   a)  Jolliff
   b)  Polyethylene
   c)  Other methods
3. Microscopic characteristics of cross-sections
   a)  Documentation of the observed characteristics
   b)  Relationship between the fiber cross-sectional shape and its longitudinal appearance.
4. Microscopic comparison

2.2  Required Readings

2.3 Practical Exercises

1. The trainer will provide samples of man-made fibers of various known cross-sectional shapes for the trainee to cross-section and examine. These should include round, peanut, bean, multi-lobed, bicomponent and several different trilobal shapes. The trainee will cross-section the fiber samples using various techniques.

2. The trainee will examine the physical cross-section and compare to the longitudinal cross-section.

2.4 Practical Examination

The trainee will cross-section an unknown sample set, identify the cross-sectional shape and document the cross-section with photomicrographs.

2.5 Written Exercises

The trainee will provide written answers to the following questions:

1. What is the modification ratio? Why is this important?
2. How does manufacturing processing affect cross-sectional shape?
3. List different cross-sectional shapes associated with melt, wet and dry spinning and end use.

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
**Preparer**

*Sandy Parent*  
Trace Advisory Board Chair  
Date: 09/30/2008

**Concurrence**

*Zoë M. Smith*  
Quality Assurance  
Date: 09/30/2008

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INFRARED MICROSPECTROSCOPY OF FIBERS

Duration
One to Two Weeks

Purpose
Familiarize the trainee with the use of infrared microspectroscopy for identification and comparison of manmade fibers.

1 Objectives

1.1 Theoretical

Infrared microspectroscopy is an important part of forensic fiber analysis. Use of the infrared microscope attachment allows analysis of a small sample and provides information about the polymer composition of the fiber. It is valuable not only in determining the generic group to which a fiber belongs, but also in separating fibers within generic groups on the basis of differences in composition.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Properly operate and maintain the infrared microspectrometer and its accessories.
2. Obtain spectra from fiber samples.
3. Identify and compare the polymer composition of man-made fibers.

2 Lesson Plan

2.1 Instructional Outline

1. Sample preparation
2. Use and routine maintenance/calibration of the infrared microspectrometer
3. Evaluation of spectra and discuss libraries
4. Advantages and disadvantages

2.2 Required Readings

Trace Evidence Standard Operating Procedures. Infrared Microspectroscopy of Man-Made Fibers. Texas Department of Public Safety.


Effective Date: 04/17/2012
Issued by: QA Coordinator


2.3 Practical Exercise

The trainer will provide samples of man-made fibers from the most common generic classes for the trainee to analyze. The fibers must include:

1. acetate
2. triacetate
3. acrylic (three types)
4. modacrylic,
5. nylon 6
6. nylon 6.6
7. olefin
8. polyester
9. rayon

2.4 Practical Examination

The trainee will be given an unknown sample set consisting of at least five different fiber types to analyze, evaluate and identify.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. Describe the FTIR theory and application in layman terms
2. What fibers cannot be distinguished solely on FTIR?
3. What are the limitations of FTIR?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
**Training Manual**

**Trace Evidence**

**Subject: Infrared Microspectroscopy of Fibers**

---

**Preparer**

*Brad Mullins*  
Trace Advisory Board Chair  
Date: 01/18/2012

**Concurrence**

*Diana D. Salas*  
Quality Assurance  
Date: 03/19/2012

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Major revision – All sections  
Advisory Board 06/05/2008 |
| 02        | 04/17/2012     | Minor revision – Sections 1.2, 2.3, and 2.5  
Advisory Board |
COLOR COMPARISON OF FIBERS BY MICROSPECTROMETRY

**Duration**  
One week

**Purpose**  
Familiarize the trainee with the use of the microspectrometer for color comparison of fibers.

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<td><strong>1.1 Theoretical</strong></td>
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<td>Microspectrometry provides a nondestructive, objective evaluation of color from very small areas of a fiber. The human eye can be used as a screening tool for color differentiation, however it cannot determine whether or not the colors are actually the same or a metameric pair or if differences in color shade are due to different dye absorption or different colorants. The microspectrometer can differentiate colors by measuring absorbance across visible and/or ultraviolet light wavelengths in order to obtain the absorption spectra of a fiber. A valid comparison of a single questioned fiber color to that of a known fiber item requires comprehensive sampling and analysis of the known fibers.</td>
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| **1.2 Practical** |
| Upon completion of this module, the trainee will be able to: |
| 1. Properly operate and maintain the microspectrometer. |
| 2. Obtain and compare the spectra of questioned and known fibers. |

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| **2.2 Required Readings** |
| Trace Evidence Standard Operating Procedures. Microspectrophotometry of Fibers. Texas Department of Public Safety |
2.3 Practical Exercise

1. Obtain Holmium Oxide and Neutral Density spectra in the ultra-violet and visible range.

2. The trainer will provide samples of colored fibers of various cross-sectional shapes for the trainee to examine.
   
   a) The trainee will obtain 10 transmittance spectra along the length of a single fiber for multiple fibers of various cross-sectional shapes.

   b) The trainee will scan an appropriate number of known fibers in the visible and ultraviolet range based on the color uniformity and cross-sectional shape and plot the range of spectra from a set of fibers.

   c) The trainee will scan a fiber from the same sample and treat the fiber as a questioned fiber and compare known and questioned spectra to determine the criteria of a match.

2.4 Practical Examination

The trainee will obtain spectra from a set of unknown and known fibers to determine if the color is similar based on the MSP spectra.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. Describe in layman’s terms the theory and application of the MSP

2. Define metamerism

3. How many sample scans should be performed on a single fiber?

4. How can weather affect a fiber’s color?

5. How should you obtain a known sample from a T-shirt?
3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Preparer

Brad Mullins
Trace Advisory Board Chair

Date: 01/18/2012

Concurrence

Diana D. Salas
Quality Assurance

Date: 03/19/2012

Version # Effective Date Brief Description of Change(s)
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00 07/01/2003 Original Issue

01 11/05/2008 Former DRN: TE-TM-26
Major revision – All sections
Advisory Board 06/05/2008

02 04/17/2012 Minor revision – Sections 1.2 and 2.3
Advisory Board
COLOR COMPARISON OF FIBERS BY THIN LAYER CHROMATOGRAPHY (TLC)

Duration: One to Two Weeks

Purpose: Familiarize the trainee with the proper application of the Thin Layer Chromatography (TLC) technique for fiber color comparison.

1 Objectives

1.1 Theoretical

Thin Layer Chromatography (TLC) is used to compare the dye components of colored fibers. Many dyes used to color textile fibers can be extracted and separated using TLC. The separated colors can be easily and quickly compared from the TLC plate.

1.2 Practical

Upon completion of this module, the trainee will be able to

1. Extract dyes from a variety of sample sizes and fiber types,
2. Perform thin layer chromatography on the extracts and compare the colors.

2 Lesson Plan

2.1 Instructional Outline

1. Discuss TLC
   a) Theory
   b) Dye types associated with different fiber types

2. Extraction techniques
   a) Extraction solvent
   b) Temperature

3. Different eluent systems

4. Comparison
   a) Migration
   b) Number of components
   c) UV characteristics

5. Advantages and disadvantages.

2.2 Required Readings


**2.3 Practical Exercises**

1. The trainee will extract the dye from a variety of colored fibers of various sizes.

2. The trainee will perform the thin layer chromatography of the extracted dyes using various eluenting systems

**2.4 Practical Examination**

The trainee will extract dye from questioned and known fibers, perform thin layer chromatography using an appropriate eluenting system and determine if they originated from the same source based on TLC results.
2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. Describe the process of TLC in layman’s terms.
2. What are the limitations of TLC?
3. When should TLC be performed?
4. What characteristics are used for comparison?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Training Manual
Trace Evidence
Subject: Color Comparison of Fibers by TLC

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<th>Preparer</th>
<th>Date: 09/30/2008</th>
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<td>Sandy Parent</td>
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<td>Trace Advisory Board Chair</td>
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Effective Date: 11/05/2008
Issued by: QA Coordinator
FIBER SOLUBILITY EXAMINATIONS

Duration: One to two weeks
Purpose: Familiarize the trainee with solubility and thermal microscopy techniques used to examine certain manufactured fibers.

1 Objectives

1.1 Theoretical

Certain polymers can be distinguished from one another by their solubility behavior when mounted in specific organic liquids. Acetate (diacetate) and triacetate fibers exhibit similar optical properties and infrared spectra, making it potentially difficult to distinguish between these two generic fiber classes using these techniques alone. The chemical differences between these two fibers are due to the percent of acetylated hydroxyl groups on the cellulose backbone of these two polymers. In normal cellulose acetate (diacetate) approximately 60% of the hydroxyl groups are acetylated while in the triacetate more than 90% of these sites are acetylated. The percentage of hydroxyl groups that have been acetylated affects the solubility behavior of these polymers. Although solubility testing is destructive, when carried out according to the microchemical procedure described here, the loss of material is negligible in relation to the certainty of information gained.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Apply the technique of solubility testing to determine the difference between acetate and triacetate.

2 Lesson Plan

2.1 Instructional Outline

1. Discuss solubility testing
2. Techniques and solvents
   a) 75% aqueous acetone
   b) Chloroform
3. Advantages and disadvantages

2.2 Required Readings


2.3 Practical Exercises

The trainer will provide samples of acetate and triacetate fibers for the trainee to examine. The trainee will distinguish between acetate and triacetate fibers using aqueous acetone and chloroform.

2.4 Practical Examination
The trainee will identify unknown fibers based on solubility testing.

2.5 Written Exercises

The trainee will provide written answers to the following questions:

1. Which fiber is soluble in chloroform?
2. What is a situation that solubility may be useful?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist and sign-off sheet. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
**Preparer**

*Sandy Parent*  
Trace Advisory Board Chair

Date: 09/30/2008

**Concurrence**

*Zoë M. Smith*  
Quality Assurance

Date: 09/30/2008

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INTERPRETATION OF FIBER EVIDENCE

Duration  One week
Purpose  Familiarize the trainee with the factors that affect interpretation of the significance of fiber evidence.

1 Objectives

1.1 Theoretical
Fibers occur in a variety of items, so they are often encountered as evidence. Their ultimate evidentiary value is dependent on factors and circumstances surrounding the case and the commonness of the particular evidence fibers. The forensic scientist must be able to provide expert testimony concerning the significance of an association based upon fiber evidence.

1.2 Practical
Upon completion of this module, the trainee will be able to:

   A. Understand the factors affecting the significance of fiber evidence,
   B. Report conclusions and opinions,
   C. Perform technical and administrative reviews, and
   D. Provide expert testimony that appropriately conveys the significance of fiber evidence.

2 Lesson Plan

2.1 Instructional Outline

A. Discuss the interpretation of fiber associations and the significance with the trainee.
   1. the types of fibers recovered
   2. color or variation of color in the fibers
   3. number of fibers found, location of fibers
   4. fabric type
   5. one-way or two-way transfer
   6. multiple fiber associations
   7. multiple color / type question fibers consistent with color / type known fibers from one item
   8. the use of RN/WPL information to determine manufacturer production and distribution and the value of target fiber studies

B. Discuss report wording

C. Discuss technical and administrative reviews
   Pertinent documentation and necessary components of a completed case folder

D. Discuss court testimony
2.2 Required Readings


E. Fong W, and Inami SH. Results of a Study to Determine the Probability of Chance Match Occurrence Between Fibers Known to be from Different Sources. J For Sci. 1986. 31(1), pp. 65-72.


2.3 Practical Exercises

A. Report writing

1. The trainee will review reports written by experienced examiners.

2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.
B. Technical and administrative reviews

1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.

2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

C. Court testimony

When possible, the trainee should observe actual testimony by an experienced fiber examiner.

2.4 Practical Examination

None

2.5 Written Exercises

The trainee will provide a written response to the following:

Discuss the factors that affect the significance of fiber associations.

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
## Revision History

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<td>Major revision – Section 2.4</td>
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GUNSHOT PRIMER RESIDUE EXAMINATION

Duration  Four to eight months
Purpose  The trainee will become familiar with the theoretical and practical aspects of gunshot primer residue deposition and the analysis SEM stubs for gunshot primer residue.

1  Objectives

1.1  Theoretical

Antimony, barium, and lead compounds are components of most primer mixtures and are commonly found in gunshot primer residue. Significant levels of these three elements can be deposited on the hands of a person who discharges a weapon, is near a weapon when it is fired, or handles a weapon or ammunition component.

Scanning Electron Microscopy-Energy Dispersive Spectrometry (SEM-EDS) is a highly sensitive and discriminating analytical technique. SEM-EDS is used to analyze stubs for the presence of antimony, barium, lead and particle morphology characteristic of gunshot primer residue.

1.2  Practical

Upon completion of this module, the trainee will be able to:

A. Understand the origin, occurrence, and significance of gunshot primer residue,
B. Properly collect SEM stubs for gunshot primer residue analysis,
C. Determine if the stubs warrant analysis,
D. Interpret the data obtained from case samples,
E. Understand and explain the theory and principles of SEM-EDS analysis,
F. Properly operate and maintain the SEM-EDS instrumentation,
G. Report conclusions and opinions,
H. Perform technical and administrative reviews, and
I. Provide expert testimony that appropriately conveys the significance of GSR evidence.

2  Lesson Plan

2.1  Instructional Outline

A. Discuss gunshot primer residue
   1. Formation
   2. Composition
   3. Morphology
   4. Sources
   5. History of analysis and collection
   6. Significance
B. SEM-EDS instrumentation
   1. Theory
   2. Operation
   3. Calibration
   4. QC procedures
   5. Sample preparation
   6. Elemental identification
   7. Limitations
   8. Maintenance

C. Sample collection and analysis
   1. Hand stub collection
   2. Inanimate object collection
   3. Criteria for GSR collection (DPS policy and its development)
   4. Sample preparation for SEM-EDS analysis

D. Interpretation and significance

E. Discuss report writing

F. Discuss technical and administrative reviews
   Pertinent documentation and necessary components of a completed case folder

G. Discuss court testimony

2.2 Required Readings

B. Texas Department of Public Safety Crime Laboratories Gunshot Primer Residue SOP.


2.3 Practical Exercises

A. The trainer will provide sets of stubs prepared by the trainer or other qualified personnel for the trainee to analyze. At least 10 stubs should be included in the sets. The samples will contain stubs with a variety of known gunshot residue particles.

B. Report writing

1. The trainee will review reports written by experienced examiners.

2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.

C. Technical and administrative reviews

1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.

2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the
trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

D. Court testimony

When possible, the trainee should observe actual testimony by an experienced GSR examiner.

2.4 Practical Examination

A. The trainer will provide 5 sets of stubs prepared by the trainer or other qualified personnel for the trainee to analyze. The samples will contain stubs with a variety of known gunshot residue particles.

B. The trainee will prepare mock case reports based on the conclusions of the analysis.

2.5 Written Exercises

1. How is gunshot primer residue formed?
2. What is the definition of characteristic GSR particles? Indicative particles?
3. Why are GSR kits collected from a victim’s hands not normally analyzed by this lab?
4. What are some environmental sources for indicative GSR particles?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and written/practical examinations. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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<td>03</td>
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OVERVIEW OF THE FIRE DEBRIS ANALYSIS TRAINING PROGRAM

1 Introduction

Fire Debris Analysis involves the identification of ignitable liquid residue either in liquid form (swabs of unknown liquid) or in debris, other burned materials, and any other materials except for blood and tissue retrieved from a possible arson crime scene.

2 Purpose

A. The following modules in this manual comprise basic training for the new Fire Debris Analyst:

1. Overview
2. Organic Chemistry Review
3. Handling of Fire Debris Evidence
4. Introduction to Petroleum Products and Petroleum Manufacturing
5. Introduction to Fire and Arson Investigation
6. Evaluation and Characterization of Fire Debris
7. Extraction Methods, Sample Preparation and Data Collection
8. Instrumental Analysis
9. Report Writing
10. Practical Assessment

B. It should be noted that each training module is not meant to be followed in exact order and overlap among and between modules is to be expected.

C. Fire Debris (FD) analysts who were specializing in either Fire Debris Analysis or who had been accepted as an expert witness in this discipline, and who had successfully completed an external proficiency test in this type of analysis prior to the issuance of this training manual, will not be required to complete this training in its entirety in order to retain their acceptance as an analyst in the Fire Debris discipline within DPS.

Situation which warrant previously-qualified individuals to complete portions of this training program may include:

1. If the analyst in question is a subcontractor;
2. If the analyst fails to complete an assigned proficiency and/or competency test;
3. If their proficiency/competency test results do not conform to the consensus results by the proficiency/competency test provider;
4. If he/she is rejected as an expert witness by a court;
5. Or, based on technical reviews of casework, the FD Section Supervisor determines that remedial training is necessary

3 Trainee Responsibilities

A. All analysts, regardless of their prior experience, are required to read, review and be familiar with all Fire Debris related SOPs, especially
1. TE-13-01 Handling of Fire Debris Analysis Items,
2. TE-13-02 Instrumental Analysis of Fire Debris,
3. TE-13-03 Fire Debris Analysis Equipment,
4. TE-13-04 Ignitable Liquid Reference Standards and Materials, and
5. Appropriate sections of the Crime Laboratory Service and LIMS Manuals.

B. The trainee must read all modules in their entirety in order to develop a complete understanding of the requirements.

C. During the training period, the trainee will observe forensic arson cases being processed/analyzed by an authorized analyst or section supervisor for a period of 2 to 6 weeks (to be determined by section supervisor). During this time, the trainee will complete the required sections of the training manual which includes preparation and analysis of samples from the ignitable liquid reference library; and preparation of these in mixed matrices.

D. Parts of the training notebook that can be saved in a computer data file (i.e. word, excel, pdf) should be retained by the trainee for ease of recording, editing and reviewing. This will be temporarily copied to the Fire Debris folder on the P:drive (in a folder with the analyst’s name) and be updated at least once a month to ensure the FD Section retains a copy until such time as it can be added to the system record per work authorization protocols. At the end of each month (or when prompted by the trainer), the trainee will print out the training log and place the printed copies in a binder labeled with their name and “Training Notebook” to be reviewed by the trainer. A Statement of Qualifications (SOQ) will also be completed and saved per DPS protocol (CLS Manual Chapter 34, Section 34.2).

E. The trainee will successfully complete supervised analysis of non-evidence samples either created by the trainer from ignitable liquid or of chromatographic data pulled from previously analyzed cases (i.e. documented case file data found on the various GC/MS’s in the instrument room of the laboratory). These are to be assigned by the trainer or Section Supervisor and documented in the training notebook.

F. All analysts, regardless of their prior experience, must pass at least one in-house competency test conducted by the FD Section Supervisor.

G. Analysts are encouraged to request training in the various modules as a refresher when external training is unavailable due to budgetary constraints.

4 Trainer Responsibilities

A. A new analyst will work closely with the FD Section Supervisor or another designated, senior analyst who will act as a primary mentor when being assigned a fire debris analysis case. Background readings, previous case files and discussion of case approach would take place prior to supervised casework by a new analyst.

B. The amount of time allotted for training will largely depend upon the trainee’s particular background and experience, and the available resources. Generally, this is 9-12 months from their start date. The trainer will record completion of the training modules.

C. Individuals who come to the FD section as qualified examiners from another laboratory system will generally move more quickly through the training program. The trainer will review the individual’s previous experience and training and will assess competency in
each required area. This training generally involves a familiarization with the SOP’s and instrumentation and proceeds quickly to competency testing if the individual is performing the same analysis in which he/she was previously qualified. Modifications to the training program may be recommended by the trainer or FD Section Supervisor and must be approved by the Quality Assurance Coordinator. Training and modifications will be documented in a training notebook and follow CLS protocols for record retention when completed (Chapters 35, 57, 61).

D. If the FD Section Supervisor is not conducting the training, the trainer will work in conjunction with the FD Section Supervisor when modifications are made to personalize the training program based upon an individuals’ experience.

E. Members of the FD Section who are identified as those that would benefit from remedial training will be given a written outline of the areas to be covered by the trainer. This will be documented in the training notebook and will follow CLS Manual training requirements (Chapter 35).

5 Training Resources

A. Suggested Readings are listed as such because they should be read by the trainee and available to him or her as a resource. The trainer and the trainee will review the pertinent points of suggested readings material selected by the trainer. Instrument manufacturer’s manuals along with numerous other references are not specified but are available to the trainee and the trainee should become familiar with these. The trainer will orient the trainee as to the location of these materials. Additionally, the trainee should review the relevant procedures as they progress through the components and complete any additional tasks, practical exercises, quizzes or tests assigned by the trainer or FD Section Supervisor. This process, including the reading of assigned reading materials, will be documented in the trainee’s training notebook.

B. As the trainee progresses through their training, opportunities to take outside courses and workshops relative to their training may arise. The trainee should be encouraged to participate in outside classes and these classes will be documented in their training notebooks. A copy of any certificates received from the courses or workshops will also be retained. If one was not received, written documentation of the date and title of the course or workshop can be documented in its place in the training notebook. The course titles and dates completed should also be added to the appropriate section of their SOQ.

C. Additional trainings and reference materials are outlined in the appendices of the Fire Debris Unit of the Trace Evidence Training Manual.

6 Assessment

A. It is both the trainer and trainee’s responsibility to ensure that all aspects of the training are documented as completed on the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).

B. Whenever practicable, the trainee should ensure a copy(ies) of the most recent training notebook documents (i.e. word, excel, pdf, etc.) are saved to a folder bearing the trainee’s name in the Fire Debris folder of the P:drive.

C. A module will be considered to have been successfully completed after all questions, exercises, and assessments within the module have been finished and addressed to the satisfaction of the trainer and signed off by the FD Section Supervisor.
D. Prior to being authorized to perform supervised casework, a trainee must have successfully completed at least one competency test and a mock trial. Additional competency tests or mock trial may be needed if determined by the trainer or FD Section Supervisor. A memo as to review of testimony protocol and criteria for analysis may take the place of a second mock trial.

E. After the successful completion of all modules within the training unit and at the recommendation of the trainer and/or FD Section Supervisor, the trainee may begin performing supervised casework with the approval of the Laboratory Director, using the Work Authorization form (LAB-309).

7 Supervised Casework

Supervised casework requirements will conclude with independent examiner approval when the following are met:

A. The trainer or Section Supervisor will oversee the trainee’s casework for 2-4 months of supervised casework analysis and will initial chromatographic data and other work documentation to show their concurrence with the work performed. Protocols for appropriate administrative and technical reviews will also be followed (CLS Manual Chapters 53-56, LIMS Manual).

B. The trainee must successfully complete at least one other competency test and/or successfully complete the external proficiency test (preferably both) prior to being authorized to conduct technical reviews on active casework.

C. The trainer(s) who recommend the trainee be approved for independent casework will ensure that all the required documentation of training is completed in the trainee’s training notebook and will follow protocols for Work Authorization (CLS Manual Chapter 36).

8 Evaluation of Training

The trainee will complete an evaluation of each module’s content or that of the entire training unit, including the trainer, using the Laboratory Training Program Evaluation Form (LAB-304).

9 References

A. Texas Department of Public Safety Trace Evidence Training Manual
B. Texas Department of Public Safety Evidence Receiving Training Manual
C. Texas Department of Public Safety Crime Laboratory Service Manual
D. Texas Department of Public Safety General Laboratory Training Manual
E. Texas Department of Public Safety LIMS Manual
F. Equipment Manuals
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ORGANIC CHEMISTRY REVIEW

Duration 1 to 2 weeks

Purpose Through completion of this module the trainee will review the basic classes of organic compounds as a precursor to discussing petroleum products and their components.

Prerequisite General Laboratory Training; concurrent with TE-TM-03

1 Objectives

1.1 Theoretical

Upon completion of this training, the trainee will have knowledge of:

A. Organic chemistry as it relates to fire debris analysis

B. Key (chemistry) components in the various ignitable liquid classes

1.2 Practical

Following the completion of training, the trainee will be able to:

A. Identify key components (ions) as it pertains to ignitable liquid classes

B. Apply organic chemistry knowledge (hydrocarbons) to the fire debris analysis process

2 Training Outline

2.1 Lesson Plan

A. Review of key ion profiles in ignitable liquid classes (i.e. alkanes, aromatics, cycloalkanes/isoalkanes, indanes, polynuclear aromatics, etc.)

B. Be familiar with basic structure of particular hydrocarbons

2.2 Required Readings

Readings that have been completed in previous modules may be omitted or reviewed at trainer’s discretion.

For literature references, use of the most current edition is recommended.


2.3 Suggested Readings


3 Practice

3.1 Safety

None

3.2 Observed Performance

A. The trainer and trainee will discuss the topics listed in the Objectives as they relate to organic chemistry in fire debris analysis.

B. The trainee will discuss with the trainer the basic classes of organic compounds and how this applies to petroleum products, their components, and fire debris analysis.

C. The trainer and the trainee will review and discuss other pertinent points as it relates to the handling and analysis of ignitable liquid residue.

D. The trainer and trainee will review and discuss the pertinent points of selected Readings.

3.3 Independent Exercises

A. The trainee will provide written answers to a set of questions provided by the trainer.

B. If possible, the trainee should attend outside training courses or workshops in Organic Chemistry, as it may apply to chemical analysis in arson investigation.

4 Assessment

4.1 Competence and Qualifying Examination

A. The trainer will review the written answers to the Independent Exercise questions with the trainee.

B. The trainee will complete either a verbal or written quiz. The trainer will review the answers to the questions with the trainee.

4.2 Evaluation of Training

The trainee and trainer will complete the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).
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HANDLING OF FIRE DEBRIS EVIDENCE

Duration 5 to 7 days

Purpose To familiarize the trainee with evidence handling procedures used within the DPS Crime Laboratory Service, and the Fire Debris section specifically.

Prerequisite General Laboratory Training; concurrent with TE-TM-FD-02

1 Objectives

1.1 Theoretical

Upon completion of this training, the trainee will have knowledge of:

A. DPS policies regarding security, evidence, and evidence storage areas
B. Factors influencing the deterioration of evidence
C. Evidence handling procedures
D. Definition of a “proper seal”

1.2 Practical

Following the completion of training, the trainee will be able to:

A. Complete detailed, comprehensive notes and other documentation
B. Appropriately label evidentiary materials
C. Handle evidence in a safe manner, to include biohazards and chemical hazards
D. Effectively communicate, verbally and in writing, proper evidence handling with other forensic analysts and outside agencies

2 Training Outline

2.1 Lesson Plan

A. Rules for evidence submission
B. Chain of custody
C. Case notes/documentation to include:
   1. Date, initials and case and item number identification
   2. Abbreviations and common notations, both within the lab system and those specific to fire debris analysis
   3. Condition and description of evidence
   4. Number of items/packages
   5. Procedures conducted
6. Use of digital camera to record damaged evidence/packaging

2.2 Required Readings

Readings that have been completed in previous modules may be omitted or reviewed at trainer’s discretion.

For literature references, use of the most current edition is recommended.

   A. Texas DPS Crime Laboratory Service Manual,
      1. Part II: Laboratory Customer Handbook, Chapter 25 – Materials (Trace) Analysis, section on Fire Debris
      2. Part IV: Laboratory Operations,
         a) Chapter 40 – Laboratory Security and Access; 
         b) Chapter 41 – Emergency Preparedness

   B. Austin Regional Laboratory Manual, AUS-POL-021 – Austin Laboratory Security Policy

   C. ASTM E2451 “Preserving Ignitable Liquids and Ignitable Liquid Residue Extracts from Fire Debris Samples”

3 Practice

3.1 Safety

   A. Follow standard procedures for use of personal protective equipment and applicable safety practices.

   B. Refer to the Safety Manual

3.2 Observed Performance

   A. The trainer and trainee will discuss the topics listed in the Objectives as they relate to evidence handling.

   B. The trainer and trainee will review and discuss the pertinent points of selected Readings.

   C. Trainee will observe qualified analyst handling, securing, and storing evidence during the analysis process.

4 Assessment

4.1 Competence and Qualifying Examination

The trainee will complete either a verbal or written quiz. The trainer will review the answers to the questions with the trainee.

4.2 Evaluation of Training

The trainee and trainer will complete the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).
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INTRODUCTION TO PETROLEUM PRODUCTS AND PETROLEUM MANUFACTURING

Duration 1 to 2 weeks

Purpose Introduce the trainee to the history, composition, and manufacturing of petroleum products that may be encountered during Fire Debris analysis.

Prerequisite Concurrent with TE-TM-FD-02

1 Objectives

1.1 Theoretical

Upon completion of this training, the trainee will have knowledge of:

A. History of petroleum products.
B. Composition of various petroleum fractions.
C. Manufacturing processes of petroleum distillates and the end use of products.

1.2 Practical

Following the completion of training, the trainee will be able to:

A. Identify major processes for manufacturing of petroleum products and how this affects final analysis results
B. True definition of ‘octane’ ratings in gasoline

2 Training Outline

2.1 Lesson Plan

A. Review of hydrocarbons found in petroleum products
B. Review chromatographic data in relation to various petroleum products, including those ‘naturally’ occurring in (mixed) matrices to distinguish from actual ignitable liquid residues

2.2 Required Readings

Readings that have been completed in previous modules may be omitted or reviewed at trainer's discretion.

For literature references, use of the most current edition is recommended.

2.3 Suggested Readings


3 Practice

3.1 Safety

None

3.2 Observed Performance

A. The trainee will discuss with the trainer the pertinent aspects of petroleum products and their manufacturing.

B. The trainer and trainee will review and discuss other pertinent points of petroleum products and their manufacturing as it relates to fire debris analysis and detection of ignitable liquid residue.

C. The trainer and trainee will review and discuss the pertinent points of selected Readings.

3.3 Independent Exercises

A. The trainee will provide written answers to a set of questions provided by the trainer.

B. If possible, the trainee should attend outside training courses or workshops regarding petroleum products, ignitable liquids and their extraction and/or analysis, as it may apply to fire debris analysis and detection of ignitable liquid residue.

4 Assessment

4.1 Competence and Qualifying Examination

A. The trainer will review the written answers to the Independent Exercise questions with the trainee.

B. The trainee will complete either a verbal or written quiz. The trainer will review the answers to the questions with the trainee.

4.2 Evaluation of Training

The trainee and trainer will complete the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).
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INTRODUCTION TO FIRE AND ARSON INVESTIGATION

Duration 1 to 2 weeks

Purpose Introduce the trainee to investigation of fire scenes, including related terminology and procedures for evidence collection.

Prerequisite TE-TM-FD-02 through TE-TM-FD-04

1 Objectives

1.1 Theoretical

Upon completion of this training, the trainee will have knowledge of:

A. Arson and accelerant terminology
B. Fire scene investigations
C. Proper techniques in recovery, collection, preservation and packaging of fire debris evidence

1.2 Practical

Following the completion of training, the trainee will be able to:

A. Understand dynamics of a fire scene
B. Define fire debris analysis and arson related terminology
C. Communicate and conduct proper procedures for collecting, packaging and storing fire debris evidence

2 Training Outline

2.1 Lesson Plan

A. Compare and contrast the meanings and uses of:
   1. combustible vs. flammable
   2. accelerant vs. ignitable
   3. fire triangle vs. fire tetrahedron
B. Define key fire science/scene and fire debris analysis terms
C. Review of flash point and limiting factors
D. Discuss some considerations that should be made prior to the collection of evidence; areas of collection around a pour and selection of samples from crime scene (i.e. where and what to collect)
2.2 Required Readings

Readings that have been completed in previous modules may be omitted or reviewed at trainer’s discretion.

For literature references, use of the most current edition is recommended.


D. Texas DPS Crime Laboratory Service Manual, Part II: Laboratory Customer Handbook, Chapter 25 – Materials (Trace) Analysis, section on Fire Debris

2.3 Suggested Readings


3 Practice

3.1 Safety

A. Follow guidelines for crime scene safety.

B. Refer to the Safety Manual.

3.2 Observed Performance

A. The trainer and trainee will review and discuss the pertinent points of selected Readings.

B. If possible, the trainee shall visit fire scenes, observe evidence collection and observe controlled burns.

C. If possible, the trainee shall network with SFMO Fire Investigators and SFMO K9 Fire Investigation teams to learn the ins and outs of how a fire scene is investigated.

3.3 Independent Exercises

The trainee will provide written answers to a set of questions provided by the trainer.
4 Assessment

4.1 Competence and Qualifying Examination

A. The trainer will review the written answers to the Independent Exercise questions with the trainee.

B. The trainee will complete either a verbal or written quiz. The trainer will review the answers to the questions with the trainee.

4.2 Evaluation of Training

The trainee and trainer will complete the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).
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EVALUATION AND CHARACTERIZATION OF FIRE DEBRIS

Duration 2 to 3 weeks

Purpose Familiarize trainee with different types of fire debris evidence and matrices, known reference samples, and the ignitable liquid classifications.

Prerequisite TE-TM-FD-05

1 Objectives

1.1 Theoretical

Upon completion of this training, the trainee will have knowledge of:

A. The effect that the substrate/debris can have on the identification of petroleum products.
B. Manufacturing processes of turpentine.
C. The composition of soft woods versus terpenes.

1.2 Practical

Following the completion of training, the trainee will be able to:

A. Explain how the different substrates and matrices can affect ignitable liquid residues (e.g., soil, plastics, inks/toners, soft woods, etc.) and how to minimize these ‘background effects’
B. The limitation in identifying turpentine (vs. terpenes) and other single non-oxygenated peaks
C. Understand pyrolysis products and distinguish them from actual ignitable liquid residues

2 Training Outline

2.1 Lesson Plan

A. Review chromatographic data of matrices and substrates against known ignitable liquid reference samples and be able to distinguish their peak patterns and ion profiles
B. Review the criteria for identifying single non-oxygenated peaks, limonene, and turpentine in final analysis results
C. Review chromatographic data to identify possible pyrolysis products

2.2 Required Readings

Readings that have been completed in previous modules may be omitted or reviewed at trainer’s discretion.

For literature references, use of the most current edition is recommended.


2.3 Suggested Readings


3 Practice

3.1 Safety

A. Follow standard procedures for use of personal protective equipment.

B. Refer to the Safety Manual.

C. Perform exercises in hood.

3.2 Standards, Controls, Reagent Preparation

- Ignitable liquid known reference samples
- Solvents

3.3 Equipment

- Chemical hood
- Ignitable liquids oven
- Butane torch
3.4 Observed Performance

A. The trainer and trainee will review and discuss the pertinent points of each Reading.

B. The trainer will discuss the criteria for ignitable liquid identification as outlined in ASTM E1618.

C. The trainer will preview the trainee on required criteria for the various ignitable liquid classes and the differences when compared to expected spectra from the various matrices and substrates.

3.5 Supervised Performance

A. Collect samples of materials commonly seen with fire debris that are known to give off pyrolysis products to be extracted and run by GC/MS in order to make a pyrolysis library for the training log (see TE-TM-FD-08). GC/MS run to be performed by the trainer and chromatographic results discussed with trainee.

B. Prepare mixed matrix debris for K9 teams and run one uncontaminated can and one can spiked with ignitable liquid through the analysis process to see differences in results.

C. If possible, melt some ABS plastic, newsprint, and softwood in separate cans and take through analysis process to see chromatographic results.

D. Repeat steps described in A through C above with known ignitable liquid reference samples.

3.6 Independent Exercises

The trainee will provide written answers to a set of questions provided by the trainer.

4 Assessment

4.1 Competence and Qualifying Examination

A. The trainer will review the written answers to the Independent Exercise questions with the trainee.

B. The trainee will complete either a verbal or written quiz. The trainer will review the answers to the questions with the trainee.

4.2 Evaluation of Training

The trainee and trainer will complete the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).
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EXTRACTION METHODS, SAMPLE PREPARATION AND DATA COLLECTION

Duration 2 to 4 weeks

Purpose Introduce the trainee to extraction techniques used by the Fire Debris analyst.

Prerequisite TE-TM-FD-06

1 Objectives

1.1 Theoretical

Upon completion of this training, the trainee will have knowledge of:

A. Documentation procedures, including note-taking, use of worksheets, and approved abbreviations.

B. Extraction techniques employed for Fire Debris analysis.

C. Quality control procedures for the GC/MS.

1.2 Practical

Following the completion of training, the trainee will be able to:

A. Perform current extraction techniques to include headspace, solvent, dynamic and passive adsorption/elution.

B. Determine which extraction procedure to use under varying sample conditions.

C. Prepare samples for injection into the GC/MS.

D. Prepare blanks and Standard Ignitable Mixes (SIM).

E. Tune instruments.

F. Perform various instrument maintenance procedures (i.e. changing septa, injection needles, filaments, etc.)

2 Training Outline

2.1 Lesson Plan

A. Review and discuss the extraction process

B. Discuss and review the various maintenance and quality assurance/quality control requirements for the GC/MS.

C. Review solvent use and known ignitable liquid reference library.
2.2 Required Readings

Readings that have been completed in previous modules may be omitted or reviewed at trainer's discretion.

For literature references, use of the most current edition is recommended.

A. ASTM E 1412 “Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration with Activated Charcoal.”

B. ASTM 1386 “Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Solvent Extraction.”


2.3 Suggested Readings


3 Practice

3.1 Safety

A. Follow standard procedures for use of personal protective equipment and applicable safety practices.

B. Perform exercises in hood.

C. Refer to the Safety Manual.

3.2 Standards, Controls, Reagent Preparation

- Ignitable liquid known reference samples
- Solvents and Standard Ignitable Mix
3.3 Equipment
- Ignitable liquids oven
- Chemical hood
- GC/MS
- Can lid press

3.4 Observed Performance
A. The trainer will discuss with the trainee how to take appropriate notes, how to properly use worksheets and what abbreviations are in standard use for fire debris analysis.
B. The trainer will demonstrate headspace vapor extraction via use of c-strip and preparation of solvent vial for injection into the GC/MS.
C. The trainer and trainee will review and discuss the pertinent points of selected Readings.

3.5 Supervised Performance
A. The trainee will receive a set of unknown samples consisting of paint cans prepared by the trainer from reference library samples. These unknown samples will be extracted by passive adsorption/elution (charcoal strip) in conjunction with the Independent Exercises for TE-TM-FD-08 (Instrumental Analysis).
B. The trainee will receive a set of unknown samples prepared in mixed matrices to be extracted by passive adsorption/elution (charcoal strip) in conjunction with the Independent Exercises for TE-TM-FD-08 (Instrumental Analysis).

3.6 Independent Exercises
The trainee will provide written answers to a set of questions provided by the trainer.

4 Assessment
4.1 Competence and Qualifying Examination
A. The trainer will review the written answers to the Independent Exercise questions with the trainee.
B. The trainee will complete either a verbal or written quiz. The trainer will review the answers to the questions with the trainee.

4.2 Evaluation of Training
The trainee and trainer will complete the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).
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INSTRUMENTAL ANALYSIS

Duration 2 to 3 months

Purpose Familiarize the trainee with the fundamental theory and operations of the GC-MS instrument as it relates to Fire Debris analysis.

Prerequisite TE-TM-FD-07

1 Objectives

1.1 Theoretical

Upon completion of this training, the trainee will have knowledge of:

A. The principles of Gas Chromatography-Mass Spectrometry (GC-MS).
B. The process of pattern recognition and ion-profiling when identifying ignitable liquids.
C. Testimony regarding the analysis process and final analysis results.

1.2 Practical

Following the completion of training, the trainee will be able to:

A. Describe and demonstrate the application of GC-MS to the identification of petroleum products and ignitable liquid residue classes.
B. Utilize GC chromatographic data pattern recognition coupled with ion-profiling in the evaluation of GC-MS data.
C. Identify volatile compounds vs compounds intrinsic in substrates/matrices in the headspace of samples.
D. Describe these above referenced processes in layman’s terms for testimony purposes.

2 Training Outline

2.1 Lesson Plan

A. Review of exercises to include a discussion regarding major pattern differences, weathering, and overlap.
B. Review of exercises to include ASTM standard criteria for the various ignitable liquid classes.
C. Discussion of mixed matrices and substrate patterns and ion profiles, including discussion of hydrocarbon pattern similarities to ignitable liquids.
D. Discussion of various instrument quality assurance checks and maintenance plans, to include the ignitable liquids oven.
E. Discussion and review of key legal elements regarding evidence and testimony on casework.
2.2 Required Readings

Readings that have been completed in previous modules may be omitted or reviewed at trainer's discretion.

For literature references, use of the most current edition is recommended.


D. ASTM E1388 “Standard Practice for Static Headspace Sampling of Vapors from Fire Debris Samples.”


2.3 Suggested Readings


3 Practice

3.1 Safety
A. Follow standard procedures for use of personal protective equipment.
B. Perform exercises in hood.
C. Refer to Safety Manual.

3.2 Standards, Controls, Reagent Preparation
- Ignitable liquid known reference samples
- Solvents and Standard Ignitable Mix (SIM)

3.3 Equipment
- GC/MS
- Ignitable Liquids Oven
- Chemical Hood

3.4 Observed Performance
A. The trainer and trainee will review and discuss the pertinent points of selected Readings.
B. The trainer will demonstrate use of the GC/MS for producing chromatographic case file data, including use of the various macros, library spectra extraction and production of required total ion chromatogram (TIC) data and extracted ion chromatogram (EIC) data.
C. The trainer will demonstrate various quality assurance checks for the GC/MS and ignitable liquid oven, including maintenance procedures.
D. The trainer will demonstrate protocol naming conventions and labeling requirements on case file chromatographic data.
E. The trainer and the trainee will discuss the interpretation of fire debris evidence and its relevance and weight in reports and in testimony. Discussion will include identifying a class of products versus individual identification of a commercial product.

3.5 Supervised Performance
A. The trainee will perform the QC procedures for the gas chromatograph/mass spectrometers for a minimum of one week.
B. The trainee will demonstrate the carbon strip extraction method to the trainer.
C. The trainee will demonstrate use of the GC/MS for analytical data retrieval, including quality assurance and maintenance checks, to include the ignitable liquids residue oven.
D. The trainee will demonstrate use of the database within LIMS to practice editing case file information and results, entering information into the database, and reporting cases. The trainee will also demonstrate proficiency using LIMS to retrieve information on previously worked cases.
E. The trainee will successfully complete a mock trial in fire debris analysis testimony.
F. Where practicable, the trainee will enroll in and attend courses (internal to agency or externally offered) in either fire debris analysis, instrumental analysis, GC/MS maintenance and troubleshooting and/or expert testimony.

3.6 Independent Exercises

A. The trainee will provide written answers to a set of questions provided by the trainer.

B. Known samples: obtain Total Ion Chromatograms (TIC) and Extracted Ion Chromatograms (EIC) by passive adsorption/elution (charcoal strip) for each substance below. Identify the class of each sample.

   *Substitutions should be of the same ASTM class as the original product*

1. 100% gasoline
2. 50% weathered gasoline
3. 100% kerosene
4. 50% weathered kerosene
5. 100% diesel fuel
6. Royal Oak Charcoal Lighter fuel
7. Citronella Lamp Oil
8. Coleman Fuel
9. Ronsonol Cigarette Lighter Fluid
10. Smokeless Odorless candle oil
11. Ethanol
12. Methanol
13. Isopropanol
14. Acetone
15. Isopar H and/or Isopar
16. Condea Vista 142 (or its equivalent)

C. The trainee will run their samples from the Supervised Performance exercises in TE-TM-FD-07 (Extraction Methods, Sample Preparation and Data Collection) using GC-MS.

1. Obtain the TIC and EIC profile for each liquid
2. Identify the class of each liquid.

D. The trainee will run their extracts of the pyrolysis product samples collected in the Supervised Performance exercise of TE-TM-FD-06 (Evaluation and Characterization of Fire Debris).
E. The trainee will prepare a case file as per TE-13-02, Section 6 (Instrumental Analysis of Fire Debris).

4 Assessment

4.1 Competence and Qualifying Examination

A. The trainer will review the written answers to the Independent Exercise questions with the trainee.

B. The trainee will complete either a verbal or written quiz in instrumental analysis of fire debris. The trainer will review the answers to the questions with the trainee.

C. The trainee will complete either a verbal or written quiz in expert testimony (i.e. presenting fire debris analysis procedures and results/conclusions in court). The trainer will review the answers to the questions with the trainee.

4.2 Evaluation of Training

The trainee and trainer will complete the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).
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REPORT WRITING

Duration 2 to 4 weeks

Purpose To familiarize the trainee with the process and guidelines for fire debris casework report writing, as well as technical and administrative case review.

Prerequisite TE-TM-FD-08

1 Objectives

1.1 Theoretical

The laboratory report is used to communicate analytical results to its reader. The report should be correct in all details including description of evidence, results of analysis, and any administrative information available to the laboratory.

1.2 Practical

Following the completion of training, the trainee will be able to:

A. Explain all the steps necessary in producing and releasing a case report after the completion of the analysis of a case.

B. Enter the results from case analysis into the laboratory reporting software to produce a report.

C. Technically review a completed case record.

D. Administratively review a completed case record.

2 Training Outline

2.1 Lesson Plan

A. Reporting guidelines (see Required Readings for comprehensive list)

1. Name and address of the laboratory and the location where the tests were carried out

2. Case report title

3. Page number and total number of pages on all pages of the report

4. Issue date of the report (defined as the date the administrative review is completed) on all pages of the report

5. Laboratory case number on all pages of the report

6. Name of the requesting agency representative and agency name and address

7. Submitting agency’s case number (if available)
8. Item number (including agency assigned item number if different from LIMS assigned number) and description of that item’s packaging (i.e. one-gallon metal can, etc.)

9. Offense information (county and date, if available)

10. Description of evidence (if available)

11. Date of receipt and date of analysis

12. Results and explanation of results

13. Any qualifying statements (i.e. possible contamination issues, proper seal issues, etc.)

14. Type of analysis performed and test method used

15. Name and title of analyst performing work

16. Statement of Qualifications and Disclosures, where practicable

B. Elements of a technical review

1. Checking each page in the case folder for laboratory case number, analyst initials, and any page numbering required.

2. Conformance with proper technical procedures (test methods) and applicable laboratory policies and procedures.

3. Printout of sequence data, with case number for that particular case file highlighted or marked in some way.

4. Accuracy of results and/or conclusions in the case report and that it is supported by analytical data.

5. Required labeling and identification protocols have been followed on the analytical/chromatographic data.

6. Required chromatographic data of knowns if test results are positive.

7. Required quality assurance printouts (i.e. blanks between samples, Standard Ignitable Mixes or SIMs, tune evaluations, etc.)

8. Associations are properly qualified in the case report; transcription of results correct.

C. Elements of an administrative review:

1. The case report contains all required information.

2. Information between submission form and case report agree.

3. Appropriate information recorded on an analysis worksheet, especially final results, were correctly transcribed to the case report.

4. Corrections of typos, mismatched and/or nonsensical information from numbers 1 and 2.
D. Special Circumstances

1. Exemplars or controls: not requested by laboratory, but when submitted and analyzed are to be identified on the report either in the evidence description or in the result
   a) Gauze (control)
   b) Negative (exemplar)

2. Packaging issues: if analysis is performed on evidence with either broken seals and/or damage/breach in packaging, this is to be reflected in the report
   a) *Due to improper packaging (i.e. holes in cans, rusted cans, lid not secured etc.), the results may not be accurate as improper packaging leads to both evidence loss and cross contamination.
   b) *Due to improper packaging (i.e. use of a container other than a sealed metal can), the results may not be accurate as improper packaging leads to both evidence loss and cross contamination.

3. Exam gloves included in evidence: where practicable, a photo should be taken and possible cross-contamination from exam gloves should be noted on the report:
   *CROSS-CONTAMINATION (possible): Examination glove(s) was/were found inside the evidence container of this item. This practice is not recommended for evidence undergoing this type of analysis as it is possible to unknowingly contaminate the inside of an examination glove through contact with skin exposed to an ignitable liquid. Therefore, laboratory cannot confirm that the positive result comes from the evidence and not the glove(s).

4. No analysis wording: when analysis is not performed on evidence, the reason shall be cited on the report
   a) NO ANALYSIS: Evidence was not analyzed as the laboratory does not conduct this type of examination.
   b) NO ANALYSIS (PACKAGING): Evidence was not analyzed due to improper packaging. The evidence can lacked structural integrity, possibly due to corrosion or other causes, leaving the evidence vulnerable to possible contamination before analysis.
   c) NO ANALYSIS (PACKAGING): Evidence was not analyzed due to improper packaging. The evidence packaging (i.e. paper bag) is not considered appropriate packaging for this type of analysis due to its porous nature which lends to possible cross contamination and/or rapid evidence loss.
   d) NO ANALYSIS (EMPTY): Evidence can in this item contained no debris or any significant item nor had any indication of any residue present.

5. Preliminary results: preliminary results may be released to submitting agencies per their request in order to aid in investigation as long as they have been technically reviewed.
2.2 Required Readings

DPS Crime Laboratory Service Manual,

A. Chapter 54 – Laboratory Reports, Letters, and Certificates
B. Chapter 55 – Review of Laboratory Records
C. Chapter 61 – Electronic Storage and Archival of Records

3 Practice

3.1 Safety

None

3.2 Observed Performance

A. The trainer will review and discuss with the trainee the standard analysis report wording for cases with fire debris evidence, including wording for special issues such as possible contamination, packaging breaches, etc.

B. The trainer will demonstrate reporting of analytical results using the LIMS software, including entry of result(s) and/or disposition notes. At least ten cases must be demonstrated.

C. The trainer will demonstrate and discuss review of case/item numbers entered in a sequence run (i.e. batch data), review of worklists against case file and physical data, technical and administrative review of cases. At least ten cases must be demonstrated.

3.3 Supervised Performance

A. The trainer will provide fifty cases, if possible, previously examined by other qualified fire debris examiners for the trainee to perform technical and administrative review.

1. The exact number of cases will be determined by the trainer.

2. The trainer will review the cases and discuss any findings with the trainee.

Note: Trainee can go through review process in LIMS under trainer’s supervision, but will not complete milestones.

3.4 Independent Exercises

Using a test case or one designated/created by the section supervisor, the trainee will generate appropriate worksheets and analysis reports using the LIMS software for given training samples as part of analysis training. Refer to the LIMS Manual and TE-13-02 Instrumental Analysis of Fire Debris.

4 Assessment

4.1 Competence and Qualifying Examination

The trainee will complete either a verbal or written quiz. The trainer will review the answers to the questions with the trainee.
4.2 Evaluation of Training

The trainee and trainer will complete the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).
## Revision History

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Effective Date: 06/01/2019  
Issued by: QA Coordinator
PRACTICAL ASSESSMENT

Duration 3 to 9 months

Purpose To assess the trainee’s ability to independently analyze, evaluate, and report results for fire debris evidence.

Prerequisite TE-TM-FD-09

1 Objectives

1.1 Theoretical

The trainee will be able to:

A. Identify criteria for the classification of ignitable liquids as outlined by both the American Society for Testing and Materials (ASTM) E1618 and additional criteria outlined by the fire debris section (see TE-13-02 Instrumental Analysis of Fire Debris).

B. Use above referenced criteria to characterize fire debris and issue accurate conclusions.

C. Be able to evaluate the analysis of other fire debris analysts.

D. Update case file data, including marking milestones in the LIMS systems, and issue proper final analysis reports.

E. Be able to perform required quality assurance checks both in casework preparation and analysis as well as in all instrumentation involved in the analysis process; be able to troubleshoot fire debris instrumentation.

F. Ability to testify with appropriate courtroom presentation and demeanor

1.2 Practical

Following the completion of training, the trainee will be able to independently demonstrate:

A. Familiarity with the instrumentation and appropriate software, including ability to perform quality checks and troubleshooting.

B. Competence in the analysis of fire debris evidence.

C. Ability to evaluate and report the analytical results in accordance with laboratory policy.

D. Successfully complete a mock trial.

2 Training Outline

2.1 Lesson Plan

A. Sequence set-up, including preparation of quality controls

B. Performance checks and troubleshooting, including preventive maintenance where practicable

C. Evidence examination and analysis
D. Data Assessment

E. Documentation and reporting of analytical results

F. Demonstrate ability to testify professionally in a mock trial to include:
   1. Addressing and making direct eye contact with the prosecution, defense, and/or jury.
   2. Dressing professionally.
   3. Maintaining composure on the witness stand and being aware of verbal inflections and body language.
   4. Respond to questions in a clear, concise and accurate manner.
   5. Answer technical questions in layman’s terms.
   6. Maintain unquestionable ethical standards and conduct.
   7. Prepare for court with good note taking and documentation skills.
   8. Prepare for court with good communication skills.

2.2 Required Readings


C. Appropriate instrument manuals available in workstations and online

D. Various Frye and Daubert Standard, Brady and Morton Act articles as assigned by section supervisor

E. GLT Manual Legal Training

3 Practice

3.1 Safety

A. Follow standard procedures for use of personal protective equipment.

B. Perform exercises in hood.

C. Refer to Safety Manual.

3.2 Independent Exercises

As the trainee progresses through fire debris training, the trainee will begin to process training samples as if these samples were submitted for real casework analysis, to include issuing an analysis report. There will be a minimum of three of these “case” files completed prior to issuance of the final competency test.
4 Assessment

4.1 Competence and Qualifying Examination

A. Casework Competency

The trainee will be provided with a final competency test designed to mimic actual casework to the maximum extent possible.

1. The trainee will be provided with competency samples for analysis, which may include chromatographic data from a previously analyzed case in place of samples prepared from the ignitable liquid known reference samples.

2. The trainee will provide conclusions and chromatographic data to support these conclusions following analysis protocols as described in TE-13-02.

B. Qualifying Examination

The trainer will administer a written, comprehensive exam. The score must be 75% or better to pass.

C. Mock Trial

Using the competency test sample(s) or a case file from evidence previously analyzed (and completed by another authorized analyst), the trainee will undergo a mock trial. The trainee will be assessed on the applications of practical training covering technical knowledge, sample receipt/preparation, extraction, instrumental testing and reporting.

4.2 Evaluation of Training

The trainee and trainer will complete the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).
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FIRE DEBRIS GLOSSARY

1 Scope

A glossary of terms as they are applied to the series of documents within the Trace Manual that pertain to Fire Debris analysis.

2 Terms

Analysis Worksheet: A form used to record the description of the evidence and the procedures employed in the preparation of the evidence for analysis. The bottom of the page has space for the analyst to describe the analysis and interpretation of data. Multiple forms may be used within a case when there are multiple items of evidence, multiple tests performed, or copious notes regarding data interpretation.

Blank – Sample of quality tested solvent run before each evidence sample run to verify that no cross-contamination has occurred between each run

Chain of Custody – the record of every transfer of evidence to a person, evidence vault or other laboratory location to include (at the minimum) the date and initials or name of person making the transfer. For a complete record, the time of transfer may also be included.

Chemical Extraction – A planned and systematic removal of analyte(s) of interest from material in order to concentrate and separate the analyte(s) from as many background interferences as possible. Extraction promotes representative sampling. Extraction seeks to place the analyte of interest into a form which may be more easily analyzed. For some analyte(s) multiple extraction methods may be required. Extraction may be, but is not limited to:

- Vapors from the vapor space above solid materials
- Vapors from the vapor space above liquids
- Vapors from the vapor space above mixed solid and liquid materials

Comparison sample: Materials collected by an investigator at a crime scene with the reasonable expectation that its identity is as purported (examples include: liquid from a can labeled “charcoal starter fluid” collected from a storage shelf in a home that had a fire, liquid from a bottle labeled “lamp oil” from a business storeroom that sells hurricane lamps, etc...).

Evidence tape – A specialized tape that is used to seal the opening(s) of evidence containers. This tape will be made of thin plastic or paper and is either serrated edged or scored so that the tape cannot be removed from the container without indication that the seal has been breached (cut, torn, shredded). The tape may be colored and imprinted with the word “Evidence” or other imprints identifying its source.

Extracted Ion Chromatogram (EIC) – The display of a selected ion or set of combined ions accumulated in a mass spectrometer and displayed in a graphical manner with time from injection as the x-axis and the abundance of the ion(s) as the y-axis. A chromatogram that is re-assembled from the total data collected in a TIC to show only a specific ion fragment or summed combination of ion fragments. Essential component of “Ion Profiling” performed in fire debris analysis. (Sometimes referred to as a “Reconstructed Ion Chromatogram”)

Extraction – The act of removing an item or information of interest. The technique of selectively removing an item or information of interest from a larger, non-representative sample in order to increase the probability of obtaining an analyzable sample.

Full Scale Chromatogram (FSC) – a single page graph in landscape format showing a chromatogram with the “X” axis covering “0” minutes through the end of data collection for the
sample being analyzed and with the “Y” axis as 100% relative scale. A Full Scale Chromatogram may be a Total Ion Chromatogram (TIC) or Reconstructed Ion Chromatogram.

**Gas Chromatography (GC)** – A chemical separation method whereby a complex mixture of organic compounds may be separated into individual and similar components by passing the complex mixture, which is carried by a mobile phase of inert gas, over a stationary phase. This phase interacts with the components in the mixture so that they will pass through the stationary phase at different rates of speed.

**Gas Chromatography/Mass Spectrometry (GC/MS)** – Coupling a mass spectrometer as a detector on a gas chromatograph to allow a separation of mixed organic materials while collecting the mass spectra of the separated components. Through the use of algorithms, ion profiles of ignitable liquids can be produced and used as diagnostics in determining the presence and identity of ignitable liquids.

**Holding time** – time elapsed from the date of evidence item preparation until the start of analysis.

**Mass Spectroscopy (MS)** – A spectroscopic analytical technique based on causing the controlled fragmentation of organic chemical compounds into characteristic fragments. All organic molecules will fragment predictably based on their structure. This allows the identification of specific compounds by examination of mass spectra. Additionally, experience with mass spectroscopy has shown that certain organic classes of compounds contain fragments of a characteristic mass (amu). For example, alkane compounds typically will have fragments with a mass to charge ratio (m/z) of 57, 71, 85, and 99 amu. Whereas, aromatic compounds often have fragments with m/z of 91, 105, 119, and 134 amu.

**Matrix comparison sample**: Matrix materials collected by an investigator at a crime scene with the reasonable expectation that it is free of any ignitable liquid or explosive residue. The item is collected to determine if there are compounds inherent to the matrix that are of the same composition and abundance as found on the unknown (examples include: carpet from unburned bedroom #3 that is the same type of carpet as is in bedroom #1 where the fire occurred). Matrix comparison samples may also be deliberately burned in order to determine the type and quantity of chemicals produced from the thermolysis of the material. Note that this type of comparison sample is NOT needed at this laboratory and is actually discouraged.

**Matrix reference samples**: Physical materials and manufactured artifacts which are purchased or donated by a lumber, home improvement, or retail store for the purpose of determining any interference compounds or inherent ignitable liquids that may be extracted from the item. Matrix reference samples may also be deliberately burned in order to determine the type and quantity of chemicals produced from the thermolysis of the material.

**Passive Headspace Concentration** – ASTM E1412 (current edition) “Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration With Activated Charcoal” – A technique for extracting ignitable liquids and other volatile organic compounds from fire debris that is sensitive, relatively non-invasive of the evidence sample, and representative of a full range of the components of an ignitable liquid. Some variations on parameters described in the ASTM practice may be permitted but must be explained.

**Primary chemical standard**: pure chemical compounds, or standardized chemical mixtures from chemical supply vendors (Fisher, ACROS, etc...), or reference standards vendors (AccuStandard, NIST, Cerrilliant, etc...) with known origins. This also includes reference ignitable liquids purchased from the National Center for Forensic Science, Ignitable Liquids...
Reference Collection or directly from manufacturers, refiners, formulators, or distributors of ignitable liquids.

**Reference Sample** – Known samples of uncontaminated, quality tested ignitable liquids maintained in the laboratory that are used to provide representative chromatographs for comparison/matching to evidence samples. Also referred to as Reference Standards or Ignitable Liquid References. Used as comparison (chromatograms) in cases with positive, identifiable results.

**Reference Standards** – Liquid samples (i.e. ASTM Test Mix) prepared by the laboratory with known peak outcomes used to quality check GC/MS sensitivity and functionality. Its introduction serves as a marker that the extraction process worked for samples with no appreciable concentration of extracted organics and as a measure of the consistency of chromatographic separation from one sample to another by the regularity of the retention time.

**Representative Sample** – a sample that is typical of the whole product. This is only possible if the sample is homogenous. Not all samples are homogenous. In that event, an extraction (vapor or liquid) may be used to obtain a homogenous sample from which a representative sample may be taken for analysis; type of sample selection

**Sampling** – Selection of a sample for testing, according to a procedure. Taking a part of a substance, material, or product for analysis as a representative sample of the whole. Two key factors are (1) the report shall state conclusions about “the whole” based on testing only a portion, and (2) from the start, there shall be a reasonable assumption of homogeneity (or made so by the analyst) of the whole.

**Sample Selection** – A practice of selecting a sample(s) from the whole based upon training, experience, and competence. There is no assumption of homogeneity of the whole. Testing is carried out on the selected sample(s) and the report is clear that the results are based only on the portion(s) analyzed.

**Scraping** – Removal of a portion of solid material from a surface and in some instances from the break in an item’s surface so that the interior of the item is exposed. This results in samples that are in the form of powder, crystals, or slivers that may be directly analyzed for the analyte of interest.

**Secondary chemical standard**: chemicals or ignitable liquids purchased from local vendors (examples include charcoal lighter fluid from Home Depot, automotive engine cleaners from automobile supply stores, or liquid candles from a boutique).

**Shelf Life**: The amount of time that a product or chemical can be expected to remain stable and efficacious at normal room temperature and humidity before it deteriorates or destabilizes. While the shelf life or stability of many compounds can be found in various sources of literature, the preferred resource for the FAL is the United States National Library of Medicine Website, [http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB](http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB). Chemicals can be searched by name and under a sub-search of its “Chemical Safety & Handling”, Stability/Shelf Life. Note that not all chemicals and materials found in the FAL have a shelf life. Those that do can be found in the aforementioned resource.

**Swabbing** – Utilizing a clean piece of absorbent material to rub against the surface of an object suspected of containing deposits of the analyte of interest. A swabbing may be directly tested by some analytical techniques, but is typically subjected to extraction.

**Total Ion Chromatogram (TIC)** – The display of all ions within a broad designated range of atomic masses which are accumulated in a mass spectrometer and displayed in a graphical
manner, with time from injection (retention time) as the x-axis and the abundance of the ion as the y-axis. The initial graphical display, from a gas chromatograph/mass selective detector-mass spectrometer, that shows all ions within the same range.

**Turnaround Time** – time (measured in days) from receipt of the evidence into the laboratory and the completion of the analysis by the assigned analyst (defined by the issuing of final analysis report)

**Vapor Space** – Within a closed system, the space or volume of the container above the material that may be off-gassing vapors.
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ADDITIONAL TRAINING

Based on availability of course and funds, the trainee/analyst should try to attend the following external courses:

1. Fire Debris Analysis Course offered through the National Center of Forensic Science.

2. GC-MS instrumentation courses (relevant to the manufacturer of the GC-MS instruments in the FD section).

3. FBI chromatography or Fire Debris Analysis course, or other relevant chromatography/fire debris analysis courses.

4. FBI Mass Spectroscopy course, or other relevant MS courses.
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RECOMMENDED READINGS

1 Scope

A list of recommended reading materials for the trainee/analyst. It should be noted, some of the referenced periodicals, articles, and texts may already appear in the training modules. These readings are not required to complete training unless noted in a training module or specifically assigned by the trainer. Additional completed readings can be noted at the end of the Fire Debris Analysis Training Checklist (LAB-TE-TM-FD).

2 Readings


3. ASTM E 1388-05 “Standard Practice for Sampling of Headspace Vapors from Fire Debris Samples.”


5. ASTM E1618-06e1 “Standard Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry”.


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INTRODUCTION TO IMPRESSION EVIDENCE

Duration One to Two Weeks
Purpose Familiarize the trainee with the basic concepts of footwear and tire track imprint/impression evidence and comparison.

1 Objectives

1.1 Theoretical

Impression evidence is generally defined as “objects or materials that have retained the characteristics of other objects or materials through direct physical contact.” By this definition impression evidence can be left by a wide variety of objects. For the purposes of this training, impression evidence will be limited to footwear and tire impressions.

Footwear and tires are mass produced using different manufacturing processes, in a variety of designs and are used extensively in the population. Through daily wear and tear, additional randomly acquired markings are created. Combine these factors and it becomes possible to associate an impression to a particular tire or footwear.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Understand the different types of manufacturing processes, and
2. Identify and describe the value of class characteristics, randomly acquired characteristics and wear patterns on shoe soles, tires and impressions.

2 Lesson Plan

2.1 Instructional Outline

1. Footwear manufacturing process
   a) molding processes
   b) cutting processes
2. Tire manufacturing process
   a) shell mold
   b) segmented mold
   c) noise treatment
   d) tread wear indicators
3. Tire components
4. Tire sidewall information
5. Types of tire tread design
   a) rib and center rib tires
   b) block design
   c) all-terrain and off-road tires
   d) motorcycle tires
6. Characteristics and conclusions
   a) class characteristics
   b) randomly acquired characteristics
   c) wear characteristics

7. Databases

2.2 Required Reading

2.3 Practical Exercises
None

2.4 Practical Examination
None

2.5 Written Exercises
The trainee will provide written responses to the following questions:
   1. Explain the footwear manufacturing process for both mold and cutting manufacturing.
   2. Describe mold characteristics.
   3. What is acid etching? How can it be identified?
4. What is noise treatment?
5. Describe the tread design of a rib tire.
6. Is wear considered a class or randomly acquired characteristic? Why?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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DETECTION AND RECOVERY OF IMPRESSION EVIDENCE

Duration: One to Two Weeks

Purpose: Familiarize the trainee with the techniques used to detect, recover, and preserve footwear and tire track impression evidence.

1 Objectives

1.1 Theoretical

Impression evidence is left anytime two objects come into contact and there is a transfer of pattern. These impressions can be left in a variety of substrates such as dust, mud, or bodily fluid. This makes impression evidence likely at a crime scene but possibly difficult to detect. Different lighting and photographic techniques are available to help detect impressions in both dry and wet substances. It is also possible to detect some wet impressions using chemical techniques which will be addressed during chemical enhancement training.

The next step is to recover and preserve the impression for analysis and comparison. Recovery can be challenging depending on whether the impression is wet or dry, on a collectable item such as tile or on a permanent object such as a driveway, two dimensional or three dimensional. Photography is critical to all recovery and preservation efforts followed by casting and or lifting techniques.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Detect and recover wet, dry, two- and three-dimensional impression evidence using photography, lifting and casting techniques.

2 Lesson Plan

2.1 Instructional Outline

1. Introduction to detection of impressions
   a) oblique lighting
   b) alternate light source

2. Specific discussion and demonstration of impression recovery techniques
   a) photography (documentation vs. examination quality photos)
   b) techniques used for casting of impressions
   c) electrostatic lifting
   d) gel lifts

3. Evaluation of recovery techniques
   a) advantages
   b) disadvantages

2.2 Required Readings:

Trace Evidence Standard Operating Procedure.Detection of Impression Evidence by Oblique Lighting. Texas Department of Public Safety Crime Laboratory.


2.3 Practical Exercises

1. The trainee will document and photograph impressions (footwear/tire) in different substrates and environments in order to obtain both general and examination quality photos.

2. The trainee will recover impressions (footwear/tire) using the discussed techniques. The trainer will provide impressions that are suitable for the particular technique being used. The amount of samples for each technique will be determined by the trainer depending on the performance of the trainee.

   a) castings
   b) electrostatic lifting
   c) gel lifts

2.4 Practical Examination

The trainee will be provided multiple impressions to document, evaluate and correctly apply the techniques discussed. At least one example for each technique should be provided by the trainer.

2.5 Written Exercises

The trainee will provide a written response to the following questions:

1. What is oblique lighting and what is its purpose?

2. What is the difference between an examination quality photograph and general photograph? Give examples of each as it applies at a crime scene.

3. What general options should a camera being used for examination photos have? Please describe the proper procedure to take an examination quality photograph of an impression?

4. What does a casting of an impression capture that a photograph does not? Why is this important?
5. When is an electrostatic lifter typically used? Describe the general procedure and some of the safeguards that need to be taken while processing and during storage of the evidence?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned/processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist and sign-off sheet. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
## Training Manual

**Subject:** Detection and Recovery of Impression Evidence

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### Preparer

*Brad Mullins*

Trace Advisory Board Chair

Date: \[01/18/2012\]

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### Concurrence

*Diana D. Salas*

Quality Assurance

Date: \[03/19/2012\]

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Effective Date: 04/17/2012  
Issued by: QA Coordinator
IMPRESSION TEST PRINTS

Duration       One Week
Purpose        Familiarize the trainee with the techniques used to generate footwear and tire track test prints for comparison purposes.

1  Objectives

1.1  Theoretical
Comparison of an evidence impression to a shoe or tire can be difficult. A visual examination cannot show how a feature or characteristic within a shoe or tire will appear in an impression. Test prints of suspected shoes or tires are made to compare to the recovered evidence impression.

1.2  Practical
Upon completion of this module, the trainee will be able to:

1. Produce two- and three-dimensional test prints from footwear and tires

2  Lesson Plan

2.1  Instructional Outline

1. Discussion and demonstration of techniques used
   a) Large ink pad
   b) Silicone spray
   c) Invisible ink
   d) Petroleum jelly
   e) Bio-foam
   f) Casts

2. Labeling of test prints

3. Evaluation of the techniques
   a) Advantages
   b) Disadvantages

2.2  Required Readings
Trace Evidence Standard Operating Procedure. Known Footwear and Tire Track Impressions. Texas Department of Public Safety Crime Laboratory.


Bodziak WJ. Chapter 4: Known Exemplars of Tires for Elimination and Examination. Tire Tread and Tire Track Evidence. CRC Press. 2008.
2.3 Practical Exercises
1. The trainer will provide the trainee with several items (shoes, boots, tires, etc.) which will be used to produce test prints. The items should have several randomly acquired characteristics that are reproducible for evaluation purposes.

2. The trainee will produce and evaluate several test prints. Observations made by the trainee should be documented for further evaluation by the trainer.
   a) Multiple techniques should be used for each item
   b) Duplicate test prints should be made for each technique used

3. The trainee and the trainer will compare the test prints created and discuss the differences observed between techniques and evaluate their advantages and disadvantages.

2.4 Practical Examination
1. The trainee will be provided a tire and shoe to produce test prints.

2. The trainee will properly document the items
   General description (class characteristics, measurements, etc)

3. The trainee will produce a test print of each item
   Proper documentation of reproducible randomly acquired characteristics should be documented and verified by the trainer.

2.5 Written Exercises
The trainee will provide written responses to the following questions:
1. Describe in depth the steps that should or shouldn’t be taken to create an ideal tire test print and shoe test print?

2. What needs to be considered before attempting a test print on evidentiary items?

3. Can a comparison be made with only a test impression and questioned impressions submitted? Why or why not?

3 Conclusion
3.1 Assessment
The trainer will ensure satisfactory completion or written/practical exercises and practical examination. The type of samples assigned/processed should be representative of those encountered in case work.

3.2 Evaluation
The trainee and trainer will complete a checklist and sign-off sheet. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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ENHANCEMENT OF IMPRESSION EVIDENCE

Duration  One to Two Weeks
Purpose Familiarize the trainee with the chemical treatments used to enhance footwear and tire track impressions for comparison purposes.

1 Objectives

1.1 Theoretical
Some impressions may be obvious to the unaided eye while others may be very faint or not seen at all. Detection and enhancement of these faint impressions with chemical treatments may cause them to become of sufficient quality to allow comparison to suspected footwear or tires. The chemical techniques discussed here are most often used to detect and enhance bloody impression evidence.

1.2 Practical
Upon completion of this module, the trainee will be able to

1. Detect and enhance faint impressions on a variety of substrates.

2 Lesson Plan

2.1 Instructional Outline
1. Chemical enhancement techniques
   a) Diaminobenzidine
   b) Amido black
   c) Luminol
   d) Leucocrystal violet
2. Evaluation of the techniques
   a) Advantages
   b) Disadvantages
3. Documentation and quality control
4. Effects of other testing before and after chemical treatments

2.2 Required Readings:
Trace Evidence Standard Operating Procedure. Sulfosalicylic Acid Fixer Solution. Texas Department of Public Safety Crime Laboratory.
Trace Evidence Standard Operating Procedure. Enhancement of Impressions by Amido Black. Texas Department of Public Safety Crime Laboratory.
Trace Evidence Standard Operating Procedure. Enhancement of Impressions by Leucocrystal Violet. Texas Department of Public Safety Crime Laboratory.
Material Safety Data Sheets for: 5-sulfosalicylic acid; 3,3-Diaminobenzidine tetrahydrochloride, Amido black, glacial acetic acid, methanol, citric acid, luminol, sodium carbonate, sodium perborate, sodium acetate, Leucocrystal violet dye.

2.3 Practical Exercises
1. The trainer will provide the trainee with several bloody impressions on different substrates to chemically enhance. There should be enough impressions for multiple enhancements with each technique covered.
2. The trainee will demonstrate proper documentation and quality control of the following:
   a) Diaminobenzidine
   b) Amido black
   c) Luminol
   d) Leucocrystal violet
3. The trainee will enhance multiple bloody impressions provided by the trainer using each technique covered.
4. The trainee should demonstrate proper documentation before and after enhancement so an evaluation by the trainer can be completed.

2.4 Practical Examination
1. The trainee will be provided a bloody impression(s) to chemically enhance.
2. The trainee will chemically enhance the impression(s).
   a) Proper documentation of the enhancement solution and technique(s) used should be completed by the trainee.
   b) Proper documentation of the bloody impression before and after enhancement should be completed by the trainee
3. The trainee should demonstrate proper selection and documentation of the enhancement technique(s) and proper enhancement of the impression(s) provided.

2.5 Written Exercises
The trainee will provide written responses to the following questions:
1. What is the purpose of chemically enhancing a bloody impression and how do you decide which method to use?
2. Please describe what needs to be done before enhancing a bloody impression with the impression itself and the solutions being used?
3. Where would you get the safety information for the reagents used to make the enhancement solutions? Please provide an example copy(s) of the relevant paperwork along with a brief explanation.
3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned/processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist and sign-off sheet. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
**Preparer**

Devin Crago-Stasicha  
Trace Advisory Board Chair  
Date: 08/21/2009

**Concurrence**

Zoë M. Smith  
Quality Assurance  
Date: 09/14/2009

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COMPARISON OF IMPRESSION EVIDENCE

Duration Two to Three Weeks
Purpose Familiarize the trainee with the process, conclusions and significance of impression evidence comparison.

1 Objectives

1.1 Theoretical

Even though footwear and tires are mass-produced, there are a finite number of shoes (and tires) that share the class characteristics of a specified size and design. Each of these items becomes exposed to damage that cannot be exactly reproduced from one item to the other. This damage, known as randomly acquired characteristics, can be used to identify a particular shoe print or tire track as being made from one shoe (or tire).

1.2 Practical

Upon completion of this module, the trainee will be able to

A. Identify and compare the class characteristics, randomly acquired characteristics and wear patterns on shoe soles, tires and question impressions, and
B. Report conclusions and opinions,
C. Perform technical and administrative reviews, and
D. Provide expert testimony that appropriately conveys the significance of impression evidence.

2 Lesson Plan

2.1 Instructional Outline

A. Comparison methodology
   1. Documentation of questioned and known
   2. Test prints of known exemplars
   3. Side by side method and overlay method
   4. Conformation of randomly acquired characteristics to known item
   5. Randomly acquired characteristics verified by second examiner

B. Comparison process
   1. Criteria used to make a class association will be discussed and demonstrated
   2. Criteria used to make an identification will be discussed and demonstrated
   3. Criteria used to make an elimination or exclusion will be discussed and demonstrated

C. Conclusions and disclaimers or limitations
D. Discuss technical and administrative reviews
   Pertinent documentation and necessary components of a completed case folder
E. Discuss court testimony
2.2 Required Readings

A. Trace Evidence Standard Operating Procedure. Comparison of Impression Evidence. Texas Department of Public Safety Crime Laboratory.


2.3 Practical Exercises

A. The trainer will provide a questioned impression(s) and a known item(s) (shoe/tire) for comparison, conclusions will include:
   1. Class association
   2. Identification
   3. Elimination

B. The trainee will demonstrate proper documentation of the comparison along with appropriate conclusion statements for the samples provided.

C. The trainer will evaluate the documentation and conclusion statements and discuss recommendations and/or corrections if required.

D. Additional samples may be assigned as determined by the trainer after the evaluation

E. Trainee will review reports written by experienced examiners

F. Technical and administrative reviews
   1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.

   2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee's efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.
G. Court testimony
When possible, the trainee should observe actual testimony by an experienced impression examiner.

2.4 Practical Examination
A. The trainee will be provided a questioned impression(s) and a known item(s) (shoe/tire) for comparison.
B. At the discretion of the trainer, the trainee may be provided samples that require the impression to be collected or enhanced for comparison.
C. The trainee will complete a comparison(s) with the items provided and a conclusion(s) will be determined.
D. The trainee’s documentation and report must support the comparison and conclusion.

2.5 Written Exercises
The trainee will provide written responses to the following questions:

1. Explain what a class association is and provide an example? Discuss the significance of a class association.
2. Explain what a positive identification is and provide an example? Discuss the significance of a positive identification.
3. What is distortion as it applies to impressions? Give some possible causes.
4. Please discuss how the time line between incident and recovery of a known item can affect an impression comparison or conclusion? Give an example of a conclusion statement where a class association is present but a difference in wear is observed. The known item was worn/used for several months after the incident in question.

3 Conclusion
3.1 Assessment
The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned/processed should be representative of those encountered in routine case work.

3.2 Evaluation
The trainee and trainer will complete a checklist and sign-off sheet. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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DIGITAL IMAGE PROCESSING

Duration: One to Two Weeks
Purpose: Familiarize the trainee with the use of Photoshop in digital image processing.

1 Objectives

This course begins with the trainee already having the ability to capture and acquire images. The practical aspect for this course will include the introduction, use, and application of software to carry out digital image processing.

1.1 Theoretical

Many of the traditional darkroom techniques that were historically accepted for use in forensic science have a direct counterpart by applying digital image processing with a computer and appropriate software. Adobe Photoshop is used for the viewing and processing of digital images of various impressions acquired through digital photography and scanning. The goal of digital image processing is to improve the contrast of an impression against the background so that comparison to known shoes/tires can be performed more effectively. The software records the sequence of digital processing made by the forensic scientist and is essential to the integrity of the image. The trainee will gain extensive knowledge of equipment and software used for digital image processing and archiving, and have an extensive understanding of the available image processing tools for calibration, color evaluation, and tonal range and contrast adjustments to apply in sequence to impressions.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Evaluate images for clarity (focus), distortion, and capture area (inclusion of scale)
2. Perform digital image processing on impression evidence using image processing software

2 Lesson Plan

2.1 Instructional Outline

1. Image processing software
   a) Adobe Photoshop (current version)
      i. Photoshop tools and tool bars
         • Approved tools vs. prohibited tools
         • Special tools requiring guidelines for use (levels, area selection, dodge, and burn)
      ii. Image size
         • Calibration: Resample must be off - to ensure that changes to the dimensions of the image (width and height) are also made to the resolution
         • Re-sizing: Resample must be on – to ensure that changes made to the resolution are not made to the dimensions of the image
iii. Shortcuts
   • Setups/settings
   • History tracking functionality
   • Camera raw viewer
     – White balance adjustments
     – Exposure adjustments
     – Shadow and highlights adjustments (fill light)

2. Recommended general workflow for Adobe Photoshop digital image processing
   a) Copy/duplicate image
   b) Calibrate
      i. Crop Method
      ii. Ruler (measure) Tool Method
   c) Rotate, if necessary (90° increments)
   d) Evaluate Color
      i. Color mode (select single color channel)
         • RBG
         • CMYK
         • Lab Color
      ii. Adjusting individual color values
         • Black and white
         • Hue/saturation
         • Calculations
         • Color Balance
      iii. Chromatic FFT (Pattern Removal Filter)
   e) Convert to Grayscale Mode
   f) Pattern Removal Filter
   g) Adjust tonal range and contrast
      i. Brightness/contrast
      ii. Levels
         • Legal ramifications
         • Suggested guidelines
      iii. Shadow and highlights
      iv. Curves
      v. Dodge/burn
         • Legal ramifications
         • Suggested guidelines
vi. Exposure
vii. Apply image

h) Fine tune
i. Noise
   • Dust and scratches
   • Reduce noise

ii. Sharpen
   • Unsharp mask
   • Smart sharpen
   • Sharpen edges

3. Specialized techniques
   a) JPG artifact reduction
   b) Image stitching

4. Archiving
   a) Legal ramifications
      i. Do not alter original file
         • Save original file
      ii. Save processed image
   b) Electronic Media
      i. Non-rewritable electronic media (i.e. CD-R or DVD-R)
   c) Foray

5. Printing
   i. Printer, paper, and ink selection
      • Specification
   ii. Life size representations and enlargements
   iii. Documentation of printed photo
      • Info placed on photo
      • Processed vs. original

6. Contact sheet

2.2 Required Readings


2.3 Practical Exercises

1. The trainee will process at least five images with different backgrounds. Once completed the trainee will provide the trainer with the original photo, processed photo, and history.

2.4 Practical Examination

1. The trainee will process three images with different backgrounds. Once completed the trainee will provide the trainer with the original photo, processed photo, and history.

2.5 Written Exercises

The trainee will provide written responses to the following questions:

1. What are three tools that should not be used in Photoshop to process an image?

2. What is DPI and PPI? What does each one refer to?
3. What are the main differences between RAW and JPG formats?
4. Explain the steps to calibrate an image.
5. What information needs to be present on a printed photograph?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned/processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist and sign-off sheet. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Preparers

Justin Parker
Trace Advisory Board Chair

Date: 11/15/2016

Concurrence

Valerie Turner
Quality Assurance Specialist

Date: 11/10/2016

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1 Objectives

1.1 Theoretical

Fabric impressions are the transfer of the weave characteristics and/or knit pattern on a textile material through direct physical contact and are usually observed as a pattern of thin parallel lines. As with other types of impressions, the class and randomly acquired characteristics of fabric impressions may be compared and associations or identifications can be made.

1.2 Practical

Upon completion of this module, the trainee will be able to

A. Detect and recover fabric impressions using photography, enhancement, and lifting techniques,
B. Prepare test impressions of fabric materials, and
C. Identify and compare the class characteristics and, if present, randomly acquired characteristics of fabric impressions.

2 Lesson Plan

2.1 Instructional Outline

A. Textile patterns
   1. Weave
   2. Knit
   3. Fancy weaves
   4. Non-woven fabrics
B. Types of impressions
   1. Two-dimensional – positive and negative impressions
   2. Three-dimensional
C. Collection and documentation of fabric impression evidence
   1. Photography
   2. Enhancement
   3. Lifting
D. Describing fabric impressions and known fabric standards
   1. Class characteristics (e.g., yarn twist, seam location, etc.)
   2. Randomly acquired characteristics (e.g., cuts, tears, unraveling, etc.)
E. Test impression methods
   1. Fingerprint ink or washable paint
   2. Inkless kit
   3. Petroleum jelly and fingerprint powder
   4. Fingerprint powder and lift tape or gel lifter

F. Comparisons, interpretation, and testimony

2.2 Required Readings
   D. Schwartz, T. Impression Evidence Workshop PowerPoint (PDF)
   E. Schubert, G. Fabric Impression Workshop PowerPoint (PDF)

2.3 Practical Exercises
   A. The trainee will demonstrate proper documentation and collection of questioned fabric impressions on various surfaces including, but not limited to, metal, glass and plastic.
   B. The trainee will prepare test impressions of fabric materials, including dragging/sliding impressions, using at least two different test impression methods.
   C. The trainee will compare test and questioned impressions, properly document observations, and draw conclusions (must include one association and one elimination).
   D. Additional samples may be assigned as determined by the trainer.

2.4 Practical Examination
   A. The trainer will provide a questioned impression(s) and a known item(s) for comparison.
   B. At the discretion of the trainer, the trainee may be provided samples that require the impression to be collected or enhanced for comparison.
   C. The trainee will perform the comparison(s), prepare appropriate documentation, determine a conclusion(s), and write reporting statements, as is appropriate.
2.5 Written Exercises

The trainee will provide written responses to the following questions:

1. Define and describe two types of textile patterns and provide an example of each.

2. What are three methods that a fabric impression may be transferred to a surface?

3. How is a fabric impression documented and collected?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned/processed should be representative of those encountered in routine case work.

3.2 Evaluation

The trainee and trainer will complete a checklist and sign-off sheet. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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INTRODUCTION TO PRESSURE SENSITIVE ADHESIVE TAPE

Duration  One to Two Weeks
Purpose   Familiarize the trainee with the examination and comparison of adhesive tape products.

1 Objectives

1.1 Theoretical
The trainee must have general knowledge about the forensic examination of pressure sensitive adhesive tape evidence. This module will introduce the trainee to the type of tape encountered in case work and the tests used to compare pressure sensitive adhesive tape samples in a forensic laboratory.

1.2 Practical
Upon completion of this module, the trainee will be able to discuss the forensic examination and comparison of pressure sensitive adhesive tape evidence.

2 Lesson Plan

2.1 Instructional Outline
1. Classification of different types of tapes
   a) duct tape
   b) electrical tape
   c) filament tape
   d) packaging tape
   e) masking/paper/acetate tapes

2. Manufacturing process

2.2 Required Readings


2.3 Practical Exercises
None

2.4 Practical Examination
None

2.5 Written Exercise
The trainee will provide written responses to the following question:

1. Describe the different types of tape and how likely they are to be encountered in case work.
3 Conclusion

3.1 Assessment
The trainer will ensure satisfactory completion of written exercise.

3.2 Evaluation
The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Training Manual
Trace Evidence
Subject: Introduction Pressure Sensitive Adhesive Tape

Preparer

Devin Crago-Stasicha
Trace Advisory Board Chair

Date: 07/23/2010

Concurrence

Zoë M. Smith
Quality Assurance

Date: 07/23/2010

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Effective Date: 09/13/2010
Issued by: QA Coordinator
EXAMINATION OF PRESSURE SENSITIVE ADHESIVE TAPE

Duration Two to three Weeks
Purpose Familiarize the trainee with the examination and comparison of adhesive tape products.

1 Objectives
1.1 Theoretical

The first step in pressure sensitive adhesive tape analysis is to determine if a physical match exists between the known and questioned tape sources. A physical match between a known and questioned tape source excludes the need for additional testing. If no physical match is present, then the physical characteristics of the backing, scrim fabric (if present) and adhesive are used to compare questioned tape to known tape. A meaningful difference in these physical properties between the questioned and known tape samples would eliminate the need for any further analysis.

Instrumental/microscopic analysis of the backing, scrim fabric and adhesive may be performed by Infrared Spectroscopy and/or Pyrolysis Gas Chromatography. Comparison and interpretation of microscopic characteristics, spectra, and pyrograms can help determine differences that may be present in questioned and known samples.

1.2 Practical

Upon completion of this module, the trainee will be able to:

1. Discuss the forensic examination and comparison of pressure sensitive adhesive tape evidence and the significance of tape as associative evidence, and
2. Examine and compare pressure sensitive adhesive tapes and form an opinion as to possible common origin.

2 Lesson Plan
2.1 Instructional Outline

1. Trace evidence recovery from tape
2. Physical characteristics
   a) width of tape
   b) color of backing
   c) presence and shape of any calendering
   d) overall thickness and thickness of the backing
   e) fabric weave
   f) number of threads per inch in the warp and fill directions
   g) color of the adhesive
   h) polymer orientation
3. Microscopic analysis
   a) Examination of adhesive and backing
b) Cross sections of tape

c) Fiber Analysis

4. Chemical and polymer analysis

a) Fiber analysis

b) Backing analysis

c) Adhesive analysis

5. Instrumental analysis

a) FTIR

b) XRD

c) XRF

d) PGC or PGC-MS

2.2 Required Readings

Trace Evidence Standard Operating Procedure. Comparison of Adhesive Tape. Texas Department of Public Safety Crime Laboratory.

Trace Evidence Standard Operating Procedure. Fiber Initial Examination and Overview. Texas Department of Public Safety Crime Laboratory.


Trace Evidence Standard Operating Procedure. Physical Comparison. Texas Department of Public Safety Crime Laboratory.


Trace Evidence Standard Operating Procedure. Microscopic Examination of Fibers. Texas Department of Public Safety Crime Laboratory.


Trace Evidence Standard Operating Procedure. Infrared Microspectroscopy of Man-Made Fibers. Texas Department of Public Safety Crime Laboratory.


Bradley MJ. Forensic Analysis of Pressure-Sensitive Tapes presented at the Pressure Sensitive Tape Council Technical Meeting, Orlando Florida. 2001

Material Safety Data Sheets for: hexane, xylene, Permount, and other relevant chemicals.

### 2.3 Practical Exercises

The trainer will provide the trainee with several types and brands of adhesive tape to document physical characteristics and obtain infrared spectra and pyrograms of tape components. The types of tape should include multiple samples of each of the following types of tape:

- **a)** duct tape
- **b)** electrical tape
- **c)** filament tape
- **d)** packaging tape
- **e)** masking/paper/acetate tapes

### 2.4 Practical Examination

1. The trainer will provide trainee with tape samples to compare and document physical characteristics, microscopic characteristics, and obtain and compare infrared spectra and pyrograms.

2. The trainee will prepare a written report on the results of the practical examination.

### 2.5 Written Exercises

The trainee will provide written responses to the following questions:

1. Why are physical and microscopic comparisons so important in tape examinations?

2. What instrumental analysis can be used in tape comparison?

3. Describe the layers found in duct tape and how they can be used to differentiate samples.

### 3 Conclusion

#### 3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

#### 3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
Revision History

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INTERPRETATION OF PRESSURE SENSITIVE ADHESIVE TAPE EVIDENCE

Duration: One Week

Purpose: Familiarize the trainee with the significance of pressure sensitive adhesive tape evidence examinations.

1 Objectives

1.1 Theoretical
Pressure sensitive adhesive tapes are encountered in a variety of different cases. Its ultimate evidentiary value is dependent on factors and circumstances surrounding the case and the commonness of the particular type of pressure sensitive adhesive tape. The forensic scientist must be able to provide expert testimony concerning the significance of an association based upon pressure sensitive adhesive tape evidence.

1.2 Practical
Upon completion of this module, the trainee will be able to:

A. Understand the factors affecting the significance of pressure sensitive adhesive tape evidence,
B. Report conclusions and opinions,
C. Perform technical and administrative reviews, and
D. Provide expert testimony that appropriately conveys the significance of pressure sensitive adhesive tape evidence.

2 Lesson Plan

2.1 Instructional Outline
A. Discuss the interpretation, significance, and limitations of pressure sensitive adhesive tape comparisons and associations.
B. Discuss report wording
C. Discuss technical and administrative reviews
   Pertinent documentation and necessary components of a completed case folder
D. Discuss court testimony

2.2 Required Readings
2.3 Practical Exercises

A. The trainee will explain the significance of the results of a mock pressure sensitive adhesive tape case

B. Report writing
   1. The trainee will review reports written by experienced examiners.
   2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.

C. Technical and administrative reviews
   1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.
   2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

D. Court testimony

   When possible, the trainee should observe actual testimony by an experienced tape examiner.

2.4 Practical Examination

None

2.5 Written Exercises

The trainee will provide a written response to the following questions:
   1. Discuss the factors that affect the significance of pressure sensitive adhesive tape examinations.
   2. Explain why a physical match is more probative than other conclusions.
   3. What other types of evidence can be encountered on pressure sensitive adhesive tape?
   4. What conclusions can be drawn after a tape comparison?

3 Conclusion

3.1 Assessment

The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples processed should be representative of those encountered in routine casework.

3.2 Evaluation

The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
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UNKNOWN SUBSTANCES EXAMINATION

Duration        Four to six weeks
Purpose         Develop within the trainee the ability to apply a systematic approach to the analysis and identification or characterization of unknown materials.
Prerequisite     General Microscopy Training Module, Instrumental Analysis Training Module

1 Objectives

1.1 Theoretical

Trace evidence analysts will be required at times to analyze materials that do not fit nicely into one of the categories of sub-disciplines within the Trace Evidence SOP. Forensic analysis of unknown materials requires a systematic approach, utilizing all the tools at the disposal of the forensic scientist. The tools available include wet chemical methods, polarized light microscopy and microchemical methods, and instrumental methods.

1.2 Practical

Following the completion of this module, the trainee will:

A. Be able to apply the principles of chemical microscopy to the analysis of unknown materials;
B. Understand and use a systematic approach to the analysis of unknown materials;
C. Understand the capabilities and limitations of the various instruments used,
D. Be able to identify, or characterize for comparison to knowns, solid and liquid unknown materials.
E. Report conclusions and opinions,
F. Perform technical and administrative reviews, and
G. Provide expert testimony that appropriately conveys the significance of hair evidence.

2 Training Outline

2.1 Lesson Plan

A. Review of microscopy (Kohler illumination, refractive index, retardation, birefringence, crystal optics)
B. Analysis of solids
   1. Stereomicroscopic exam
   2. Chemical microscopy
   3. Instrumental analysis
C. Analysis of liquids
   1. Aqueous liquids
   2. Organic liquids
D. Particle manipulation techniques
E. Types of unknown substance cases
   1. General unknowns, solids and liquids
   2. Pre- and post-blast low explosives
   3. Product tampering
   4. Residues on clothing, including but not limited to lubricants, lachrymators, and chemical dye packs

F. Discuss report writing

G. Discuss technical and administrative reviews
   1. Pertinent documentation and necessary components of a completed case folder

H. Discuss court testimony

2.2 Required Readings


2.3 Further Reading

2.4 Practical Exercises
A. The trainee will be given solid samples to analyze using the various techniques in unknown substance analysis.
B. The trainee will be given liquid samples to analyze using the various techniques in unknown substance analysis.
C. The trainee will be given samples to practice identifying contaminants in household items and food products.
D. The trainee will be given samples to identify residues on clothing, to include OC spray, lubricants, and MAAQ.
E. Report writing
   1. The trainee will review reports written by experienced examiners.
   2. The trainee will be given various case scenarios and/or mock evidence results and the trainee will issue reports based on those results.

F. Technical and administrative reviews
   1. The trainee will be given case folders that have already been reviewed for their review and familiarization of folder contents. The number of completed case folders will be determined by the trainer.
   2. The trainee will be given non-reviewed case folders and allowed to technically review the folders before they are given to a qualified reviewer. The results of the trainee’s efforts will be evaluated by the trainer. The number of completed case folders will be determined by the trainer.

G. Court testimony
   When possible, the trainee should observe actual testimony by an experienced unknown substance examiner.

2.5 Practical Examination
   The trainee must demonstrate competency by the successful completion of a practical examination involving the identification of unknown samples using the techniques demonstrated above. The trainee will be given unknown substances to analyze and identify.

2.6 Written Exercises
   The trainee will provide written answers to the following questions:
   1. Name and describe the characteristics of the six crystal systems. Which are isotropic? Uniaxial? Biaxial?
   2. Describe a method to separate a mixture of unknown crystalline substances.
   3. Describe an analytical scheme to identify an unknown liquid.
   4. Can an unknown substance be identified by using a mass spectra library match? Why or why not?
   5. An unknown substance was analyzed on a GC/MS and resulted in a blank chromatogram, without any peaks. Why?

3 Conclusion
3.1 Assessment
   The trainer will ensure satisfactory completion of written/practical exercises and practical examination. The type of questions and samples assigned should be representative of those encountered in routine casework.

3.2 Evaluation
   The trainee and trainer will complete a checklist. The trainee will evaluate the module content and the trainer(s) at the completion of the unit.
## Revision History

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<td>09/13/2010</td>
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<tr>
<td>01</td>
<td>04/17/2012</td>
<td>Major revision – Section 2.1&lt;br&gt;Minor revision – Sections 1.2, 2.2, and 2.5&lt;br&gt;Advisory Board</td>
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<td>04/25/2019</td>
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**Overview**

TE-TM-01: Overview of the Trace Evidence Training Program

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# TE-TM-02: Instrumental Analysis Overview

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## 2 LESSON PLAN

### 2.1 Instructional Outline
- □ Lecture/discussion of theory, capabilities, and limitations of instruments used in trace evidence analysis
  - Infrared spectroscopy
  - Microspectrometry
  - Gas chromatography
  - GRIM
  - Mass spectrometry
  - SEM/EDS
  - X-Ray fluorescence
  - X-Ray diffraction

### 2.2 Required Readings
- □ Electron Beam X-Ray Microanalysis
- □ Uniting Microscopy and Spectroscopy
- □ Principles of Instrumental Analysis
- □ Understanding Mass Spectra
- □ An Infrared Spectroscopy Atlas for the Coatings Industry
- □ Analytical Pyrolysis: An Overview with Forensic Applications

### 2.3 Practical Exercises
- □ Observe an experienced analyst(s) prepare samples, operate the instruments available in the trainee’s laboratory, and interpret data

### 2.4 Practical Examination
- □ None
## TE-TM-02: Instrumental Analysis Overview

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## 1 OBJECTIVES

### 1.1 Theoretical
- Theoretical objectives reviewed

### 1.2 Practical
- Practical objectives reviewed

## 2 LESSON PLAN

### 2.1 Instructional Outline
- Lecture/discussion of review of properties of electromagnetic radiation; un-polarized and polarized light
- Lecture/discussion of Snell’s Law, refraction, refractive index, and optics of lenses
- Lecture/discussion of aberrations and correcting aberrations
- Lecture/discussion of review of microscope parts and function
- Lecture/discussion of Abbe’s Law of Resolution, resolving power, and numerical aperture
- Lecture/discussion of focal planes, Köhler illumination, and contrast vs. resolution
- Lecture/discussion of micrometry
- Lecture/discussion of crystal systems, isotropy, and anisotropy
- Lecture/discussion of polarized light microscopy
- Lecture/discussion of the Michel-Levy chart
- Lecture/discussion of sample preparation and mounting media
- Lecture/discussion of the comparison microscope
- Lecture/discussion of photomicrography

### 2.2 Required Readings
- Polarized Light Microscopy
- Particle Characterization by PLM Part I: No Polars
- Particle Characterization by PLM Part II: Single Polar
- Particle Characterization by PLM Part III: Crossed Polars
## TE-TM-03: General Microscopy

**2.3 Further Reading**
- The Particle Atlas
- The Particle Atlas (Edition Two)

**2.4 Practical Exercises**
- Demonstrate and explain how to properly obtain Köhler illumination and demonstrate conjugate focal planes
- Calibrate an ocular micrometer for various objectives
- Prepare and mount samples in various ways
- Measure refractive index and determine optic sign of a set of samples
- Determine the amount of birefringence for a set of samples using the Michel-Levy chart

**2.5 Practical Examination**
- Determine the optical properties of a set of unknown samples

**2.6 Written Exercises**
- Provide written responses to all questions

### 3 CONCLUSION

**3.1 Assessment**
- Satisfactory completion of written/practical exercises and practical examination assessed by trainer

**3.2 Evaluation**
- Evaluation of training module and trainer by trainee

### OTHER
# General Microscopy

**TE-TM-03A Fluorescence Microscopy**

<table>
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### General Microscopy

#### TE-TM-03A Fluorescence Microscopy

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- Intensity of fluorescence
- Color of fluorescence under various wavelengths
- Excitation wavelength producing the maximum fluorescence

#### 2.2 Required Readings

- An evaluation of Mounting Media for use in Forensic Textile Fiber Examination
- The Forensic Aspect of Textile Fiber Examination
- Microspectrofluorimetry of Fluorescent Dyes and Brighteners on Single Textile Fibers: Part 1 – Fluorescence Emission Spectra
- Microspectrofluorimetry of Fluorescent Dyes and Brighteners on Single Textile Fibers: Part 2 – Colour Measurements
- Microspectrofluorimetry of Fluorescent Dyes and Brighteners on Single Textile Fibers: Part 3 – Fluorescence Decay Phenomena
- Introduction to Fluorescence
- Introduction to Fluorescence Microscopy
- Microscopical Examination of Fibers

#### 2.3 Practical Exercises

- Mount a set of fibers in 3 different mounting media and observe their fluorescence properly recording their characteristics
- Cross-section each of the fibers from the set, mount the cross-sections in the best mounting media, and record their characteristics including the depth of penetration

#### 2.4 Practical Examination

- Using a set of question and known fibers, determine if any of the fibers could have a common origin based on their fluorescent properties

#### 2.5 Written Exercises

- Provide written responses to all questions
### 3 CONCLUSION

#### 3.1 Assessment

- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

- [ ] Evaluation of training module and trainer by trainee

### OTHER

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# TX-LAB-TE-TM-05: Physical Comparison Cut-Tear

**Trainee Name** ___________________________ **Date Training Began** ______________

### 1 OBJECTIVES

1.1 Theoretical

- Theoretical objectives reviewed

1.2 Practical

- Practical objectives reviewed

### 2 LESSON PLAN

#### 2.1 Instructional Outline

- Lecture/discussion of general cut, tear, and puncture characteristics
- Textile type (knitted, woven, etc.), wire security screen, tape (electrical and duct), paper
- Force
- Direction
- Implement used
- Other variables
- Lecture/discussion of visual and stereoscopic exams
- Lecture/discussion of test cuts and tears
- Lecture/discussion of documentation
- Notes
- Photography
- Lecture/discussion of interpretation, limitations, and significance
- Lecture/discussion of report writing
- Lecture/discussion on technical and administrative reviews
- Lecture/discussion of court testimony

#### 2.2 Required Readings

- Determination of Cut/Tear in Textiles SOP
- Damage to Clothing-Cuts and Tears
- Stab Wound Dynamics – A Recording Technique for Use in Medico-Legal Investigations
- Clothing Damage Analysis and the Phenomenon of the False Sexual Assault
2.3 Practical Exercises

- Examine several textile items and perform cuts, tears, and punctures
  - Items should include various clothing items (woven and knitted) and window screening
  - Document and compare the characteristics of the test cuts, tears, and punctures
  - Make test cuts and tears using various implements, with varying amounts of force, and in different directions relative to the weave
- Review cut/tear reports issued by qualified examiners
- Issue reports based on case scenarios and/or mock evidence
- Review completed case folders
- Perform technical reviews on non-reviewed case folders

2.4 Practical Examination

- Document observations and conclusions to determine the nature of the damage present on a set of at least 5 items with cuts/tears
- Prepare mock case reports based on the conclusions of the cut/tear exams

2.5 Written Exercises

- Provide written responses to all questions

3 CONCLUSION

3.1 Assessment

- Satisfactory completion of written/practical exercises and practical examination assessed by trainer

3.2 Evaluation

- Evaluation of training module and trainer by
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<td>□ Footwear Impression Evidence</td>
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<tr>
<td>2.3 Practical Exercises</td>
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</tr>
<tr>
<td>□ Prepare a number of practice physical comparisons using different techniques (ie. cutting with scissors and a scalpel, ripping, breaking) and using different materials such as duct tape, cloth, plastic, and paint</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Trainee Name ________________________________

<table>
<thead>
<tr>
<th>TE-TM-PHYS-01: Physical Comparison</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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</thead>
<tbody>
<tr>
<td>□ Note how each technique affects the different materials</td>
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<tr>
<td>□ Perform a physical match comparison and demonstrate proper documentation on these same items</td>
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<tr>
<td>□ Review examples of physical match comparison reports</td>
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<tr>
<td>□ Issue reports based on case scenarios and/or mock evidence</td>
<td></td>
<td></td>
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<tr>
<td>□ Review completed case folders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Perform technical reviews on non-reviewed case folders</td>
<td></td>
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</tr>
</tbody>
</table>

2.4 Practical Examination

□ Conduct a physical comparison examination as well as properly documenting any physical matches that might be found on at least 2 sets of broken material

2.5 Written Exercises

□ Provide written responses to all questions

3 CONCLUSION

3.1 Assessment

□ Satisfactory completion of written/practical exercises and practical examination assessed by trainer

3.2 Evaluation

□ Evaluation of training module and trainer by trainee

OTHER

__________________________________________

__________________________________________

__________________________________________

__________________________________________

__________________________________________
Trainee Name __________________________ Date Training Began ________________

### 1 OBJECTIVES

#### 1.1 Theoretical

- [ ] Theoretical objectives reviewed

#### 1.2 Practical

- [ ] Practical objectives reviewed

### 2 LESSON PLAN

#### 2.1 Instructional Outline

- [ ] Lecture/discussion of packaging documentation
  - Condition of seal
  - Package description
- [ ] Lecture/discussion of item documentation
  - Written
    - Physical condition including any damages or stains
    - Any identifying information, such as tag information on a garment
    - Drawing a sketch
  - Photographic
    - Overall condition
    - Areas of interest, such as stains or smears
- [ ] Lecture/discussion of introduction to recovery techniques including demonstration and case record documentation
  - Picking
  - Tape lifting
  - Scraping
  - Combing
  - Clipping
  - Vacuum sweeping
- [ ] Lecture/discussion of recovery techniques
  - When to use each technique
  - How to prevent loss and/or contamination for each technique
### TE-TM-EVID-01: Evidence Collection and Preservation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
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<tbody>
<tr>
<td>Advantages and disadvantages of each technique</td>
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<tr>
<td>Proper documentation</td>
<td></td>
<td></td>
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<tr>
<td>Lecture/discussion of stereoscopic exam of recovered evidence</td>
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<tr>
<td>Setting up the stereoscope</td>
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<tr>
<td>Screening examinations of recovered evidence</td>
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<tr>
<td>Documentation of stereoscopic findings (hairs, fibers, paint, etc.)</td>
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<tr>
<td>Lecture/discussion of collection of standards (for various types of evidence including but not limited to: fiber standards, hair standards, and paint standards)</td>
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<tr>
<td>When to collect a standard</td>
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<tr>
<td>How to collect a standard</td>
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<tr>
<td>Proper documentation</td>
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<tr>
<td>Lecture/discussion of report writing</td>
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<tr>
<td>Lecture/discussion of technical and administrative reviews</td>
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<tr>
<td>Lecture/discussion of court testimony</td>
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</tbody>
</table>

#### 2.2 Required Readings

- Examination and Recovery Techniques SOP
- Trace Evidence Recovery Guidelines
- Forensic Examination of Fibres
- The Forensic Aspects of Textile Fiber Examination
- Microscopy and Microchemistry of Physical Evidence
- The Recovery of Fibres from the Surface of Clothing for Forensic Examination

#### 2.3 Practical Exercises

- Perform individual recovery techniques on different items of evidence
- Demonstrate proper documentation, application of technique, and proper attention to loss and contamination potential
- Practice recovery standards on different items of evidence
TE-TM-EVID-01: Evidence Collection and Preservation

<table>
<thead>
<tr>
<th>Demonstrate proper documentation, application of technique, and proper attention to loss and contamination potential</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereoscopically examine and document recovered trace evidence on a series of tape lifts and at least one petri dish of scrapings</td>
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<tr>
<td>Review examples of reports</td>
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<tr>
<td>Issue reports based on case scenarios and/or mock evidence</td>
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<tr>
<td>Review completed case folders</td>
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</tr>
<tr>
<td>Perform technical reviews on non-reviewed case folders</td>
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</tr>
<tr>
<td>Observe actual testimony by an experienced examiner</td>
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</tbody>
</table>

2.4 Practical Examinations

| Examine at least 5 mock items | | | |
| Determine the best way to document each item | | | |
| Determine what technique of evidence recovery and preservation should be used and apply that technique | | | |
| Recover standards if appropriate and prevent any loss and/or contamination | | | |
| Stereoscopically examine and document the recovered trace evidence where appropriate | | | |
| Document unknown debris from various collections | | | |

2.5 Written exercises

| Provide written responses to all questions | | | |

3 CONCLUSION

3.1 Assessment

| Satisfactory completion of written/practical exercises and practical examination assessed by trainer | | | |

3.2 Evaluation

| Evaluation of training module and trainer by trainee | | | |

OTHER
Trainee Name ________________________________

<table>
<thead>
<tr>
<th>TE-TM-EVID-01: Evidence Collection and Preservation</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/ Evaluation</th>
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Trainee Name ____________________________

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<th>Trainer Initials/ Evaluation</th>
</tr>
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<tr>
<td><strong>1 OBJECTIVES</strong></td>
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<tr>
<td><strong>1.1 Theoretical</strong></td>
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<tr>
<td>☐ Theoretical objectives reviewed</td>
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<tr>
<td><strong>1.2 Practical</strong></td>
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<td></td>
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</tr>
<tr>
<td>☐ Practical objectives reviewed</td>
<td></td>
<td></td>
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<tr>
<td><strong>2 LESSON PLAN</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.1 Instructional Outline</strong></td>
<td></td>
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<tr>
<td>☐ Lecture/discussion of introduction to gunshot primer residue</td>
<td></td>
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<tr>
<td>☐ Particle morphology and composition</td>
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<tr>
<td>☐ Formation and deposition of particles</td>
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<tr>
<td>☐ Items suitable for gunshot primer residue collection</td>
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<tr>
<td>☐ Significance and limitations of analysis procedure</td>
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<tr>
<td>☐ Other gunshot residue deposits</td>
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<tr>
<td>☐ Lecture/discussion of preparations for collection</td>
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<td>☐ SEM stubs</td>
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<td>☐ Site preparation</td>
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<tr>
<td>☐ Lecture/discussion of sample collection</td>
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<tr>
<td>☐ Control sample</td>
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<tr>
<td>☐ Clothing</td>
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<tr>
<td>☐ Other inanimate objects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Documentation of samples</td>
<td></td>
<td></td>
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<tr>
<td><strong>2.2 Required Readings</strong></td>
<td></td>
<td></td>
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<tr>
<td>☐ Summary of the FBI Laboratory's Gunshot Residue Symposium</td>
<td></td>
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<tr>
<td>☐ The Incidence of Transient Particulate Gunshot Primer Residue in Oregon and Washington Bow Hunters</td>
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<tr>
<td>☐ The Retention of Gunshot Residue on Clothing After Laundering</td>
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<tr>
<td><strong>2.3 Practical Exercises</strong></td>
<td></td>
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</tr>
<tr>
<td>☐ Properly prepare the site for the collection of gunshot primer residue from clothing</td>
<td></td>
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<tr>
<td>☐ Collect gunshot primer residue from an article of clothing and other inanimate objects</td>
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</tbody>
</table>
## TE-TM-EVID-02: Collection of Gunshot Primer Residue Samples

<table>
<thead>
<tr>
<th>2.4 Practical Examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Explain and demonstrate the collection of gunshot primer residue by stubbing at least two articles of clothing</td>
</tr>
<tr>
<td>□ Explain and demonstrate the collection of gunshot primer residue from other inanimate objects</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.5 Written exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Provide written responses to all questions</td>
</tr>
</tbody>
</table>

### 3 CONCLUSION

#### 3.1 Assessment

|   □ Satisfactory completion of written/practical exercises and practical examination assessed by trainer |

#### 3.2 Evaluation

|   □ Evaluation of training module and trainer by trainee |

### OTHER


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## Unit Examination and Competency

<table>
<thead>
<tr>
<th></th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td>□ Competency examinations</td>
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<tr>
<td>□ Comprehensive written examination</td>
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</tbody>
</table>
### TE-TM-GLS-01: Introduction to Glass Evidence

<table>
<thead>
<tr>
<th>Trainee Initiallys</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
</table>

#### 1 OBJECTIVES

1.1 **Theoretical**
- [ ] Theoretical objectives reviewed

1.2 **Practical**
- [ ] Practical objectives reviewed

#### 2 LESSON PLAN

2.1 **Instructional Outline**
- [ ] Lecture/discussion of definition of glass and its characteristics
- [ ] Lecture/discussion of composition
- [ ] Lecture/discussion of glass types, manufacturing processes, and end uses
  - [ ] Tempered glass
  - [ ] Float glass
  - [ ] Soda-lime-silica glass
  - [ ] Laminated glass
  - [ ] Glass fibers
  - [ ] Other
- [ ] Lecture/discussion of overview of analysis techniques
  - [ ] Visual
  - [ ] Microscopic
  - [ ] Density
  - [ ] Refractive index
  - [ ] Elemental analysis
- [ ] Lecture/discussion of collection of known samples
  - [ ] Crime scene
  - [ ] Laboratory setting
- [ ] Lecture/discussion of transfer and persistence

2.2 **Required Readings**
- [ ] Elemental Analysis of Glass Fragments
<table>
<thead>
<tr>
<th>Topic</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td>The Retention of Glass Particles on Woven Fabrics</td>
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<tr>
<td>The Composition and Manufacture of Glass and its Domestic and Industrial Applications</td>
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<tr>
<td>Forensic Interpretation of Glass Evidence</td>
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<tr>
<td>A Classification Scheme for Glass</td>
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<tr>
<td>Transfer and persistence of Glass Fragments on Garments</td>
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<td>The Forensic Significance of Glass Composition and Refractive Index Measurements</td>
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<tr>
<td>Microscopical Characterization of Glass Fragments</td>
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<td>Microscopical Characterization of Glass Fragments</td>
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<td>Forensic Glass Comparisons</td>
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<td>Glass Exam and Comparison</td>
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<td>Forensic Glass Comparisons</td>
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</table>

2.3 Practical Exercises

- None

2.4 Practical Examination

- None

2.5 Written Exercises

- Provide written responses to all questions

3 CONCLUSION

3.1 Assessment

- Satisfactory completion of written/practical exercises and practical examination assessed by trainer

3.2 Evaluation

- Evaluation of training module and trainer by trainee

OTHER
<table>
<thead>
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<th>Trainee Initials</th>
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<tr>
<td>TE-TM-GLS-02: Initial Evaluation Glass Evidence</td>
<td>Trainee Initials</td>
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<td><strong>1 OBJECTIVES</strong></td>
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<tr>
<td>1.1 Theoretical</td>
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<tr>
<td>- Theoretical objectives reviewed</td>
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<tr>
<td>1.2 Practical</td>
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<tr>
<td>- Practical objectives reviewed</td>
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<tr>
<td><strong>2 LESSON PLAN</strong></td>
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<tr>
<td>2.1 Instructional Outline</td>
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<tr>
<td>- Lecture/discussion of initial examination and identification techniques</td>
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<td>- Recovery</td>
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<td>- Cleaning</td>
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<td>- Polarized light microscope</td>
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<td>- Lecture/discussion of color evaluation</td>
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<td>- Lecture/discussion of thickness measurements</td>
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<tr>
<td>- Lecture/discussion of UV reactions</td>
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<tr>
<td>- Lecture/discussion of fracture processes and characteristics</td>
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<td>- Fracture shapes</td>
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<td>- Concoidal fractures</td>
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<td>- Hackle marks</td>
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<tr>
<td>- Direction of force indicators</td>
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<td>- Radial and concentric cracks</td>
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<td>- Sequence of cracks</td>
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<tr>
<td>- Center frost lines</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>- Lecture/discussion of physical match</td>
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<tr>
<td>- Lecture/discussion of documentation and use of the “Glass Examination” worksheet</td>
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<tr>
<td><strong>2.2 Required Readings</strong></td>
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<tr>
<td>- Glass Initial Examination and Overview SOP</td>
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<tr>
<td>- Some Physical Properties of a Large Number of Window Glass Specimens</td>
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<tr>
<td>- Microscopic Techniques for Glass Examination</td>
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## TE-TM-GLS-02: Initial Evaluation Glass Evidence

<table>
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<th>Trainer Initials/Evaluation</th>
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<tr>
<td>Interpretation of Physical Aspects of Glass Evidence</td>
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<tr>
<td>Glass Fracture Mechanism</td>
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<tr>
<td>Glass Fracture Documentation at the Scene and Reconstruction Techniques</td>
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</tbody>
</table>

### 2.3 Practical Exercises

- Demonstrate how to identify glass from non-glass items given various glass and non-glass materials
- Examine various types of glass and document color, thickness, UV reactions, edge characteristics, and microscopic characteristics using the “Glass Examination” worksheet

### 2.4 Practical Examination

- Examine a set of question and known glass samples and perform a comparison of those samples based on color, thickness, UV reactions, edge characteristics, and microscopic characteristics

### 2.5 Written Exercises

- Provide written responses to all question

### 3 CONCLUSION

#### 3.1 Assessment

- Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

- Evaluation of training module and trainer by trainee

### OTHER
**TE-TM-GLS-03: Determination of Glass Refractive Index**

<table>
<thead>
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<th>Trainee Initials</th>
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<td><strong>1.2 Practical</strong></td>
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</table>

| 2 LESSON PLAN |                  |                |                             |
| **2.1 Instructional Outline** |                  |                |                             |
| Lecture/discussion of refractive index |                  |                |                             |
| Definition |                  |                |                             |
| Measurement techniques |                  |                |                             |
| Variation in glass samples |                  |                |                             |
| Lecture/discussion of GRIM2 |                  |                |                             |
| Theory |                  |                |                             |
| Operation |                  |                |                             |
| Calibration |                  |                |                             |
| QC procedures |                  |                |                             |
| Refractive index oil choice |                  |                |                             |
| Sample preparation |                  |                |                             |
| Measurements and edge counts |                  |                |                             |
| Interpretation |                  |                |                             |

| **2.2 Required Readings** |                  |                |                             |
| Glass Refractive Index Determination SOP |                  |                |                             |
| Discrimination of Glass Sources Using Elemental Composition and Refractive Index: Development of Predictive Models |                  |                |                             |
| Standard Test Method for the Automated Determination of Refractive Index of Glass Samples Using the Oil Immersion Method and a Phase Contrast Microscope |                  |                |                             |
| Factors Affecting the Refractive Index Distribution of Window Glass |                  |                |                             |
## TE-TM-GLS-03: Determination of Glass Refractive Index

<table>
<thead>
<tr>
<th>Task</th>
<th>Trainee Initials</th>
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<th>Trainer Initials/Evaluation</th>
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<tr>
<td>Precision of Glass Refractive Index Measurements: Temperature, Variation, and Double Variation Methods, and the Value of Dispersion</td>
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<tr>
<td>A Study of the Refractive Index Variation Within and Between Sealed Beam Headlight Using a Precise Method</td>
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<td>Precise Refractive Index Determination by the Immersion Method, Using Phase Contrast Microscopy and the Mettler Hot Stage</td>
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<tr>
<td>The Interpretation of Refractive Index Measurements</td>
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<tr>
<td>GRIM2, Installation &amp; Instructional Manual</td>
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<tr>
<td>Glass Comparison Using a Computerized Refractive Index Database</td>
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<td>Distribution of Refractive Index Values in Sheet Glasses</td>
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<tr>
<td>The Forensic Significance of Glass Composition and Refractive Index Measurements</td>
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<tr>
<td>Comparison of Refractive Index, Energy Dispersive S-Ray Fluorescence and Inductively Coupled Plasma-Atomic Emission Spectrometry for Forensic Characterization of Sheet Glass Fragments</td>
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<td>The Variation in Refractive Index and Density Across Two Sheets of Window Glass</td>
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<td>Reference Glasses and Silicone Oils for Refractive Index Determination</td>
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<td>Density, Refractive Index, and Dispersion in the Examination of Glass: Their Relative Worth as Proof</td>
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<tr>
<td>Multiple Refractive Index in Float Glass</td>
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</table>

### 2.3 Practical Exercises

- Measure the refractive index of a set of glass samples using the GRIM2
- Measure the refractive index of various locations of a single glass sample

### 2.4 Practical Examination

- Examine a set of question and known glass samples and perform a comparison of those samples based on refractive index measurements
<table>
<thead>
<tr>
<th>TE-TM-GLS-03: Determination of Glass Refractive Index</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tr>
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<tr>
<td><strong>3 CONCLUSION</strong></td>
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<td><strong>3.1 Assessment</strong></td>
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<td><strong>3.2 Evaluation</strong></td>
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<tr>
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## TE-TM-GLS-04: Interpretation of Glass Evidence

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<th>1 OBJECTIVES</th>
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<th>Trainer Initials/ Evaluation</th>
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<tr>
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<tr>
<td>□ Practical objectives reviewed</td>
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### 2 LESSON PLAN

#### 2.1 Instructional Outline

- □ Lecture/discussion of interpretation, significance, and limitations of glass comparisons and associations
- □ Variations in physical and chemical characteristics within individual samples
- □ Variation within the glass population
- □ Effects of sample size
- □ Quantity and distribution of recovered glass
- □ Persistence of glass transfers
- □ Lecture/discussion of report wording
- □ Lecture/discussion technical and administrative Reviews
- □ Lecture/discussion of court testimony

#### 2.2 Required Readings

- □ The Retention of Glass Particles on Woven Fabrics
- □ The Theory of Interpreting Scientific Transfer Evidence
- □ The Interpretation of Glass Evidence: A Practical Approach
- □ Further Observations of Glass Evidence Interpretation
- □ Value of Glass as Evidence
- □ A Survey of the Distribution of Glass on Clothing
- □ Statistical Interpretation of Glass Evidence
- □ On the Problem of Assessing the Evidential Value of Glass Fragments Embedded in
## TE-TM-GLS-04: Interpretation of Glass Evidence

<table>
<thead>
<tr>
<th>Footwear</th>
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<tr>
<td><strong>2.3 Practical Exercises</strong></td>
</tr>
<tr>
<td>- [ ] Review reports written by experienced examiners</td>
</tr>
<tr>
<td>- [ ] Issue reports based on various case scenarios and/or mock evidence results</td>
</tr>
<tr>
<td>- [ ] Review completed case folders</td>
</tr>
<tr>
<td>- [ ] Perform technical reviews on non-reviewed case folders</td>
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<tr>
<td>- [ ] Observe actual testimony by an experienced glass examiner</td>
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<tr>
<td><strong>2.4 Practical Examination</strong></td>
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<tr>
<td>- [ ] None</td>
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<tr>
<td><strong>2.5 Written Exercises</strong></td>
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<tr>
<td>- [ ] Provide written responses to all question</td>
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<tr>
<td><strong>3 CONCLUSION</strong></td>
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<tr>
<td><strong>3.1 Assessment</strong></td>
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<tr>
<td>- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer</td>
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<td><strong>3.2 Evaluation</strong></td>
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<td>- [ ] Evaluation of training module and trainer by trainee</td>
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**OTHER**
### TE-TM-GLS-05: Glass Analysis by X-Ray Fluorescence

#### 1 OBJECTIVES

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<th>Theoretical</th>
<th>Practical</th>
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<tbody>
<tr>
<td>Theoretical objectives reviewed</td>
<td>Practical objectives reviewed</td>
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</table>

#### 2 LESSON PLAN

##### 2.1 Instructional Outline

- Lecture/discussion of elemental composition of various glass types
- Lecture/discussion of XRF theory
- Lecture/discussion of instrument familiarization
- Lecture/discussion of instrument operation
  - Operating parameters
  - Calibration
  - QC procedures
  - Sample preparation
  - Element identification
  - Spectral comparisons (overlays)
  - Elemental ratio analysis
- Lecture/discussion of limitations
  - Element range
  - Concentration
  - Sample size
- Lecture/discussion of interpretation

##### 2.2 Required Readings

- Elemental Analysis of Glass Fragments
- Eagle III μ–EDXRF User School Notebook
- Elemental Analysis of Glass
- The Analysis of Small Glass Fragments Using Energy Dispersive X-Ray Fluorescence Spectrometry
## TE-TM-GLS-05: Glass Analysis by X-Ray Fluorescence

| Comparison of Refractive Index, energy Dispersive S-Ray Fluorescence and Inductively Coupled Plasma-Atomic Emission Spectrometry for Forensic Characterization of Sheet Glass Fragments | Trainee Initials | Date Completed | Trainer Initials/Evaluation |
| Analysis of ‘As-Is’ Glass Particulates Using μ-Beam EDXRF Methods |
| Atomic X-Ray Spectroscopy |

### 2.3 Practical Exercises

- Analyze various glass samples to identify their elemental compositions
- Analyze glass samples and compare them using spectral overlays and elemental ratios

### 2.4 Practical Examination

- Examine a set of question and known glass samples and perform a comparison of those samples based on XRF analysis

### 2.5 Written Exercises

- Provide written responses to all question

### 3 CONCLUSION

#### 3.1 Assessment

- Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

- Evaluation of training module and trainer by trainee

### OTHER
Trainee Name __________________________

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<thead>
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<th>Unit Examination and Competency</th>
<th>Trainee Initials</th>
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<th>Trainer Initials/ Evaluation</th>
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## 1 OBJECTIVES

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</table>

### 1.1 Theoretical

- Theoretical objectives reviewed

### 1.2 Practical

- Practical objectives reviewed

## 2 LESSON PLAN

### 2.1 Instructional Outline

- Lecture/discussion of tungsten filament characteristics
  - Physical properties
  - Oxidation states
  - Incandescence process
  - Halogen cycle
  - Water cycle
- Lecture/discussion of coil manufacturing processes
  - Retractable mandrel process
  - Continuous coil process
- Lecture/discussion of lamp construction
  - B style bulbs
  - C style bulbs
  - Other bulb styles
  - Posts and supports
  - Getter
  - Bases
- Lecture/discussion of specific automotive bulbs and locations in vehicles
- Lecture/discussion of collection of evidence samples
  - Crime scene
  - Laboratory setting
### TE-TM-LAMP-01: Introduction to Filament Evidence

<table>
<thead>
<tr>
<th>Section</th>
<th>Required Readings</th>
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<th>Trainer Initials/Evaluation</th>
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<td>2.2</td>
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<td>Lamp Examination for On or Off in Traffic Accidents</td>
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<td></td>
<td>Vehicle Lights and Their Use as Evidence</td>
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<td>2.3</td>
<td>Practical Exercises</td>
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<td>Examine multiple styles of vehicle bulbs noting the different components that are present</td>
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<td>2.5</td>
<td>Written Exercises</td>
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<td>Provide written responses to all questions</td>
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### 3 CONCLUSION

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### OTHER

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<td><strong>1.2 Practical</strong></td>
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<td><strong>2 LESSON PLAN</strong></td>
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<td><strong>2.1 Instructional Outline</strong></td>
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<td>☐ Lecture/discussion of normal use lamp characteristics</td>
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<td>☐ Mechanical distortions</td>
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<td>☐ Squirm</td>
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<td>☐ Age sag</td>
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<td>☐ Pitting</td>
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<td>☐ Lecture/discussion of damage characteristics</td>
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<td>☐ Hot shock or thermal shock</td>
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<td>☐ Broken glass envelope</td>
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<td>☐ Burnouts</td>
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<td>☐ Water exposure</td>
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<td>☐ Glass etching</td>
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<td>☐ Lecture/discussion of lamp examinations</td>
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<td>☐ Stereoscopic examinations and photography</td>
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<td>☐ Techniques for breaking glass envelopes</td>
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<tr>
<td>Lecture/discussion of interpretation and significance of the observations</td>
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### 2.2 Required Readings

- Lamp Filament Examinations SOP
- Lamp Examination for On or Off in Traffic Accidents
- The Effect of Impact on the Filaments of Quartz Halogen Headlamps
- Determination of the Temperature of the Filament Adjacent to the Incandescent Filament in a Double Beam Headlight
- Interpretation of Vehicle Globe Failures – The Unlit Condition
- Metallurgical Investigation of Component Failures
- Switched On?
- Lamp Filaments – A Method of Determining Whether Lights were “On” or “Off”
- Noninvasive Evaluation of Vehicular Lamp Bulbs
- Examination of Lightbulb Filaments After a Car Crash: Difficulties in Interpreting the Results

### 2.3 Practical Exercises

- Demonstrate the breaking of bulbs of lamps and expose the bare filaments without damaging the filaments
- Correctly identify at least one example of each of the following:
  - Age-sag
  - Pitting
  - Tungsten deposition
  - Various oxidation states (blackening and secondary colors)
  - Oxide dust/deposits
  - Hot shock distortion
  - Angular breaks
### TE-TM-LAMP-02: Lamp Filament Examination

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<td>☐ Normal functioning burnout</td>
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<tr>
<td>☐ Bring lamps of various types to incandescence and determine how much</td>
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<tr>
<td>comparative force is needed to produce significant distortion</td>
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<td>☐ Demonstrate the proper way to operate an ohmmeter on at least one</td>
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<tr>
<td>sealed-lamp, one B-type lamp and one halogen lamp</td>
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#### 2.4 Practical Examination

<table>
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<td>☐ Examine various style bulbs and determine if the bulbs were on or</td>
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#### 2.5 Written Exercises

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<td>☐ Provide written responses to all questions</td>
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#### 3 CONCLUSION

#### 3.1 Assessment

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#### 3.2 Evaluation

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<td>TE-TM-LAMP-03: Interpretation of Filament Evidence</td>
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<td>Date Completed</td>
<td>Trainer Initials/Evaluation</td>
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<tr>
<td>2.1 Instructional Outline</td>
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<tr>
<td>☐ Lecture/discussion of the significance of filament examinations</td>
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<td>☐ Lecture/discussion technical and administrative Reviews</td>
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<td>☐ Lecture/discussion of court testimony</td>
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<td>☐ Lamp Filament Examinations SOP</td>
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<td>☐ Lamp Examination for On or Off in Traffic Accidents</td>
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<tr>
<td>2.3 Practical Exercises</td>
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<tr>
<td>☐ Review filament examination reports written by experienced examiners</td>
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<tr>
<td>☐ Issue reports based on results given various case scenarios and/or mock evidence</td>
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<td>☐ Review completed case folders</td>
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<tr>
<td>☐ Perform technical reviews on non-reviewed case folders</td>
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<tr>
<td>☐ Observe actual testimony by an experienced filament examiner</td>
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<td>2.4 Practical Examination</td>
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<tr>
<td>☐ None</td>
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<tr>
<td>2.5 Written Exercises</td>
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<tr>
<td>☐ Provide written responses to all questions</td>
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</table>
### TE-TM-LAMP-03: Interpretation of Filament Evidence

<table>
<thead>
<tr>
<th>3 CONCLUSION</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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<tr>
<td>3.1 Assessment</td>
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<td>□ Satisfactory completion of written/practical exercises and practical examination assessed by trainer</td>
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<td>3.2 Evaluation</td>
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<tr>
<td>□ Evaluation of training module and trainer by trainee</td>
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### Unit Examination and Competency

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<tr>
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<td>□ Comprehensive written examination</td>
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## TE-TM-HAIR-01: Introduction to Hair

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<th>Date Completed</th>
<th>Trainer Initials/ Evaluation</th>
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</table>

### 1 OBJECTIVES

#### 1.1 Theoretical

- [ ] Theoretical objectives reviewed

#### 1.2 Practical

- [ ] Practical objectives reviewed

### 2 LESSON PLAN

#### 2.1 Instructional Outline

- [ ] Lecture/discussion of the history and development of forensic examination and comparisons of hair evidence and the current state of hair evidence
- [ ] Lecture/discussion of the structure and chemical composition of human hair
- [ ] Lecture/discussion of the growth cycle and root stages of human hair
- [ ] Lecture/discussion of wig hair
- [ ] Lecture/discussion of transfer and persistence
- [ ] Lecture/discussion of hair examinations and comparisons
- [ ] Lecture/discussion of hair conclusions

#### 2.2 Required Readings

- [ ] The Forensic Identification and Association of Human Hair
- [ ] Proceedings of the International Symposium on Forensic Hair Comparisons
- [ ] Microscopy of Hair
- [ ] Atlas of Human Hair Microscopic Characteristics
- [ ] Forensic Examination of Hair

#### 2.3 Practical Exercises

- [ ] None

#### 2.4 Practical Examination

- [ ] None

#### 2.5 Written Exercises

- [ ] Provide written responses to all questions
### 3 CONCLUSION

#### 3.1 Assessment

- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

- [ ] Evaluation of training module and trainer by trainee

#### OTHER

- [ ]
- [ ]
- [ ]
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- [ ]
## TE-TM-HAIR-02: Macroscopic Examination and Comparisons of Human Hair

<table>
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<tr>
<th>1 OBJECTIVES</th>
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<tr>
<td>1.2 Practical</td>
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### 2 LESSON PLAN

#### 2.1 Instructional Outline

- Lecture/discussion of macroscopic characteristics
  - Human
    - Head hair
    - Pubic hair
    - Body hair
  - Animal
- Lecture/discussion of visual and macroscopic differences of human hairs from common animal hairs and fibers
  - Diameter
  - Color (shade, uniformity, and banding)
  - Luster
  - Length
  - Cross-sectional shape
- Lecture/discussion of macroscopic characteristics of roots
  - Anagen
  - Catagen
  - Telogen
- Presence of tissue
- Lecture/discussion of required documentation for a macroscopic comparison
  - Length
  - Root
  - Color
### TE-TM-HAIR-02: Macroscopic Examination and Comparisons of Human Hair

<table>
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<td>Lecture/discussion of criteria for an association and the limitations of a macroscopic association</td>
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<td>Lecture/discussion of factors that may affect a macroscopic hair comparison</td>
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<td>Sample size</td>
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#### 2.2 Required Readings

- Macroscopic Examination of Hair SOP
- Microscopy of Hair
- Atlas of Human Hair: Microscopic Characteristics
- Forensic Examination of Hair

#### 2.3 Practical Exercises

- Macroscopically examine and document human hairs, animal hairs, and fibers
- Examine and document the macroscopic characteristics of head hair, pubic hair, and body hair
- Collect 10 hairs in different growth cycles (pulling and combing) and document the presence or absence of a root and tissue
- Determine the criteria of an association by comparing one hair designated as the question hair to the known hair of the same individual

#### 2.4 Practical Examination

- Determine if question material is human hair, animal hair, or fibers based on the macroscopic characteristics
- Determine somatic origin and the presence/absence of a root of an unknown set of hairs based on the macroscopic characteristics

#### 2.5 Written Exercises

- Provide written responses to all questions
### TE-TM-HAIR-02: Macroscopic Examination and Comparisons of Human Hair

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<th>Trainee Initials</th>
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#### 3 CONCLUSION

**3.1 Assessment**

- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer

**3.2 Evaluation**

- [ ] Evaluation of training module and trainer by trainee

#### OTHER
<table>
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<td><strong>2 LESSON PLAN</strong></td>
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<tr>
<td><strong>2.1 Instructional Outline</strong></td>
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<tr>
<td>[ ] Lecture/discussion of macroscopic characteristics of various known animal guard and fur hair</td>
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<td>[ ] Roots</td>
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<td>[ ] Medulla</td>
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<td>[ ] Pigmentation</td>
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<td>[ ] Scales</td>
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<td>[ ] Other pertinent characteristics</td>
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<td>[ ] Lecture/discussion of different microscopical characteristics between animal and human hairs</td>
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<td>[ ] Medullary pattern</td>
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<td>[ ] Tips</td>
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<td>[ ] Color and banding</td>
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<tr>
<td>[ ] Shape</td>
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<td>[ ] Diameter</td>
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<tr>
<td>[ ] Lecture/discussion of scale casting methods</td>
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<tr>
<td>[ ] Nail polish (clear)</td>
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<tr>
<td>[ ] Polaroid coater</td>
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<td>[ ] Lecture/discussion of animal hair examination</td>
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<tr>
<td>[ ] Conclusions</td>
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<td>[ ] Limitations of hair comparisons</td>
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<tr>
<td><strong>2.2 Required Readings</strong></td>
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<tr>
<td>☐ Species Determination of Hair SOP</td>
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<tr>
<td>☐ Microscopy of Hair</td>
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<td>☐ Matthews’ Textile Fibers</td>
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<tr>
<td>☐ Rapid Method of Preparing Hair Cuticle Scale Casts</td>
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<tr>
<td>☐ Material Safety Data Sheets for Xylene, Permoun, Polaroid Film Coater, Acetone, Fingernail Polish (Clear)</td>
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<td><strong>2.3 Practical Exercises</strong></td>
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<tr>
<td>☐ Perform nail polish and Polaroid coater scale casting techniques on a minimum of five (5) animal hairs</td>
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<tr>
<td>☐ Microscopically examine and document microscopic characteristics of a minimum of ten (10) animal hairs including dog, cat, rabbit, cow, horse, and deer</td>
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<tr>
<td><strong>2.4 Practical Examination</strong></td>
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<tr>
<td>☐ Microscopically determine if a minimum of 10 hairs are human or animal and document the microscopic characteristics used to support those conclusions</td>
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<tr>
<td>☐ Microscopically determine the family of animal hairs of a set of unknown common animal hairs and document relevant microscopic characteristics</td>
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<tr>
<td><strong>2.5 Written Exercises</strong></td>
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<tr>
<td>☐ Provide written responses to all questions</td>
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Trainee Name __________________________

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<thead>
<tr>
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<tr>
<td><strong>3 CONCLUSION</strong></td>
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<td>3.1 Assessment</td>
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<tr>
<td>√ Satisfactory completion of written/practical exercises and practical examination assessed by trainer</td>
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<tr>
<td>3.2 Evaluation</td>
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<td>√ Evaluation of training module and trainer by trainee</td>
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### TE-TM-HAIR-04: Microscopic Characteristics of Human Hair

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<td>□ Theoretical objectives reviewed</td>
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</tr>
<tr>
<td>2 LESSON PLAN</td>
</tr>
<tr>
<td>2.1 Instructional Outline</td>
</tr>
<tr>
<td>□ Lecture/discussion of method of mounting with an appropriate medium and proper documentation of hair slides</td>
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<tr>
<td>□ Lecture/discussion of microscopic observations</td>
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<tr>
<td>□ Type of root growth stages</td>
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<td>□ Medulla</td>
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<tr>
<td>□ Pigmentation</td>
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<td>□ Cortical fusi</td>
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<tr>
<td>□ Ovoid bodies</td>
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<tr>
<td>□ Cuticle</td>
</tr>
<tr>
<td>□ Damage areas</td>
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<td>□ Demarcation lines</td>
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<td>□ Characteristics of diseases</td>
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<td>□ Characteristics of artificial treatment</td>
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<td>□ Other pertinent characteristics</td>
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<tr>
<td>□ Lecture/discussion of microscopic observations of Caucasian, Negroid, and Mongoloid hairs and the differences between each</td>
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<tr>
<td>□ Lecture/discussion of cross-section of Caucasian, Negroid, and Mongoloid head hairs and the differences between each</td>
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<tr>
<td>□ Lecture/discussion of the difference between head hair, pubic hair, and body hair</td>
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<tr>
<td>Lecture/discussion of procedures for demounting hairs from slides that are going to be DNA tested</td>
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<tr>
<td>Liquid nitrogen method</td>
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<td>Xylene method</td>
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<td>Lecture/discussion of suitability for DNA analysis</td>
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<td>Nuclear DNA</td>
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<td>Mitochondrial DNA testing</td>
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</table>

### 2.2 Required Readings

- Racial Characteristics and Somatic Origin Determination of Human Hair SOP
- Microscopy of Hair
- Atlas of Human Hair: Microscopical Characteristics
- Forensic Examination of Hair

### 2.3 Practical Exercises

- Demonstrate the method of mounting with permount, making proper documentation on the hair slides, and demounting hairs
- Mount Caucasian, Negroid, and Mongoloid head hair and pubic hair and examine and document the microscopic characteristics
- Roots
- Medulla
- Pigmentation
- Cortical fusi
- Ovoid bodies
- Cuticle
- Other pertinent characteristics
- Mount, examine, and document relevant microscopic characteristics of body hair including chest, beard/mustache, underarm hairs, eyebrow, eyelash, and trunk hair
- Microscopically examine the growth cycles and status of the root sheath for a minimum of ten head hairs (pulled and combed)
Trainee Name ________________________________

<table>
<thead>
<tr>
<th>TE-TM-HAIR-04: Microscopic Characteristics of Human Hair</th>
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<th>Date Completed</th>
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<tr>
<td><strong>2.4 Practical Examination</strong></td>
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<tr>
<td>□ Identify somatic origin of at least ten human hairs</td>
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<tr>
<td>□ Identify racial origin of at least ten head and pubic hairs</td>
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<tr>
<td><strong>2.5 Written Exercises</strong></td>
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<tr>
<td>□ Provide written responses to all questions</td>
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<tr>
<td><strong>3 CONCLUSION</strong></td>
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<td><strong>3.2 Evaluation</strong></td>
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<tr>
<td>□ Evaluation of training module and trainer by trainee</td>
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Trainee Name ____________________________

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<tr>
<td>□ Theoretical objectives reviewed</td>
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<td><strong>1.2 Practical</strong></td>
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<tr>
<td>□ Practical objectives reviewed</td>
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<tr>
<td><strong>2 LESSON PLAN</strong></td>
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<tr>
<td><strong>2.1 Instructional Outline</strong></td>
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<td>□ Lecture/discussion of microscope set-up</td>
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<td>□ Proper procedure on how to set-up and operate the comparison microscope (Köhler illumination)</td>
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<td>□ Color balance the light source and correct any defects in the system using two slides containing the same hair</td>
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<td>□ Lecture/discussion of microscopic characteristics of human hairs used in comparison</td>
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<td>□ Lecture/discussion of suitability of hairs for microscopic comparison</td>
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<td>□ Fragments</td>
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<td>□ Lecture/discussion of factors that affect a microscopic comparison and/or conclusions</td>
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<tr>
<td>□ Improper Köhler illumination</td>
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<td>□ Insufficient representative sample</td>
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<tr>
<td>□ Time lapse between transfer of question hair to collection of known hair</td>
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<tr>
<td>□ Known hair samples consisting of cut hairs</td>
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<td>□ Known hair samples consisting of hairs from a hair brush</td>
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<tr>
<td>□ Known hair samples consisting of hairs less than 1/2 inch</td>
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<tr>
<td>□ Known hair samples consisting of hair that have been artificially colored soon after the date of offense</td>
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<td>TE-TM-HAIR-05: Microscopic Comparison of Human Hair</td>
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<tr>
<td><strong>2.2 Required Readings</strong></td>
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<td>[ ] Human Hair Comparison SOP</td>
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<td>[ ] Microscopy of Hair</td>
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<tr>
<td>[ ] Atlas of Human Hair: Microscopic Characteristics</td>
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<td>[ ] Forensic Examination of Hair</td>
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<tr>
<td>[ ] Probabilities and Human Hair Comparison</td>
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<tr>
<td>[ ] Microscopical Discrimination of Twins’ Head Hair</td>
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<td>[ ] Proceedings of the International Symposium on Forensic Hair Comparison</td>
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<tr>
<td>[ ] An Attempt at Determining Probabilities in Human Scalp Hair Comparison</td>
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<tr>
<td>[ ] Probabilities and Human Hair Comparisons</td>
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<tr>
<td>[ ] Secondary Transfer of Human Scalp Hair</td>
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<tr>
<td>[ ] Some Further Thought on Probabilities and Human Hair Comparisons</td>
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<tr>
<td>[ ] A Supplementary Discussion on Probabilities and Human Hair Comparisons</td>
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<tr>
<td>[ ] Assessment of Information Gained from the Microscopical Comparison of Hair Samples</td>
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<tr>
<td>[ ] Strong Negative Conclusions in Hair Comparison – A Rare Event</td>
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<tr>
<td>[ ] Further Evaluation of Probabilities in Human Scalp Hair Comparisons</td>
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<tr>
<td>[ ] Human Hair Histogenesis for the Mitochondrial DNA Forensic Scientist</td>
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<tr>
<td>[ ] Correlation of Microscopic and Mitochondrial DNA Hair Comparisons</td>
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<tr>
<td><strong>2.3 Practical Exercises</strong></td>
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<tr>
<td>[ ] Prepare slides to assist in balancing the illumination of the microscope using a brown, black, or red hair</td>
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<tr>
<td>[ ] Collect hairs from at least 5 different known sources</td>
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<tr>
<td>TE-TM-HAIR-05: Microscopic Comparison of Human Hair</td>
<td>Trainee Initials</td>
<td>Date Completed</td>
<td>Trainer Initials/ Evaluation</td>
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<tr>
<td>□ Mount a representative sample from the 5 different collected hair samples, microscopically examine the known hair samples, and document the microscopic characteristic as well as the variation within the known sample</td>
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<tr>
<td>□ Mount 1 hair from each of the 5 different collected hair samples for a question hair and compare this hair to its known source and to all other known mounted hairs to determine the criteria of an association and the significance of any differences</td>
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<tr>
<td>2.4 Practical Examination</td>
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<tr>
<td>□ Determine if any question hairs could have originated from the known samples when given a minimum of 5 sets of question and known hairs</td>
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<tr>
<td>□ Document the microscopic characteristics, the variation of the known samples, and the conclusion of the comparison</td>
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<tr>
<td>2.5 Written Exercises</td>
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<tr>
<td>□ Provide written responses to all questions</td>
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<tr>
<td>3 CONCLUSION</td>
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<tr>
<td>3.1 Assessment</td>
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<tr>
<td>□ Satisfactory completion of written/practical exercises and practical examination assessed by trainer</td>
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<td>3.2 Evaluation</td>
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<tr>
<td>□ Evaluation of training module and trainer by trainee</td>
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<tr>
<td>OTHER</td>
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</table>
## TE-TM-HAIR-06: Interpretation of Hair Evidence

<table>
<thead>
<tr>
<th>1 OBJECTIVES</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td><strong>1.1 Theoretical</strong></td>
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<tr>
<td>[ ] Theoretical objectives reviewed</td>
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<tr>
<td><strong>1.2 Practical</strong></td>
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<tr>
<td>[ ] Practical objectives reviewed</td>
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</table>

### 2 LESSON PLAN

#### 2.1 Instructional Outline

- [ ] Lecture/discussion of the interpretation, significance, and limitations of hair examinations/comparisons and associations
- [ ] Variations within known samples
- [ ] Variation within the population
- [ ] Color, condition, and characteristics of hair
- [ ] Quantity and location of recovered hair and the relationship between the individuals/scene
- [ ] Root stage
- [ ] Time lapse between transfer of questioned hairs and collection of known hairs
- [ ] Lecture/discussion of why probative hair associations in casework must be verified by a second examiner
- [ ] Lecture/discussion of why hair comparisons are not means of absolute personal identification
- [ ] Lecture/discussion of why the disclaimer “It is recognized that hair comparisons do not constitute a basis for absolute personal identification” should be part of a probative association
- [ ] Lecture/discussion of report wording for
  - Hair from the questioned (Q) source exhibit the same microscopic characteristics as the hairs in a known (K) hair sample
  - Hairs from the questioned source are microscopically dissimilar to the hairs in a known hair sample
Questioned hairs exhibit both similarities and slight differences to hairs found in a known hair sample and no conclusion can be reached whether they could have originated from the known source.

Lecture/discussion of technical and administrative reviews

Lecture/discussion of court testimony

2.2 Required Readings

- Human Hair Comparison SOP
- Microscopy of Hair
- Atlas of Human Hair: Microscopic Characteristics
- Forensic Examination of Hair
- Probabilities and Human Hair Comparison
- Microscopical Discrimination of Twins’ Head Hair
- Proceedings of the International Symposium on Forensic Hair Comparison
- An Attempt at Determining Probabilities in Human Scalp Hair Comparison
- Probabilities and Human Hair Comparisons
- Secondary Transfer of Human Scalp Hair
- Some Further Thought on Probabilities and Human Hair Comparisons
- A Supplementary Discussion of Probabilities and Human Hair Comparisons
- Assessment of Information Gained from the Microscopical Comparison of Hair Samples
- Strong Negative Conclusions in Hair Comparison – A Rare Event
- Further Evaluation of Probabilities in Human Scalp Hair Comparisons
- Human Hair Histogenesis for the Mitochondrial DNA Forensic Scientist
- Correlation of Microscopic and Mitochondrial DNA Hair Comparisons
### TE-TM-HAIR-06: Interpretation of Hair Evidence

<table>
<thead>
<tr>
<th>2.3 Practical Exercises</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/ Evaluation</th>
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<tbody>
<tr>
<td>Review reports written by experienced examiners</td>
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<tr>
<td>Issue reports based on various case scenarios and/or mock evidence results</td>
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<tr>
<td>Review completed case folders</td>
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<tr>
<td>Perform technical reviews on non-reviewed case folders</td>
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<tr>
<td>Observe actual testimony by an experienced hair examiner</td>
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<thead>
<tr>
<th>2.4 Practical Examination</th>
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<th>Trainer Initials/ Evaluation</th>
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<tbody>
<tr>
<td>Provide written responses to all questions</td>
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### 3 CONCLUSION

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<tr>
<th>3.1 Assessment</th>
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<th>3.2 Evaluation</th>
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<tbody>
<tr>
<td>Evaluation of training module and trainer by trainee</td>
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### OTHER

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<tr>
<th>Unit Examination and Competency</th>
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<td>Competency examinations</td>
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<td>Comprehensive written examination</td>
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### 1 OBJECTIVES

<table>
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<tr>
<th>1.1 Theoretical</th>
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<th>Trainer Initials/Evaluation</th>
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- Theoretical objectives reviewed

<table>
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<tr>
<th>1.2 Practical</th>
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- Practical objectives reviewed

### 2 LESSON PLAN

#### 2.1 Instructional Outline

<table>
<thead>
<tr>
<th>Lecture/discussion of classification of different types of paints</th>
<th>Trainee Initials</th>
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<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td>Automobile</td>
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<tr>
<td>Architectural</td>
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<td>Maintenance</td>
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<tr>
<td>Other end uses</td>
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</table>

- Lecture/discussion of classification of generic polymers
  - Plastics
  - Rubber
  - Substrates
  - Other polymers

- Lecture/discussion of general aspects of paint/polymer examination
  - Color
  - Layer sequence
  - Chemical solubility and microchemical tests
  - Binder type
  - Polymer classification
  - Chemical composition

#### 2.2 Required Readings

<table>
<thead>
<tr>
<th>Required Readings</th>
<th>Trainee Initials</th>
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<th>Trainer Initials/Evaluation</th>
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</table>

- Techniques of Crime Scene Investigation
- Forensic Paint Examination
- Composition, Manufacture and Use of Paint
- Auto Refinishing Handbook
### TE-TM-PNT-01: Introduction to Paint and Polymer Evidence

<table>
<thead>
<tr>
<th>Topic</th>
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<tbody>
<tr>
<td>☐ Forensic Analysis of Automotive Paints at the Bundeskriminalamt: The Evidential Value of Automotive Paints</td>
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<td>☐ Evaluation of Automotive Paint Flakes as Evidence</td>
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<td>☐ A Survey of the Evidential Value of Paint Transfer Evidence</td>
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<td>☐ Forensic Paint Analysis and Comparison Guidelines</td>
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<tr>
<td>☐ Trace Evidence Recovery Guidelines</td>
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<tr>
<td>☐ Microscopy and Microchemistry of Physical Evidence</td>
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</table>

#### 2.3 Practical Exercises

☐ None

#### 2.4 Practical Examination

☐ None

#### 2.5 Written Exercises

☐ Provide written responses to all questions

### 3 CONCLUSION

#### 3.1 Assessment

☐ Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

☐ Evaluation of training module and trainer by trainee

### OTHER

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</table>
## 1 OBJECTIVES

### 1.1 Theoretical
- Theoretical objectives reviewed

### 1.2 Practical
- Practical objectives reviewed

## 2 LESSON PLAN

### 2.1 Instructional Outline
- Lecture/discussion of physical characteristics of paint and polymers (color, texture, effects, etc.)
- Lecture/discussion of cross-section of paint samples and examination of cross-sections
- Lecture/discussion of solubility and micro-chemical tests of samples and interpretation of results
- Lecture/discussion of macroscopic and microscopic comparison of samples

### 2.2 Required Readings
- Paint Initial Examination and Overview SOP
- Paint Chemical Reactivity SOP
- Forensic Paint Analysis and Comparison Guidelines
- Standard Guide for Forensic Paint Analysis and Comparison
- An Evaluation of Common Methods and Paint Analysis
- Solubility Characterization of Automotive Paints
- Microscopy and Microchemistry of Physical Evidence

### 2.3 Practical Exercises
- Describe the following for known automotive and architectural paints, plastic, and rubber samples:
  - Color and effect
  - Texture
  - Layer sequence
### TE-TM-PNT-02: Initial Evaluation of Paint and Polymer Evidence

- **Chemical properties**
- **2.4 Practical Examination**
  - Determine the following for automotive and architectural paints, plastic, and rubber samples:
    - Color and effect
    - Texture
    - Layer sequence
    - Chemical properties
  - Prepare a written report on the results of the practical examination
- **2.5 Written Exercises**
  - Provide written responses to all questions
- **3 CONCLUSION**
  - **3.1 Assessment**
    - Satisfactory completion of written/practical exercises and practical examination assessed by trainer
  - **3.2 Evaluation**
    - Evaluation of training module and trainer by trainee

### Table

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<tr>
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Trainee Name ________________________________

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<th>Trainee Initials</th>
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<tr>
<td><strong>1 OBJECTIVES</strong></td>
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<tr>
<td>1.1 Theoretical</td>
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<tr>
<td>□ Theoretical objectives reviewed</td>
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<td>1.2 Practical</td>
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<td>□ Practical objectives reviewed</td>
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<tr>
<td><strong>2 LESSON PLAN</strong></td>
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<tr>
<td>2.1 Instructional Outline</td>
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<tr>
<td>□ Lecture/discussion of the theory and application of FTIR spectroscopy related to the examination of paint and polymers</td>
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<tr>
<td>□ Lecture/discussion of the preparation of paint/polymer samples and the use and maintenance of infrared spectrometer</td>
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<tr>
<td>□ Lecture/discussion of paint binder and extender classification based on FTIR spectra</td>
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<tr>
<td>□ Lecture/discussion of general polymer classification based on FTIR spectra</td>
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<td>□ Lecture/discussion of the comparison of FTIR spectra</td>
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<tr>
<td>2.2 Required Readings</td>
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<tr>
<td>□ FTIR SOP</td>
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<tr>
<td>□ Forensic Paint Analysis and Comparison Guidelines</td>
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<tr>
<td>□ Infrared Microspectroscopy of Forensic Paint Evidence</td>
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<tr>
<td>□ A Comparison of Pyrolysis Mass Spectrometry, Pyrolysis Gas Chromatography and Infra-red Spectroscopy for the Analysis of Paint Resins</td>
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<tr>
<td>□ Automotive Paint Database, P.D.Q. User Manual</td>
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<tr>
<td>□ Infrared Microscopy and Its Forensic Applications</td>
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<td>2.3 Practical Exercises</td>
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<tr>
<td>□ Determine the classification of automotive and architectural paints with known binder and extender composition and general polymer samples:</td>
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<tr>
<td>□ Acrylic paint</td>
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<tr>
<td>□ Alkyd and polyester paint</td>
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### TE-TM-PNT-03: Infrared Microspectroscopy Classification of Paints and Polymers

<table>
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<td>Lacquer paint</td>
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</tr>
<tr>
<td>Latex paint</td>
<td></td>
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<tr>
<td>Rubber (including car parts such as tires, bumpers, and door guards)</td>
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<tr>
<td>Plastic</td>
<td></td>
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</tbody>
</table>

#### 2.4 Practical Examination

- [ ] Determine the binder and extender classifications and possible associations of automotive and architectural paints provided by trainer
- [ ] Determine polymer classification and possible associations of plastic and rubber samples provided by trainer
- [ ] Prepare a written report on the results of the practical examination

#### 2.5 Written Exercises

- [ ] Provide written responses to all questions

### 3 CONCLUSION

#### 3.1 Assessment

- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

- [ ] Evaluation of training module and trainer by trainee

### OTHER
## TE-TM-PNT-04: Pyrolysis Gas Chromatography of Paints and Polymers

<table>
<thead>
<tr>
<th>1 OBJECTIVES</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Theoretical</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Theoretical objectives reviewed</td>
<td></td>
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<tr>
<td>1.2 Practical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical objectives reviewed</td>
<td></td>
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</tbody>
</table>

## 2 LESSON PLAN

### 2.1 Instructional Outline

- Lecture/discussion of the theory and application of pyrolysis gas chromatography related to the examination of paint and polymers
- Lecture/discussion of the preparation of paint samples and the use and maintenance of the pyrolysis gas chromatograph
- Lecture/discussion of the interpretation and comparison of pyrograms

### 2.2 Required Readings

- PGC SOP
- Forensic Paint Analysis and Comparison Guidelines
- A Comparison of Pyrolysis Mass Spectrometry, Pyrolysis Gas Chromatography and Infra-red Spectroscopy for the Analysis of Paint Resins
- Pyrolysis-Gas Chromatographic Examination of Paints
- Standard Guide for Forensic Paint Analysis and Comparison
- Manufacturer’s Operating Manual for the Chemical Data System Pyroprobe 1000
- Pyrolysis Capillary Gas Chromatography/Mass Spectrometry for Analysis of Automotive Paints
- Analytical Pyrolysis: An Overview with Forensic Applications
- Recent Changes in Automotive Paint Formulation Using Pyrolysis Chromatography/Mass Spectrometry

### 2.3 Practical Exercises

- Obtain and compare programs of various automotive and architectural paints of known composition
### TE-TM-PNT-04: Pyrolysis Gas Chromatography of Paints and Polymers

<table>
<thead>
<tr>
<th>2.4 Practical Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Obtain and compare programs to determine possible associations of automotive and architectural paints, plastics, and rubbers</td>
</tr>
<tr>
<td>☐ Prepare a written report on the results of the practical examination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.5 Written Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Provide written responses to all questions</td>
</tr>
</tbody>
</table>

### 3 CONCLUSION

<table>
<thead>
<tr>
<th>3.1 Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Satisfactory completion of written/practical exercises and practical examination assessed by trainer</td>
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<table>
<thead>
<tr>
<th>3.2 Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Evaluation of training module and trainer by trainee</td>
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OTHER
### TE-TM-PNT-05: Paint Data Query

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<thead>
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<tbody>
<tr>
<td>1.1 Theoretical</td>
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<tr>
<td>☐ Theoretical objectives reviewed</td>
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</tr>
<tr>
<td>1.2 Practical</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>☐ Practical objectives reviewed</td>
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<table>
<thead>
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<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Instructional Outline</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>☐ Lecture/discussion of paint examinations</td>
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<td></td>
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<tr>
<td>☐ OEM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Repaint systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Lecture/discussion of FTIR and spectral coding</td>
<td></td>
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<tr>
<td>☐ Binders</td>
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<td></td>
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<tr>
<td>☐ Extenders</td>
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<td></td>
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<tr>
<td>☐ Substrates</td>
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<tr>
<td>☐ Lecture/discussion of Munsell Color Coordinate System books for primer coding</td>
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<tr>
<td>☐ Lecture/discussion of Paint Data Query</td>
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</tr>
<tr>
<td>☐ PDQ participants and requirements</td>
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</tr>
<tr>
<td>☐ Database content and sample information</td>
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<tr>
<td>☐ PDQ software/appendix overview</td>
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<tr>
<td>☐ Layer sequence descriptors and other coding</td>
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<tr>
<td>☐ Searches and their significance</td>
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<td>☐ Layer System Queries (LSQ)</td>
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<tr>
<td>☐ Fill-in-the-blank searches (FIT B)</td>
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<tr>
<td>☐ Spectral library searches and software</td>
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<tr>
<td>☐ Assembly plant lists</td>
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<tr>
<td>☐ Lecture/discussion of refinish color collections</td>
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<tr>
<td>☐ Lecture/discussion of choosing a search scheme</td>
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<tr>
<td>☐ Lecture/discussion of significance of a hit list</td>
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<tr>
<td>☐ Ranges</td>
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</tbody>
</table>
# TE-TM-PNT-05: Paint Data Query

<table>
<thead>
<tr>
<th>Limitations</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
</table>

**2.2 Required Readings**

- [ ] Paint Data Query Database SOP
- [ ] PDQ User Manual
- [ ] PDQ-Paint Data Queries: The History and Technology Behind the Development of the Royal Canadian Mounted Police Forensic Laboratory Services Automotive Paint Database

**2.3 Practical Exercises**

- [ ] Utilize PDQ to identify possible manufacturer, plant, and year range information on a set of at least 5 paint samples
- [ ] Write sample reports for the paint sample set

**2.4 Practical Examination**

- [ ] Identify possible manufacturer, plant, vehicle, and year range information for a sample set of known paints
- [ ] Prepare a written report on the results of the practical examination

**2.5 Written Exercises**

- [ ] Provide written responses to all questions

## 3 CONCLUSION

### 3.1 Assessment

- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer

### 3.2 Evaluation

- [ ] Evaluation of training module and trainer by trainee

**OTHER**
# TE-TM-PNT-06: Interpretation of Paint and Polymer Evidence

<table>
<thead>
<tr>
<th></th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tr>
<td><strong>1 OBJECTIVES</strong></td>
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</tr>
<tr>
<td><strong>1.1 Theoretical</strong></td>
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</tr>
<tr>
<td>☐ Theoretical objectives reviewed</td>
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</tr>
<tr>
<td><strong>1.2 Practical</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>☐ Practical objectives reviewed</td>
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<td><strong>2 LESSON PLAN</strong></td>
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<tr>
<td><strong>2.1 Instructional Outline</strong></td>
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<tr>
<td>☐ Lecture/discussion of the significance of associations for:</td>
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<tr>
<td>☐ Automotive paint</td>
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<tr>
<td>☐ OEM</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>☐ Repaint Systems</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>☐ Architectural paint</td>
<td></td>
<td></td>
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<tr>
<td>☐ Tool paint</td>
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<td></td>
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<tr>
<td>☐ Maintenance paint</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Plastics and substrates</td>
<td></td>
<td></td>
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<tr>
<td>☐ Rubber</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Lecture/discussion of report writing</td>
<td></td>
<td></td>
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<tr>
<td>☐ Lecture/discussion of technical and administrative reviews</td>
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<tr>
<td>☐ Lecture/discussion of court testimony</td>
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<tr>
<td><strong>2.2 Required Readings</strong></td>
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</tr>
<tr>
<td>☐ The Evidential Value of Automobile Paint Chips</td>
<td></td>
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</tr>
<tr>
<td>☐ The Evidential Value of Automobile Paint</td>
<td></td>
<td></td>
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<tr>
<td>☐ Forensic Paint Examinations and Comparisons</td>
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<td>☐ An Assessment of the Evidential Value of Automotive Paint Comparisons</td>
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<tr>
<td>☐ The Characterization of Automotive Body Fillers</td>
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<tr>
<td>☐ Studies on the Layer Structure of Paint Flakes Collected from Motor Vehicles in Kuala Lumpur, Malaysia</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>2.3 Practical Exercises</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Review paint and polymer reports written by experienced examiners</td>
<td></td>
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</tbody>
</table>
### TE-TM-PNT-06: Interpretation of Paint and Polymer Evidence

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue reports based on the results of various case scenarios and mock evidence</td>
<td></td>
<td></td>
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<tr>
<td>Review completed case folders</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Perform technical reviews on non-reviewed case folders</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Observe actual testimony by an experienced paint/polym examiner</td>
<td></td>
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</tr>
</tbody>
</table>

#### 2.4 Practical Examination
- None

#### 2.5 Written Exercises
- Provide written responses to all questions

#### 3 CONCLUSION

#### 3.1 Assessment
- Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation
- Evaluation of training module and trainer by trainee

### OTHER

#### Unit Examination and Competency

<table>
<thead>
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<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td>Competency examinations</td>
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<tr>
<td>Comprehensive written examination</td>
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</tr>
</tbody>
</table>
# Fiber Evidence

**Trainee Name** __________________________   **Date Training Began** __________________________

## 1 OBJECTIVES

### 1.1 Theoretical

- [ ] Theoretical objectives reviewed

### 1.2 Practical

- [ ] Practical objectives reviewed

## 2 LESSON PLAN

### 2.1 Instructional Outline

- [ ] Lecture/discussion of textile definitions
  - Fiber
  - Filament
  - Staple fibers
  - Yarn
  - Warp
  - Weft/fill
  - Dye
  - Pigment
- [ ] Lecture/discussion of types of fibers
  - Man-made (cellulosics)
  - Synthetics including bicomponent
  - Natural
- [ ] Lecture/discussion of manufacturing process
  - Melt spinning
  - Wet spinning
  - Dry spinning
- [ ] Lecture/discussion of fiber transfer and persistence
- [ ] Lecture/discussion of textile labeling
- [ ] Lecture/discussion of fiber examinations
  - Type of exam
  - Conclusion of exam

<table>
<thead>
<tr>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
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</table>
## TE-TM-FIB-01: Introduction to Fiber and Textile Evidence

<table>
<thead>
<tr>
<th>Section</th>
<th>Required Readings</th>
<th>Practical Exercises</th>
<th>Practical Examination</th>
<th>Written Exercises</th>
<th>Conclusion</th>
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<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td>3.1 Assessment</td>
</tr>
<tr>
<td></td>
<td>The Forensic Aspect of Textile Fiber Examination</td>
<td></td>
<td></td>
<td></td>
<td>Satisfactory completion of written/practical exercises and practical examination assessed by trainer</td>
</tr>
<tr>
<td></td>
<td>Foundations of Forensic Microscopy</td>
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<td>3.2 Evaluation</td>
</tr>
<tr>
<td></td>
<td>Classification of Textile Fibres: Production, Structure, and Properties</td>
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<td></td>
<td></td>
<td>Evaluation of training module and trainer by trainee</td>
</tr>
<tr>
<td></td>
<td>Forensic Fiber Examination Guidelines</td>
<td></td>
<td></td>
<td></td>
<td>OTHER</td>
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<td>Trace Evidence Recovery Guidelines</td>
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<td>A Quick Guide to Manufactured Fibers</td>
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<td>2.3</td>
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<td>2.4</td>
<td>None</td>
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<td>3</td>
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</table>

### 3.1 Assessment

- Satisfactory completion of written/practical exercises and practical examination assessed by trainer

### 3.2 Evaluation

- Evaluation of training module and trainer by trainee
### TE-TM-FIB-02: Stereomicroscopic Examination of Fibers, Yarns and Fabric

<table>
<thead>
<tr>
<th>1 OBJECTIVES</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td>1.1 Theoretical</td>
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<tr>
<td>□ Theoretical objectives reviewed</td>
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</tr>
<tr>
<td>1.2 Practical</td>
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</tr>
<tr>
<td>□ Practical objectives reviewed</td>
<td></td>
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</tbody>
</table>

| 2 LESSON PLAN                                                                 |                  |                |                             |
| 2.1 Instructional Outline                                                    |                  |                |                             |
| □ Lecture/discussion of fabric construction                                  |                  |                |                             |
| □ Knits, non-woven and woven fabrics                                          |                  |                |                             |
| □ Documentation                                                               |                  |                |                             |
| □ Lecture/discussion of introduction to rope/cordage and yarns                |                  |                |                             |
| □ Documentation of characteristics                                           |                  |                |                             |
| □ Relationship of yarns in fabric construction                               |                  |                |                             |
| □ Lecture/discussion of representative sampling and mounting of fibers from different known fabric types |                  |                |                             |
| □ Selection criteria used                                                     |                  |                |                             |
| □ Demonstration of fiber mounting methodology                                 |                  |                |                             |
| □ Lecture/discussion of observable characteristics of different fibers       |                  |                |                             |
| □ Color                                                                       |                  |                |                             |
| □ Relative diameter                                                           |                  |                |                             |
| □ Shape                                                                       |                  |                |                             |
| □ Man-made versus natural                                                     |                  |                |                             |
| □ Luster                                                                       |                  |                |                             |
| □ Crimp                                                                       |                  |                |                             |
| □ Documentation                                                               |                  |                |                             |
| □ Lecture/discussion of introduction to the criteria used to select target fibers for further comparison |                  |                |                             |
| □ Developing search image for questioned fibers                              |                  |                |                             |
### TE-TM-FIB-02: Stereomicroscopic Examination of Fibers, Yarns and Fabric

<table>
<thead>
<tr>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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</tbody>
</table>

- [ ] Demonstrate the methods for removing and mounting fibers
- [ ] Documentation
- [ ] Lecture/discussion of demounting fibers

#### 2.2 Required Readings

- [ ] Fiber Initial Examination and Overview SOP
- [ ] Comparison of Thread, Yarn, and Cordage SOP
- [ ] Classification of Textile Fibers: Production, Structure, and Properties
- [ ] The Structure of Textiles: An Introduction to the Basics
- [ ] Ropes and Cordage
- [ ] The Forensic Aspect of Textile Fiber Examination

#### 2.3 Practical Exercises

- [ ] Examine fabric of various construction and document construction characteristics
- [ ] Mount known fibers in appropriate fashion for target fiber comparison
- [ ] Examine debris samples with known fibers, document observed characteristics of the fibers within the debris, select target fibers for further comparison, and remove and mount questioned fibers for further comparison
- [ ] Examine various types of cordage and document the characteristics of ropes and cordage

#### 2.4 Practical Examination

- [ ] Identify and document the construction characteristics of an unknown piece of fabric and mount known fibers for target fiber comparison
- [ ] Use the known fibers to screen debris samples, document observed characteristics of the fibers within the debris, and select and mount target fibers for further comparison
- [ ] Identify and document characteristics of an unknown and known piece of cordage and compare to make the determination if further testing is warranted
## TE-TM-FIB-02: Stereomicroscopic Examination of Fibers, Yarns and Fabric

<table>
<thead>
<tr>
<th>Trainee Name</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/ Evaluation</th>
</tr>
</thead>
</table>

### 2.5 Written Exercises
- [ ] Provide written responses to all questions

### 3 CONCLUSION

#### 3.1 Assessment
- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation
- [ ] Evaluation of training module and trainer by trainee

### OTHER

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**Note:** The document contains a table for recording trainee and evaluation details related to the stereomicroscopic examination of fibers, yarns, and fabric. The table includes columns for trainee initials, date completed, and trainer initials/evaluation. The trainee is instructed to provide written responses to all questions and to check the boxes indicating satisfactory completion and evaluation. The document is part of the Fiber Evidence training module managed by the Texas Department of Public Safety Crime Laboratory.
### TE-TM-FIB-03: Polarized Light Microscopic Examination of Fibers

<table>
<thead>
<tr>
<th>Objective</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Theoretical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Theoretical objectives reviewed</td>
<td></td>
<td></td>
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<td>□ Optical Characteristics of Vegetable Fibers SOP</td>
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<td>□ Foundations of Forensic Microscopy</td>
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<td>□ Microscopical Examination of Fibers</td>
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<td>□ Microscopy and Microchemistry of Physical Evidence</td>
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# TE-TM-FIB-03: Polarized Light Microscopic Examination of Fibers

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<td>A Flowchart for the Identification of Common Synthetic Fibers by Polarized Light Microscopy</td>
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<td>Forensic Examination of Fibers</td>
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<tr>
<td>Identification of Vegetable Fibers</td>
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<td>Microscopy of Hair</td>
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</table>

## 2.3 Practical Exercises

- Mount man-made fibers of a variety of shapes, sizes, and delustrant from the most common generic classes
  - Acetate
  - Triacetate
  - Acrylic
  - Modacrylic
  - Nylon 6 and Nylon 6,6
  - Olefin
  - Polyester
  - Rayon
  - Lyocell
  - Glass
- Examine and document fiber properties
  - Delustrant
  - Diameter
  - Birefringence
  - Sign of elongation
  - Refractive indices
- Mount, examine, and document natural fibers
  - Cotton
  - Linen
  - Wool
  - Silk

## 2.4 Practical Examination

Examine, document, and identify the generic class of a set of unknown fibers
<table>
<thead>
<tr>
<th>TE-TM-FIB-03: Polarized Light Microscopic Examination of Fibers</th>
<th>Trainee Initials</th>
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<td>□ Evaluation of training module and trainer by trainee</td>
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## TE-TM-FIB-04: COMPARISON MICROSCOPE

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### 2 LESSON PLAN

#### 2.1 Instructional Outline

- [ ] Lecture/discussion of demonstrations
- [ ] How to set-up and operate the microscope
- [ ] Color balance the light source and correct any defects in the system using two slide containing the same fibers
- [ ] Lecture/discussion of criteria used for comparison
- [ ] Lecture/discussion of factors that affect comparison
- [ ] Lecture/discussion of advantages and disadvantages

#### 2.2 Required Readings

- [ ] The Forensic Aspect of Textile Fiber Examination
- [ ] Protocols for Fiber Examinations and Initial Preparation
- [ ] Fiber Initial Examination and Overview SOP

#### 2.3 Practical Exercises

- [ ] Prepare slides to assist in balancing the illumination of the microscope using colored yarns that are uniformly dyed or pigmented and preferably delustered
- [ ] Make sets of slides consisting of two slides of the same sample to determine the criteria for a match and compare the samples on the comparison microscope

#### 2.4 Practical Examination

- [ ] Using a set of question and known fibers, determine if any of the question fibers could have originated from the known samples based on the comparison scope
<table>
<thead>
<tr>
<th>TE-TM-FIB-04: COMPARISON MICROSCOPE</th>
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### 1 OBJECTIVES

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<tbody>
<tr>
<td>1.2 Practical</td>
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</table>

### 2 LESSON PLAN

#### 2.1 Instructional Outline

- [ ] Lecture/discussion of the significance of cross-sections
  - [ ] Modification ratio
  - [ ] End use
  - [ ] Dye penetration
  - [ ] Sampling and variation within a sample
- [ ] Lecture/discussion of techniques
  - [ ] Jolliff
  - [ ] Polyethylene
  - [ ] Other methods
- [ ] Lecture/discussion of microscopic characteristics of cross-sections
  - [ ] Documentation of the observed characteristics
  - [ ] Relationship between the fiber cross-sectional shape and its longitudinal appearance
- [ ] Lecture/discussion of microscopic comparison

#### 2.2 Required Readings

- [ ] Cross-sectioning of Fibers SOP
- [ ] The Forensic Aspect of Textile Fiber Examination
- [ ] Fiber Cross-sections: Part I
- [ ] Fiber Cross-sections: Part II
- [ ] A New Method for Cross Sectioning Single Fibers
- [ ] Rapid and Unique Techniques for Cross-
2.3 **Practical Exercises**
- [ ] Cross-section fiber samples using various techniques
- [ ] Examine the physical cross-section and compare to the longitudinal cross-section

2.4 **Practical Examination**
- [ ] Cross-section an unknown sample set, identify the cross-sectional shape, and document the cross-section with photomicrographs

2.5 **Written Exercises**
- [ ] Provide written responses to all questions

3 **CONCLUSION**

3.1 **Assessment**
- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer

3.2 **Evaluation**
- [ ] Evaluation of training module and trainer by trainee

OTHER
## 1 OBJECTIVES

### 1.1 Theoretical

- [ ] Theoretical objectives reviewed

### 1.2 Practical

- [ ] Practical objectives reviewed

## 2 LESSON PLAN

### 2.1 Instructional Outline

- [ ] Lecture/discussion of sample preparation
- [ ] Lecture/discussion of the use and routine maintenance/calibration of the infrared microspectrometer
- [ ] Lecture/discussion of the evaluation of spectra and libraries
- [ ] Lecture/discussion of advantages and disadvantages

### 2.2 Required Readings

- [ ] Infrared Microspectroscopy of Man-made Fibers SOP
- [ ] The Forensic Aspect of Textile Fiber Examination
- [ ] Infrared Microscopy and its Forensic Applications
- [ ] A Forensic Examination of Synthetic Textile Fibers by Microscopic Infrared Spectrometry
- [ ] Infrared Microspectroscopy of Fibres
- [ ] Forensic Applications of Infrared Spectroscopy
- [ ] Standard Test Methods for Identification of Fibers in Textiles

### 2.3 Practical Exercises

- [ ] Analyze man-made fibers from the most common generic classes
  - Acetate
  - Triacetate
  - Acrylic (three types)
## TE-TM-FIB-07: Infrared Microspectroscopy of Fibers

<table>
<thead>
<tr>
<th>Fiber Type</th>
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<td>Olefin</td>
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<td>Polyester</td>
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<td>Rayon</td>
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</table>

### 2.4 Practical Examination
- [ ] Analyze, evaluate, and identify an unknown sample set consisting of at least five different fiber types

### 2.5 Written Exercises
- [ ] Provide written responses to all questions

### 3 CONCLUSION

#### 3.1 Assessment
- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation
- [ ] Evaluation of training module and trainer by trainee

**OTHER**

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This section is for any additional comments or notes related to the training module.
# TE-TM-FIB-08: Color Comparison of Fibers by Microspectrometry

<table>
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<tr>
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## 2 LESSON PLAN

### 2.1 Instructional Outline

- ☐ Lecture/discussion of the use and routine maintenance/calibration of the microspectrometer
- ☐ Lecture/discussion of visible vs. UV region
- ☐ Lecture/discussion of sampling
  - ☐ Selection
  - ☐ Mounting media
- ☐ Lecture/discussion of evaluation and comparison of spectra
- ☐ Lecture/discussion of various characteristics
  - ☐ Cross-sectional shape
  - ☐ Dye penetration
  - ☐ Fiber types
  - ☐ Fiber morphology
  - ☐ Dye method
- ☐ Lecture/discussion of advantages and disadvantages

### 2.2 Required Readings

- ☐ Microspectrophotometry of Fibers SOP
- ☐ The Forensic Aspect of Textile Fiber Examination
- ☐ Microspectrophotometry/Colour Measurement
- ☐ An Assessment of the Value of Blue, Red, and Black Cotton Fibers as Target Fibers in Forensic Science Investigation
- ☐ An Investigation of Known Blue, Red, and Black Dyes Used in the Coloration of Cotton Fibers
- ☐ Survey of Red, Green, and Blue Cotton Fibers
TE-TM-FIB-08: Color Comparison of Fibers by Microspectrometry

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<td>☐ The Characterization of Dyestuffs on Wool Fibers with Special Reference to Microspectrophotometry</td>
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### 2.3 Practical Exercises

- ☐ Obtain Holmium Oxide and Neutral Density spectra in the ultraviolet and visible range
- ☐ Examine samples of colored fibers of various cross-sectional shapes
- ☐ Obtain 10 transmittance spectra along the length of a single fiber for multiple fibers of various cross-sectional shapes
- ☐ Scan an appropriate number of known fibers in the visible and ultraviolet range based on the color uniformity and cross-sectional shape and plot the range of spectra from a set of fibers
- ☐ Scan a fiber from the same sample (treating the fiber as a questioned fiber) and compare known and questioned spectra to determine the criteria of a match

### 2.4 Practical Examination

- ☐ Obtain spectra from a set of unknown and known fibers to determine if the color is similar based on the MSP spectra

### 2.5 Written Exercises

- ☐ Provide written responses to all questions

### 3 Conclusion

#### 3.1 Assessment

- ☐ Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

- ☐ Evaluation of training module and trainer by trainee
## TE-TM-FIB-08: Color Comparison of Fibers by Microspectrometry

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### TE-TM-FIB-09: Color Comparison of Fibers by Thin Layer Chromatography (TLC)

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#### 1 OBJECTIVES

1.1 Theoretical
- □ Theoretical objectives reviewed

1.2 Practical
- □ Practical objectives reviewed

#### 2 LESSON PLAN

**2.1 Instructional Outline**
- □ Lecture/discussion of TLC
  - □ Theory
  - □ Dye types associated with different fiber types
- □ Lecture/discussion of extraction techniques
  - □ Extraction solvent
  - □ Temperature
- □ Lecture/discussion of different eluent systems
- □ Lecture/discussion of comparison
  - □ Migration
  - □ Number of components
  - □ UV characteristics
  - □ Lecture/discussion of advantages and disadvantages

**2.2 Required Readings**
- □ Thin Layer Chromatography of Synthetic Fibers SOP
- □ Thin Layer Chromatography of Cotton Fibers SOP
- □ Thin Layer Chromatography of Wool Fibers SOP
- □ The Forensic Aspect of Textile Fiber Examination
- □ Thin Layer Chromatographic Analysis for Fibre Dyes
- □ The Extraction and Classification of Dyes from Cotton Fibres Using Different Solvent Systems
- □ Forensic Fiber Examination Guidelines
## TE-TM-FIB-09: Color Comparison of Fibers by Thin Layer Chromatography (TLC)

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<td>The Characterization of Dyestuffs on Wool Fibres with Special Reference to Microspectrometry</td>
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<td>A Semi-micro Technique for the Extraction and Comparison of Dyes in Textile Fibers</td>
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### 2.3 Practical Exercises

- Extract the dye from a variety of colored fibers of various sizes
- Perform thin layer chromatography of the extracted dyes using various elucenting systems

### 2.4 Practical Examination

- Extract dye from questioned and known fibers, perform thin layer chromatography using an appropriate elucenting system, and determine if they originated from the same source based on TLC results

### 2.5 Written Exercises

- Provide written responses to all questions
### TE-TM-FIB-09: Color Comparison of Fibers by Thin Layer Chromatography (TLC)

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<th>Trainee Initials</th>
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### TE-TM-FIB-10: Fiber Solubility Examinations

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<tr>
<th>2 LESSON PLAN</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>2.1 Instructional Outline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Lecture/discussion of solubility testing</td>
<td></td>
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<tr>
<td>□ Lecture/discussion of techniques and solvents</td>
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<tr>
<td>□ 75% aqueous acetone</td>
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<tr>
<td>□ Chloroform</td>
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<td></td>
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<tr>
<td>□ Lecture/discussion of advantages and disadvantages</td>
<td></td>
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</tr>
<tr>
<td>2.2 Required Readings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ The Forensic Aspect of Textile Fiber Examination</td>
<td></td>
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</tr>
<tr>
<td>□ Forensic Examination of Fibres</td>
<td></td>
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</tr>
<tr>
<td>2.3 Practical Exercises</td>
<td></td>
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</tr>
<tr>
<td>□ Distinguish between acetate and triacetate fibers using aqueous acetone and chloroform</td>
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<tr>
<td>2.4 Practical Examination</td>
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<tr>
<td>□ Identify unknown fibers based on solubility testing</td>
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<tr>
<td>2.5 Written Exercises</td>
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<tr>
<td>□ Provide written responses to all questions</td>
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</table>

<table>
<thead>
<tr>
<th>3 CONCLUSION</th>
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<tbody>
<tr>
<td>3.1 Assessment</td>
<td></td>
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<tr>
<td>□ Satisfactory completion of written/practical exercises and practical examination assessed by trainer</td>
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<tr>
<td>3.2 Evaluation</td>
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<tr>
<td>□ Evaluation of training module and trainer by trainee</td>
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<td>Trainee Initials</td>
<td>Date Completed</td>
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</table>
## TE-TM-FIB-11: Interpretation of Fiber Evidence

<table>
<thead>
<tr>
<th>1 OBJECTIVES</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td>1.1 Theoretical</td>
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<tr>
<td>- Theoretical objectives reviewed</td>
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<tr>
<td>1.2 Practical</td>
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<tr>
<td>- Practical objectives reviewed</td>
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</tr>
</tbody>
</table>

### 2 LESSON PLAN

#### 2.1 Instructional Outline

- Lecture/discussion of interpretation and significance of fiber associations
- Types of fibers recovered
- Color or variation of color in fibers
- Number of fibers found and location of fibers
- Fabric type
- One-way or two-way transfer
- Multiple fiber associations
- Multiple color/type question fibers consistent with color/type known fibers from one item
- Use of RN/WPL information to determine manufacturer production and distribution and the value of target fiber studies
- Lecture/discussion of report wording
- Lecture/discussion technical and administrative Reviews
- Lecture/discussion of court testimony

#### 2.2 Required Readings

- The Forensic Aspect of Textile Fiber Examination
- Information Content: The Interpretation of Fibers Evidence
- Forensic Fiber Examination Guidelines
- Interpretation of Fibers Evidence
- Results of a Study to Determine the Probability of Chance Match Occurrence Between Fibers Known to be from Different Sources
- The Population of Coloured Textile Fibers on Outdoor Surfaces
## TE-TM-FIB-11: Interpretation of Fiber Evidence

<table>
<thead>
<tr>
<th>Activity</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/ Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Target Fiber Study Using Cinema and Car Seats as Recipient Items</td>
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<tr>
<td>The Population of Textile Fibers on Car Seats</td>
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<tr>
<td>Effect of Garment Cleaning on the Recovery and Redistribution of Transferred Fibers</td>
<td></td>
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<tr>
<td>Significant Fiber Evidence Recovered from the Clothing of a Homicide Victim After Exposure to the Elements for Twenty-Nine Days</td>
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<tr>
<td>Fiber Evidence and the Wayne Williams Trial (Part I)</td>
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<tr>
<td>Fiber Evidence and the Wayne Williams Trial (Conclusion)</td>
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<tr>
<td>The Melissa Brannen Case</td>
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<tr>
<td>A Study on the Random Distribution of a Red Acrylic Target Fiber</td>
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</tbody>
</table>

### 2.3 Practical Exercises
- Review reports written by experienced examiners
- Issue reports based on various case scenarios and mock evidence results
- Review completed case folders
- Perform technical reviews on non-reviewed case folders
- Observe actual testimony by an experienced fiber examiner

### 2.4 Practical Examination
- None

### 2.5 Written Exercises
- Provide written responses to all questions

### 3 Conclusion

#### 3.1 Assessment
- Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation
- Evaluation of training module and trainer by trainee
Fiber Evidence
LAB-TE-TM-FIB Rev.01 (04/2019) p.25 issued by: QAC

<table>
<thead>
<tr>
<th>TE-TM-FIB-11: Interpretation of Fiber Evidence</th>
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<tbody>
<tr>
<td>Trainee Initials</td>
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<table>
<thead>
<tr>
<th>Unit Examination and Competency</th>
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</thead>
<tbody>
<tr>
<td>Competency examinations</td>
</tr>
<tr>
<td>Comprehensive written examination</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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Trainee Name ____________________________
<table>
<thead>
<tr>
<th>Objective</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Theoretical</td>
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<tr>
<td>1.2 Practical</td>
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</tbody>
</table>

2 LESSON PLAN

2.1 Instructional Outline

- Lecture/discussion of gunshot primer residue
  - Formation
  - Composition
  - Morphology
  - Sources
  - History of analysis and collection
  - Significance
- Lecture/discussion of SEM-EDS instrumentation
  - Theory
  - Operation
  - Calibration
  - QC procedures
  - Sample preparation
  - Elemental identification
  - Limitations
  - Maintenance
- Lecture/discussion of sample collection and analysis
  - Hand stub collection
  - Inanimate object collection
  - Criteria for GSR collection (DPS policy and its development)
- Sample preparation for SEM-EDS analysis
- Lecture/discussion of interpretation and significance
- Lecture/discussion of report writing
## Lecture/discussion technical and administrative Reviews

- Detection of Gunshot Residue: Present Status
- Gunshot Primer Residue SOP
- Gunshot Primer Residue, The Invisible Clue
- Detection of Gunshot Residues
- Firearms Discharge Residues
- Barium and Antimony Distributions on the Hands of Nonshooters
- Activity After Shooting and its Effect on the Retention of Primer Residue
- Detection of Gunshot Residue on the Hands by Trace Element Analysis
- Characteristics of Firearms and Gunshot Wounds as Markers of Suicide
- Scanning Electron Microscopy and X-Ray Microanalysis
- Current Methods in Forensic Gunshot Residue Analysis
- Detection of Gunshot Residue by Use of the Scanning Electron Microscope
- Detection of Gunshot Residue on Hands by Scanning Electron Microscope
- Formation of Gunshot Residue
- Particle Analysis for the Detection of Gunshot Residue (Part I and Part II)
- Particle Analysis for the Detection of Gunshot Residue (Part III)
- Discharge Residues from Cartridge Operated Industrial Tools
- Officers, Their Weapons and Their Hands: An Empirical Study of GSR on the Hands of Non-Shooting Police Officers
- Gunshot Residue Similar Particles Produced by Fireworks
- Gunshot Residue, Further Studies on Particles of Environmental and Occupational Origin
- Brake Lining: A Source of Non-GSR Particles Containing Lead, Barium and Antimony

<table>
<thead>
<tr>
<th>2.3 Practical Exercises</th>
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</table>
**TE-TM-30: Gunshot Primer Residue Examination**

<table>
<thead>
<tr>
<th>Task</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Analyze at least 10 stubs for a variety of known gunshot residue particles</td>
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<tr>
<td>□ Review GSR reports prepared by qualified examiners</td>
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<tr>
<td>□ Review completed case folders</td>
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<tr>
<td>□ Perform technical reviews on non-reviewed case folders</td>
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<tr>
<td>□ Observe actual testimony by an experienced GSR examiner</td>
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</table>

**2.4 Practical Examination**

<table>
<thead>
<tr>
<th>Task</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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</thead>
<tbody>
<tr>
<td>□ Analyze 5 sets of stubs for a variety of known gunshot residue particles</td>
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<tr>
<td>□ Prepare mock case reports based on the conclusions of the analysis</td>
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</tbody>
</table>

**2.5 Written Exercises**

<table>
<thead>
<tr>
<th>Task</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Provide written responses to all questions</td>
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</table>

**3 CONCLUSION**

**3.1 Assessment**

<table>
<thead>
<tr>
<th>Task</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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</thead>
<tbody>
<tr>
<td>□ Satisfactory completion of written/practical exercises and practical examination assessed by trainer</td>
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**3.2 Evaluation**

<table>
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<tr>
<th>Task</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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</thead>
<tbody>
<tr>
<td>□ Evaluation of training module and trainer by trainee</td>
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**OTHER**

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**Unit Examination and Competency**

<table>
<thead>
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<th>Task</th>
<th>Trainee Initials</th>
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<th>Trainer Initials/Evaluation</th>
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</thead>
<tbody>
<tr>
<td>□ Competency examinations</td>
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<tr>
<td>□ Comprehensive written examination</td>
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</table>
# Fire Debris Analysis Training Checklist

**Trainee Name** __________________________  **Date Training Began** __________________________

**Trainer Initials/Date** __________________________

## TE-TM-FD-02 Organic Chemistry Review

<table>
<thead>
<tr>
<th>Required Readings</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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<tbody>
<tr>
<td>Organic Chemistry, Chapters 7, 17</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Fire Debris Analysis, Chapters 3-4</td>
<td>[ ]</td>
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</table>

<table>
<thead>
<tr>
<th>Suggested Readings</th>
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</thead>
<tbody>
<tr>
<td>Fundamentals of Organic Chemistry, Chapters 3, 4, 5, 6, 7, 8, 10, 12, 13, 18, 19, 31</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Instructor’s Manual to Accompany: Chemistry A First Course</td>
<td>[ ]</td>
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<tr>
<td>Chemistry of Catalytic Processes</td>
<td>[ ]</td>
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<tr>
<td>Prudent Practices for Disposal of Chemicals from Laboratories</td>
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</table>

### Observed Performance

- [ ] Discuss the topics listed in the Objectives with trainer
- [ ] Discuss the basic classes of organic compounds
- [ ] Review and discuss topics related to the handling and analysis of ignitable liquid residue
- [ ] Review and discuss the pertinent points of selected Readings with trainer

### Independent Exercise(s)

- [ ] Provide written answers to a set of questions provided by the trainer
- [ ] Attend outside training courses or workshops in Organic Chemistry, as it may apply to chemical analysis in arson investigation **(OPTIONAL)**

### Assessment

- [ ] Review written answers to the Independent Exercise questions with the trainer
- [ ] Verbal or written quiz – review answers with trainer upon completion

---

## TE-TM-FD-03 Handling of Fire Debris Evidence

<table>
<thead>
<tr>
<th>Required Readings</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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</thead>
</table>

**Texas DPS Crime Laboratory Service Manual**

- [ ] Chapter 25 – Materials (Trace) Analysis, section on Fire Debris
- [ ] Chapter 40 – Laboratory Security and Access
- [ ] Chapter 41 – Emergency Preparedness
# Fire Debris Analysis Training Checklist

**TE-TM-FD-03 Handling of Fire Debris Evidence**

<table>
<thead>
<tr>
<th>Observed Performance</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Discuss the topics listed in the Objectives with trainer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Review and discuss the pertinent points of selected Readings with trainer</td>
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<tr>
<td>□ Observe qualified analyst handling, securing, and storing evidence during the analysis process</td>
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</table>

**Assessment**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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</thead>
<tbody>
<tr>
<td>□ Verbal or written quiz – review answers with trainer upon completion</td>
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**TE-TM-FD-04 Introduction to Petroleum Products and Petroleum Manufacturing**

<table>
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<tr>
<th>Required Readings</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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<tbody>
<tr>
<td>□ Fire Debris Analysis, Chapters 7 and 25</td>
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<tr>
<td>□ The Chemistry and Technology of Petroleum, Chapters 9, 14-15, 20.6, 25-26</td>
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<table>
<thead>
<tr>
<th>Suggested Readings</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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</thead>
<tbody>
<tr>
<td>□ Petroleum Refining: Technology and Economics</td>
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**Observed Performance**

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<thead>
<tr>
<th>Observed Performance</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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</thead>
<tbody>
<tr>
<td>□ Discuss pertinent aspects of petroleum products and their manufacturing</td>
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<tr>
<td>□ Review and discuss other pertinent points of petroleum products and their manufacturing as it relates to fire debris analysis and detection of ignitable liquid residue</td>
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<tr>
<td>□ Review and discuss the pertinent points of selected Readings with trainer</td>
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**Independent Exercise(s)**

<table>
<thead>
<tr>
<th>Independent Exercise(s)</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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</thead>
<tbody>
<tr>
<td>□ Provide written answers to a set of questions provided by the trainer</td>
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</tr>
<tr>
<td>□ Attend outside training courses/workshops regarding petroleum products, ignitable liquids and their extraction and/or analysis, as it may apply to fire debris analysis and detection of ignitable liquid residue (OPTIONAL)</td>
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</table>

**Assessment**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Review written answers to the Independent Exercise questions with the trainer</td>
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<td></td>
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<tr>
<td>□ Verbal or written quiz – review answers with trainer upon completion</td>
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</table>
### TE-TM-FD-05 Introduction to Fire and Arson Investigation

<table>
<thead>
<tr>
<th>Required Readings</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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</thead>
<tbody>
<tr>
<td>Kirk's <em>Fire Investigation</em>, Chapters 1-7, 9, 11, 13-14, 16-17</td>
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<tr>
<td>Fire Debris Analysis, Chapters 1, 6</td>
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<tr>
<td>Texas DPS Crime Laboratory Service Manual, Chapter 25 – Materials (Trace) Analysis, section on Fire Debris</td>
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<table>
<thead>
<tr>
<th>Suggested Readings</th>
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<tbody>
<tr>
<td>Techniques of Crime Scene Investigation</td>
<td></td>
<td></td>
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<tr>
<td>Physical and Technical Aspects of Fire and Arson Investigation</td>
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<tr>
<td>Fires and Human Behavior</td>
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<tr>
<td>Flammable and Combustible Liquids Code Handbook</td>
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<tr>
<td>Fire Scene Investigations Protocol</td>
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</tbody>
</table>

### Observed Performance

- Review and discuss the pertinent points of selected Readings with trainer
- Visit fire scenes, observe evidence collection and observe controlled burns (if possible)
- Network with SFMO Fire Investigators and SFMO K9 Fire Investigation teams to learn the ins and outs of how a fire scene is investigated (if possible)

### Independent Exercise(s)

- Provide written answers to a set of questions provided by the trainer

### Assessment

- Review written answers to the Independent Exercise questions with the trainer
- Verbal or written quiz – review answers with trainer upon completion

---

### TE-TM-FD-06 Evaluation and Characterization of Fire Debris

<table>
<thead>
<tr>
<th>Required Readings</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>GC-MS Guide to Ignitable Liquids, pages 1-25</td>
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<tr>
<td>“Microbial Degradation of Gasoline in Soil”</td>
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<tr>
<td>“Turpentine in Arson Analysis”</td>
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<tr>
<td>Fire Debris Analysis, Chapter 9-10</td>
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</table>
### TE-TM-FD-06 Evaluation and Characterization of Fire Debris

- **☐** ASTM 1618 “Standard Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry”
- **☐** DPS Crime Laboratory Trace Evidence Manual: TE-13-04 – Ignitable Liquid References, Standards and Materials

#### Suggested Readings

- **☐** “Effect of Background Interference on Accelerant Detection by Canines”
- **☐** “Evaluation of Canines for Accelerant Detection at Fire Scenes”
- **☐** “The Petroleum-Laced Background”
- **☐** “Is It a Petroleum Product? How Do You Know?”
- **☐** “An Evaluation of 42 Accelerant Detection Canine Teams”
- **☐** *Flammability Handbook for Plastics*

#### Observed Performance

- **☐** Review and discuss the pertinent points of selected Readings with trainer
- **☐** Trainer will discuss the criteria for ignitable liquid identification as outlined in ASTM E1618
- **☐** Trainer will preview the trainee on required criteria for ignitable liquid classes and the differences when compared to expected spectra from the various matrices and substrates

#### Supervised Performance

- **☐** Collect and extract pyrolysis products to create pyrolysis library (GC/MS run by trainer)
- **☐** Prepare mixed matrix debris for K9 teams and run one uncontaminated can and one can spiked with ignitable liquid through the analysis process
- **☐** Melt ABS plastic, newsprint, and softwood in separate cans and take through analysis process to see chromatographic results
- **☐** Prepare known ignitable liquid reference samples (GC/MS run will be performed by trainer)
- **☐** Prepare known ignitable liquid reference samples for K9 teams and run one uncontaminated can and one can spiked with ignitable liquid through the analysis process
- **☐** Melt ABS plastic, newsprint, and softwood in separate cans and take through analysis process to see chromatographic results

#### Independent Exercise(s)

- **☐** Provide written answers to a set of questions provided by the trainer

#### Assessment

- **☐** Review written answers to the Independent exercise questions with the trainer
- **☐** Verbal or written quiz – review answers with trainer upon completion
## TE-TM-FD-07 Extraction Methods, Sample Preparation and Data Collection

<table>
<thead>
<tr>
<th>Required Readings</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ ASTM E 1412 “Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration with Activated Charcoal.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ ASTM 1386 “Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Solvent Extraction.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ <em>Fire Debris Analysis</em>, Chapters 2.2, 11</td>
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</table>

### Suggested Readings

<table>
<thead>
<tr>
<th>Suggested Readings</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ “Improved Charcoal Packaging for Accelerant Recovery by Passive Diffusion”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ “Comparison of the Eluting Efficiency of Carbon Disulfide with Diethyl Ether: The Case for Laboratory Safety”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ “The Use of Activated Charcoal Strips for Fire Debris Extractions by Passive Diffusion, Part I: The Effects of Time, Temperature, Strip Size, and Sample Concentration”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ “Multiple Analysis of Fire Debris Samples Using Passive Headspace Concentration”</td>
<td></td>
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</tr>
<tr>
<td>□ <em>Detectors for Gas Chromatography: A Practical Primer</em></td>
<td></td>
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</tr>
<tr>
<td>□ <em>Analytical Gas Chromatography</em></td>
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</tbody>
</table>

### Observed Performance

<table>
<thead>
<tr>
<th>Observed Performance</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Discuss how to take appropriate notes, how to properly use worksheets and what abbreviations are in standard use for fire debris analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Trainer will demonstrate headspace vapor extraction via use of c-strip and preparation of solvent vial for injection into the GC/MS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Review and discuss the pertinent points of selected Readings with trainer</td>
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<td></td>
</tr>
</tbody>
</table>

### Supervised Performance

<table>
<thead>
<tr>
<th>Supervised Performance</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Extract unknown samples in paint cans prepared by trainer from reference library samples using passive adsorption/elution (charcoal strip) in conjunction with the Independent Exercises for TE-TM-FD-08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Extract unknown samples (mixed matrices) by passive adsorption/elution (charcoal strip) in conjunction with the Independent Exercises for TE-TM-FD-08</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Independent Exercise(s)

<table>
<thead>
<tr>
<th>Independent Exercise(s)</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Provide written answers to a set of questions provided by the trainer</td>
<td></td>
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</tbody>
</table>

### Assessment

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Review written answers to the Independent Exercise questions with the trainer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Verbal or written quiz – review answers with trainer upon completion</td>
<td></td>
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</tr>
</tbody>
</table>
## TE-TM-FD-08 Instrumental Analysis

### Required Readings

- **Kirk's Fire Investigation**, Chapter 8 (Sections 1-3)
- **Fire Debris Analysis**, Chapter 8 (Sections 4-6), Chapter 12
- **Basic Gas Chromatography**, Chapters 10, 12
- ASTM E1388 “Standard Practice for Static Headspace Sampling of Vapors from Fire Debris Samples.”
- **Forensic Applications of Mass Spectrometry**, Chapter 4, pages 129-169
- “Mass Chromatographic Analysis of Arson Accelerants”
- **Forensic Mass Spectrometry**, Chapter 4

### Suggested Readings

- **Detectors for Gas Chromatography: A Practical Primer**
- **Analytical Gas Chromatography**
- **Gas Chromatography in Forensic Science**
- **High Resolution Gas Chromatography**
- “An Accelerant Classification Scheme Based on Analysis by Gas Chromatography/Mass Spectrometry (GC-MS)”
- “GC/MS Data from Fire Debris Samples: Interpretation and Application”
- **Interpretation of Mass Spectra**

### Observed Performance

- Review and discuss the pertinent points of selected readings with trainer
- Trainer will demonstrate use of the GC/MS for producing chromatographic case file data
- Trainer will demonstrate various quality assurance checks for the GC/MS and ignitable liquid oven, including maintenance procedures
- Trainer will demonstrate protocol naming conventions and labeling requirements on case file chromatographic data
- Discuss the interpretation of fire debris evidence and its relevance/weight in reports and in testimony, including identifying a class of products versus individual identification of a commercial product

### Supervised Performance

- Perform the QC procedures for the gas chromatograph/mass spectrometers for a minimum of one week.
- Demonstrate the carbon-strip extraction method to the trainer
- Demonstrate use of the GC/MS for analytical data retrieval, including quality assurance and maintenance checks, to include the ignitable liquids residue oven
## Fire Debris Analysis Training Checklist

**Trainer Initials/Date** __________________________

### TE-TM-FD-08 Instrumental Analysis

| Demonstrate use of the database within LIMS to practice entering, editing, reporting, and retrieving information | Trainee Initials | Date Completed |
| Complete a mock trial in fire debris analysis testimony | | |
| Attend courses (internal or externally offered) in either fire debris analysis, instrumental analysis, GC/MS maintenance and troubleshooting and/or expert testimony (OPTIONAL) | | |

### Independent Exercise(s)

| Provide written answers to a set of questions provided by the trainer | | |
| Obtain Total Ion Chromatograms (TIC) and extracted ion profiles (EIC) by passive adsorption/elution (charcoal strip) for known samples. Identify the class of each sample. | | |
| Run samples from the Supervised Performance exercises in TE-TM-FD-07 on the GC/MS; obtain the TIC and EIC profile and identify the class for each liquid. | | |
| Run extracts of the pyrolysis product samples collected in the Supervised Performance exercise of TE-TM-FD-06 | | |
| Prepare a case file | | |

### Assessment

| Review written answers to the Independent Exercise questions with the trainer | | |
| Verbal or written quiz (instrumental analysis) – review answers with trainer upon completion | | |
| Verbal or written quiz (expert testimony) – review answers with trainer upon completion | | |

### TE-TM-FD-09 Report Writing

| Required Readings | Trainee Initials | Date Completed |
| DPS Crime Laboratory Service Manual, Chapter 54 – Laboratory Reports, Letters, and Certificates | | |

### Observed Performance

| Review and discuss the standard analysis report wording for cases with fire debris evidence | | |
| Trainer will demonstrate reporting of analytical results using the LIMS software (10 cases minimum) | | |
| Trainer will demonstrate and discuss review of case/item numbers entered in a sequence run (i.e. batch data), review of worklists against case file and physical data; technical and administrative review of cases (10 cases minimum) | | |
## TE-TM-FD-09 Report Writing

<table>
<thead>
<tr>
<th>Supervised Performance</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Perform technical and administrative review of 50 cases previously examined by other qualified fire debris examiners <em>(no milestones in LIMS)</em></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Exercise(s)</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Generate appropriate worksheets and analysis reports using the LIMS software for given training samples</td>
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</table>

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Verbal or written quiz – review answers with trainer upon completion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Trainer observations of LIMS data entry and case review</td>
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</table>

## TE-TM-FD-10 Practical Assessment

<table>
<thead>
<tr>
<th>Required Readings</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ DPS Crime Laboratory Trace Evidence Manual, TE-13-02 – Instrumental Analysis of Fire Debris</td>
<td></td>
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<tr>
<td>☐ Appropriate instrument manuals available in workstations and online</td>
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<tr>
<td>☐ Various Frye and Daubert Standard Articles, Brady and Morton Act Articles as assigned by section supervisor</td>
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<tr>
<td>☐ GLT Manual Legal Training</td>
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<table>
<thead>
<tr>
<th>Independent Exercise(s)</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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<tbody>
<tr>
<td>☐ Process training samples as if submitted for real casework analysis, to include issuing an analysis report <em>(3 “cases” minimum)</em></td>
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</table>

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Casework competency</td>
<td></td>
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<tr>
<td>☐ Written, comprehensive examination</td>
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<tr>
<td>☐ Mock trial</td>
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</table>
### Fire Debris Analysis Training Checklist

**Lab-TE-TM-FD Rev.00 (06/2019) p.9 Issued by: QAC**

Trainer Initials/Date  

<table>
<thead>
<tr>
<th>Additional Courses and/or Readings</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
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<tr>
<td><strong>Specialized Courses:</strong></td>
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<tr>
<td><strong>Additional Readings</strong></td>
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</tbody>
</table>
## 1 OBJECTIVES

**1.1 Theoretical**
- [ ] Theoretical objectives reviewed

**1.2 Practical**
- [ ] Practical objectives reviewed

## 2 LESSON PLAN

**2.1 Instructional Outline**
- [ ] Lecture/discussion of footwear manufacturing process
  - Molding processes
  - Cutting processes
- [ ] Lecture/discussion of tire manufacturing process
  - Shell mold
  - Segmented mold
  - Noise treatment
  - Tread wear indicators
- [ ] Lecture/discussion of tire components
- [ ] Lecture/discussion of tire sidewall information
- [ ] Lecture/discussion of types of tire tread design
  - Rib and center rib tires
  - Block design
  - All-terrain and off-road tires
  - Motorcycle tires
  - Snow tires
  - High-performance tires
  - Agriculture and construction tires
  - All-season tires
  - Spare tires
  - Self sealing tires
  - Run flat tires or self-supporting tires
  - Implement tires
### TE-TM-IMP-01: Introduction to Impression Evidence

<table>
<thead>
<tr>
<th>Topic</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/ Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Bicycle tires</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>□ Lecture/discussion of characteristics and conclusions</td>
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<tr>
<td>□ Class characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Randomly acquired characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Wear characteristics</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>□ Lecture/discussion of databases</td>
<td></td>
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</tbody>
</table>

#### 2.2 Required Readings

- □ Awareness, Detection, and Treatment of Footwear Impression Evidence
- □ Wear Characteristics
- □ Class and Identifying Characteristics
- □ The Crime Scene
- □ A Tire Imprint Identification System
- □ Manufacturing Processes for Athletic Shoe Soles and Their Significance in the Examination of Footwear Impression Evidence

#### 2.3 Practical Exercises

- □ None

#### 2.4 Practical Examination

- □ None

#### 2.5 Written Exercises

- □ Provide written responses to all questions

### 3 CONCLUSION

#### 3.1 Assessment

- □ Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

- □ Evaluation of training module and trainer by trainee

---

Trainee Name ____________________________
### TE-TM-IMP-02: Detection and Recovery of Impression Evidence

#### 1 OBJECTIVES

<table>
<thead>
<tr>
<th>Theoretical</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical objectives reviewed</td>
<td>Practical objectives reviewed</td>
</tr>
</tbody>
</table>

#### 2 LESSON PLAN

##### 2.1 Instructional Outline

- Lecture/discussion of introduction to detection of impressions
- Oblique lighting
- Alternate light source
- Lecture/discussion of impression recovery techniques
- Photography
- Techniques used for casting of impressions
- Electrostatic lifting
- Gel lifts
- Lecture/discussion of evaluation of recovery techniques
- Advantages
- Disadvantages

##### 2.2 Required Readings

- Detection of Impression Evidence by Oblique Lighting SOP
- Casting of Impression Evidence SOP
- Recovery of Impressions Using Electrostatic Lifting SOP
- Gelatin Lift SOP
- Photography of Footwear Impressions
- Casting Three-Dimensional Footwear Impressions
- Treatment of Two-Dimensional Footwear Impressions
- Documenting and Recovering Tire Impression Evidence
- Recording Tire Imprints
### TE-TM-IMP-02: Detection and Recovery of Impression Evidence

<table>
<thead>
<tr>
<th>2.3 Practical Exercises</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document and photograph impressions (footwear/tire) in different substrates and environments obtaining both general and examination quality photos</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Recover impressions (footwear/tire) using the techniques of castings, electrostatic lifting, and gel lifts</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.4 Practical Examination</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document, evaluate, and correctly apply the techniques discussed on multiple impressions</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>2.5 Written Exercises</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide written responses to all questions</td>
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<td></td>
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</tbody>
</table>

### 3 CONCLUSION

<table>
<thead>
<tr>
<th>3.1 Assessment</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfactory completion of written/practical exercises and practical examination assessed by trainer</td>
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</table>

<table>
<thead>
<tr>
<th>3.2 Evaluation</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation of training module and trainer by trainee</td>
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</tbody>
</table>

### OTHER

|   |   |   |   |
## Objectives

### Theoretical
- Review of theoretical objectives

### Practical
- Review of practical objectives

## Lesson Plan

### Instructional Outline
- Lecture/discussion of techniques used:
  - Large ink pad
  - Silicon spray
  - Invisible ink
  - Petroleum jelly
  - Bio-foam
  - Casts
- Lecture/discussion of labeling of test prints
- Lecture/discussion of evaluation of techniques
- Advantages
- Disadvantages

### Required Readings
- Known Footwear and Tire Track Impressions SOP
- Known Shoes of Suspects and the Preparation of Known Impressions
- What Can Be Learned When You Do Have a Suspect’s Tire
- Known Exemplars of Tires for Elimination and Examination

### Practical Exercises
- Produce test prints from several items provided by the trainer
- Produce, evaluate, and document observations of several test prints
- Multiple techniques used for each item
- Duplicate test prints made for each technique used
### TE-TM-IMP-03: Impression Test Prints

<table>
<thead>
<tr>
<th>Task</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials / Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Compare test prints created, discuss the differences observed between techniques, and evaluate their advantages and disadvantages with the trainer</td>
<td></td>
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</tbody>
</table>

#### 2.4 Practical Examination

- □ Properly document a tire and shoe provided to produce test prints
- □ Produce test prints from the tire and shoe

#### 2.5 Written Exercises

- □ Provide written responses to all questions

#### 3 CONCLUSION

#### 3.1 Assessment

- □ Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

- □ Evaluation of training module and trainer by trainee

### OTHER

<table>
<thead>
<tr>
<th>Other Information</th>
<th>Trainee Initials</th>
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<th>Trainer Initials / Evaluation</th>
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<tbody>
<tr>
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</table>
## TE-TM-IMP-04: Enhancement of Impression Evidence

### 1 OBJECTIVES

<table>
<thead>
<tr>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
</table>

#### 1.1 Theoretical
- [ ] Theoretical objectives reviewed

#### 1.2 Practical
- [ ] Practical objectives reviewed

### 2 LESSON PLAN

#### 2.1 Instructional Outline
- [ ] Lecture/discussion of chemical enhancement techniques
- [ ] Diaminobenzidine
- [ ] Amido black
- [ ] Luminol
- [ ] Leucocrystal violet
- [ ] Lecture/discussion of evaluation of techniques
- [ ] Advantages
- [ ] Disadvantages
- [ ] Lecture/discussion of documentation and quality control
- [ ] Lecture/discussion of effects of other testing before and after chemical treatments

#### 2.2 Required Readings
- [ ] Enhancement of Impressions using Diaminobenzidine (DAB) SOP
- [ ] Sulfosalicylic Acid Fixer Solution SOP
- [ ] Enhancement of Impressions by Amido Black SOP
- [ ] Detection of Blood Impressions by Luminol SOP
- [ ] Enhancement of Impressions by Leucocrystal Violet SOP
- [ ] The Enhancement of Footwear Impressions
- [ ] Material Safety Data Sheets for: 5-Sulfosalicylic Acid, 3,3-Diaminobenzidine Tetrahydrochloride Amido Black, Glacial Acetic Acid, Methanol, Citric Acid, Luminol, Sodium Carbonate, Sodium Perborate, Sodium Acetate, Leucocrystal Violet Dye
## TE-TM-IMP-04: Enhancement of Impression Evidence

<table>
<thead>
<tr>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
</table>

### 2.3 Practical Exercises
- [ ] Chemically enhance several bloody impressions on different substrates
- [ ] Demonstrate proper documentation and quality control for
  - Diaminobenzidine
  - Amido black
  - Luminol
  - Leucocystal violet
- [ ] Enhance multiple bloody impressions provided by the trainer using each technique covered

### 2.4 Practical Examination
- [ ] Chemically enhance a bloody impression(s)
  - [ ] Proper documentation of the enhancement solution and technique(s) used
  - [ ] Proper documentation of the bloody impression before and after enhancement
- [ ] Demonstrate proper selection and documentation of the enhancement technique(s) and proper enhancement of the impression(s)

### 2.5 Written Exercises
- [ ] Provide written responses to all questions

## 3 CONCLUSION

### 3.1 Assessment
- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer

### 3.2 Evaluation
- [ ] Evaluation of training module and trainer by trainee

**OTHER**
### TE-TM-IMP-05: Comparison of Impression Evidence

<table>
<thead>
<tr>
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<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td>1.1 Theoretical</td>
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<tr>
<td>☐ Theoretical objectives reviewed</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1.2 Practical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Practical objectives reviewed</td>
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</tbody>
</table>

### 2 LESSON PLAN

#### 2.1 Instructional Outline
- ☐ Lecture/discussion of comparison methodology
- ☐ Documentation of questioned and known
- ☐ Test prints of known exemplars
- ☐ Side by side method and overlay method
- ☐ Conformation of Randomly acquired characteristics to known item
- ☐ Randomly acquired characteristics verified by second examiner
- ☐ Lecture/discussion of the comparison process
- ☐ Discussion/demonstration of criteria used to make a class association
- ☐ Discussion/demonstration of criteria used to make an identification
- ☐ Discussion/demonstration of criteria used to make an elimination or exclusion
- ☐ Lecture/discussion of conclusions and disclaimers or limitations
- ☐ Lecture/discussion technical and administrative Reviews
- ☐ Lecture/discussion of court testimony

#### 2.2 Required Readings
- ☐ Comparison of Impression Evidence SOP
- ☐ Comparison of the Questioned Impression with Known Shoes
- ☐ The Footwear Impression Examiner in Court
- ☐ Tire Wear
- ☐ Individual Characteristics
- ☐ Examination Methodology and Procedure for Comparison of Tire Impressions
- ☐ Resources and Databases
### TE-TM-IMP-05: Comparison of Impression Evidence

<table>
<thead>
<tr>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/ Evaluation</th>
</tr>
</thead>
</table>

- [ ] A Tire Imprint Identification System
- [ ] Preparation for Trial

#### 2.3 Practical Exercises

- [ ] Compare a question impression(s) and known item(s) (shoe/tire) with conclusions including class association, identification, and/or elimination
- [ ] Demonstrate proper documentation of the comparison along with appropriate conclusion statements
- [ ] Review examples of impression reports
- [ ] Review completed case folders
- [ ] Perform technical reviews on non-reviewed case folders
- [ ] Observe actual testimony by an experienced impression examiner

#### 2.4 Practical Examination

- [ ] Compare a question impression(s) and a known item(s) (shoe/tire)
- [ ] At the discretion of the trainer, collect or enhance provided impressions for comparison
- [ ] Complete a comparison(s) with items provided and properly document and determine a conclusion

#### 2.5 Written Exercises

- [ ] Provide written responses to all questions

### 3 CONCLUSION

#### 3.1 Assessment

- [ ] Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

- [ ] Evaluation of training module and trainer by trainee

### OTHER
<table>
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# TE-TM-IMP-06: Digital Image Processing

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<td>□ Theoretical objectives reviewed</td>
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<td><strong>1.2 Practical</strong></td>
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<tr>
<td>□ Practical objectives reviewed</td>
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## 2 LESSON PLAN

### 2.1 Instructional Outline

- □ Lecture/discussion of current digital image processing software to include:
  - □ Approved/prohibited items
  - □ Calibration/re-sizing
  - □ Shortcuts
- □ Lecture/discussion of recommended general workflow for digital image processing
- □ Lecture/discussion of special techniques, archiving, and printing digital images

### 2.2 Required Readings

- □ TE-09-16: Digital Imaging and Processing of Impression Evidence
- □ Guidelines for the Forensic Imaging Practitioner, Section 5
- □ Guidelines for the Forensic Imaging Practitioner, Section 9
- □ Guidelines for the Forensic Imaging Practitioner, Section 11
- □ Guidelines for the Forensic Imaging Practitioner, Section 16
- □ Guidelines for the Forensic Imaging Practitioner, Section 17

### 2.3 Practical Exercises

- □ Process at least five images with different backgrounds

### 2.4 Practical Examination

- □ Process at least three images with different backgrounds

### 2.5 Written Exercises

- □ Provide written responses to all questions
<table>
<thead>
<tr>
<th>3  CONCLUSION</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tr>
<td>TE-TM-IMP-07: Fabric Impressions</td>
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<td><strong>2 LESSON PLAN</strong></td>
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<tr>
<td>2.1 Instructional Outline</td>
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<tr>
<td>☐ Lecture/discussion of textile patterns</td>
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<tr>
<td>☐ Weave</td>
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<td>☐ Knit</td>
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<tr>
<td>☐ Fancy weaves</td>
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<tr>
<td>☐ Non-woven fabrics</td>
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<td>☐ Lecture/discussion of the types of fabric impressions</td>
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<td>☐ Two-dimensional – positive and negative</td>
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<td>☐ Three-dimensional</td>
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<td>☐ Lecture/discussion of the collection and documentation of fabric impression evidence</td>
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<tr>
<td>☐ Photography</td>
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<tr>
<td>☐ Enhancement</td>
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<td>☐ Lifting</td>
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<tr>
<td>☐ Lecture/discussion of describing fabric impressions and known fabric standards</td>
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<tr>
<td>☐ Class characteristics (e.g., yarn twist, seam location, etc.)</td>
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<tr>
<td>☐ Randomly acquired characteristics (e.g., cuts, tears, unraveling, etc.)</td>
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<tr>
<td>☐ Lecture/discussion of test impression methods</td>
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<tr>
<td>☐ Fingerprint ink and paper</td>
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<tr>
<td>☐ Inkless kit</td>
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<tr>
<td>☐ Petroleum jelly and fingerprint powder</td>
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<tr>
<td>☐ Fingerprint powder and lift tape</td>
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<tr>
<td>☐ Lecture/discussion of comparisons, interpretation, and testimony</td>
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Trainee Name ________________________________

### TE-TM-IMP-07: Fabric Impressions

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<tbody>
<tr>
<td>[ ] TE-09-04: Fabric Impression Evidence</td>
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<td>[ ] An Unusual Case Involving the Individualization of Fabric Impressions Made by a Sock-clad Foot</td>
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<tr>
<td>[ ] An Unusual Case Involving the Individualization of a Clothing Impression on a Motor Vehicle</td>
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<td>[ ] Impression Evidence Workshop PowerPoint (PDF)</td>
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<td>[ ] Fabric Impression Workshop PowerPoint (PDF)</td>
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<tr>
<td>[ ] Techniques of Crime Scene Investigation</td>
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<table>
<thead>
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<th>2.3 Practical Exercises</th>
<th>Trainee Initials</th>
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<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td>[ ] Document and collect questioned fabric impressions on various surfaces</td>
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<tr>
<td>[ ] Prepare test impressions using at least two different methods</td>
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<tr>
<td>[ ] Compare test and questioned impressions, document observations, and draw conclusions</td>
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<tr>
<td>[ ] Process additional samples, if necessary</td>
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<table>
<thead>
<tr>
<th>2.4 Practical Examination</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td>[ ] Process, collect, document, and compare questioned and known item(s)</td>
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<tr>
<td>[ ] Prepare reporting statements based on observations and conclusions</td>
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<table>
<thead>
<tr>
<th>2.5 Written Exercises</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
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<tbody>
<tr>
<td>[ ] Provide written responses to all questions</td>
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### 3 CONCLUSION

<table>
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<th>3.1 Assessment</th>
<th>Trainee Initials</th>
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<th>Trainer Initials/Evaluation</th>
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<td>[ ] Evaluation of training module and trainer by trainee</td>
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**OTHER**

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Trainee Name

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<td>Comprehensive written examination</td>
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Trainee Name __________________________ Date Training Began ________________

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**TE-TM-PST-01: Introduction to Pressure Sensitive Adhesive Tape**

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<tr>
<th>1 OBJECTIVES</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/ Evaluation</th>
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<tbody>
<tr>
<td>1.1 Theoretical</td>
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<tr>
<td>✅ Theoretical objectives reviewed</td>
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<tr>
<td>1.2 Practical</td>
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**2 LESSON PLAN**

<table>
<thead>
<tr>
<th>2.1 Instructional Outline</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/ Evaluation</th>
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<tr>
<td>Lecture/discussion of classification of different types of tapes</td>
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<tr>
<td>Duct tape</td>
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<tr>
<td>Electrical tape</td>
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<tr>
<td>Filament tape</td>
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<tr>
<td>Packaging tape</td>
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<tr>
<td>Masking/paper/acetate tapes</td>
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<tr>
<td>Lecture/discussion of manufacturing process</td>
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<td>Duct Tape Analysis As Trace Evidence</td>
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<tr>
<td>The Forensic Value of Duct Tape</td>
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**2.3 Practical Exercises**

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**2.5 Written Exercises**

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<th>Trainer Initials/ Evaluation</th>
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**3.2 Evaluation**

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<tr>
<td>TE-TM-PST-01: Introduction to Pressure Sensitive Adhesive Tape</td>
<td>Trainee Initials</td>
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Trainee Name ______________________

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<th>TE-TM-PST-02: Examination of Pressure Sensitive Adhesive Tape</th>
<th>Trainee Initials</th>
<th>Date Completed</th>
<th>Trainer Initials/Evaluation</th>
</tr>
</thead>
</table>

1 OBJECTIVES

1.1 Theoretical

☐ Theoretical objectives reviewed

1.2 Practical

☐ Practical objectives reviewed

2 LESSON PLAN

2.1 Instructional Outline

☐ Lecture/discussion of trace evidence recovery from tape

☐ Lecture/discussion of physical characteristics

☐ Width of tape

☐ Color and backing

☐ Presence and shape of any calendering

☐ Overall thickness and thickness of the backing

☐ Fabric weave

☐ Number of threads per inch in the warp and fill directions

☐ Color of the adhesive

☐ Polymer orientation

☐ Lecture/discussion of microscopic analysis

☐ Examination of adhesive and backing

☐ Cross sections of tape

☐ Fiber analysis

☐ Lecture/discussion of chemical and polymer analysis

☐ Fiber analysis

☐ Backing analysis

☐ Adhesive analysis

2.2 Required Readings

☐ Comparison of Adhesive Tape SOP

☐ Fiber Initial Examination and Overview SOP

☐ Fiber Fluorescence Microscopy SOP
### TE-TM-PST-02: Examination of Pressure Sensitive Adhesive Tape

<table>
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<tr>
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<td>□ Physical Comparison SOP</td>
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<td>□ Fracture Physical Match Comparison SOP</td>
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<tr>
<td>□ Microscopic Examination of Fibers SOP</td>
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<tr>
<td>□ Cross-Sectioning of Fibers SOP</td>
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<tr>
<td>□ Infrared Microspectroscopy of Man-Made Fibers SOP</td>
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<tr>
<td>□ Pyrolysis-Gas Chromatography SOP</td>
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<tr>
<td>□ Forensic Examination of Duct Tape</td>
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<tr>
<td>□ The Comparison of Black Polyvinylchloride (PVC) Tape by Pyrolysis Gas Chromatography</td>
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<tr>
<td>□ Forensic Characterization of Black Polyvinylchloride Electrical Tape</td>
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<tr>
<td>□ Identification and Comparison of Electrical Tapes Using Instrumental Statistical Techniques: 1. Microscopic Surface Texture and Elemental Composition</td>
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<tr>
<td>□ A New Approach for the Analysis of Duct Tape Backings</td>
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<tr>
<td>□ Forensic Analysis of Pressure-Sensitive Tapes presented at the Pressure Sensitive Tape Council Technical Meeting</td>
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</tbody>
</table>

#### 2.3 Practical Exercises

- □ Document the physical characteristics and obtain infrared spectra and pyrograms of tape components for several types and brands of adhesive tape such as the following:
  - Duct tape
  - Electrical tape
  - Filament tape
  - Packaging tape
  - Masking/paper/acetate tapes

#### 2.4 Practical Examination

- □ Compare and document physical and microscopic characteristics of tape samples
- □ Obtain and compare infrared spectra and pyrograms of tape samples
- □ Prepare a written report on the results of the practical examination
<table>
<thead>
<tr>
<th>TE-TM-PST-02: Examination of Pressure Sensitive Adhesive Tape</th>
<th>Trainee Initials</th>
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<tr>
<td><strong>2.5 Written Exercises</strong></td>
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<tr>
<td>□ Provide written responses to all questions</td>
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<tr>
<td><strong>3 CONCLUSION</strong></td>
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<td>□ Satisfactory completion of written/practical exercises and practical examination assessed by trainer</td>
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<tr>
<td><strong>3.2 Evaluation</strong></td>
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<td>□ Evaluation of training module and trainer by trainee</td>
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**OTHER**

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Trainee Name ________________________________
### TE-TM-PST-03: Interpretation of Pressure Sensitive Adhesive Tape

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<td>1.2 Practical</td>
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<td>2.2 Required Readings</td>
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<td>□ The Forensic Value of Duct Tape Comparisons</td>
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<td>□ Adhesive Tape Analysis: Establishing the Evidential Value of Specific Techniques</td>
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<td>□ Evidential Examinations of Duct Tape</td>
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<td>□ A Validation Study for Duct Tape End Matches</td>
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<td>□ Explain the significance of the results of a mock pressure sensitive adhesive tape case</td>
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<td>□ Review examples of pressure sensitive adhesive tape reports</td>
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<td>□ Issue reports based on case scenarios and/or mock evidence</td>
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<tr>
<td>□ Review completed case folders</td>
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<tr>
<td>□ Perform technical reviews on non-reviewed case folders</td>
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<td>□ Observe actual testimony by an experienced tape examiner</td>
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<td>2.5 Written Exercises</td>
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3 CONCLUSION

3.1 Assessment

☐ Satisfactory completion of written/practical exercises and practical examination assessed by trainer

3.2 Evaluation

☐ Evaluation of training module and trainer by trainee

OTHER

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<tr>
<th>Unit Examination and Competency</th>
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<td>2.1 Instructional Outline</td>
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<td>□ Crystal optics</td>
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<td>□ Lecture/discussion of analysis of solids</td>
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<td>□ Instrumental analysis</td>
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<td>□ General unknowns, solids, and liquids</td>
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<td>□ Pre and post-blast low explosives</td>
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<td>□ Product tampering</td>
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<td>□ Residues on clothing, including but not limited to lubricants, lachrymators, and chemical dye packs</td>
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<td>□ Lecture/discussion of report wording</td>
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### 2.2 Required Readings

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<td>Polarized Light Microscopy</td>
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<td>Particle Characterization by PLM Part I: No Polars</td>
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<td>Particle Characterization by PLM Part II: Single Polar</td>
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<td>Particle Characterization by PLM Part III: Crossed Polar</td>
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<td>Microscopy and Microchemistry of Physical Evidence</td>
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<td>Examination for Petrolatum Based Lubricants in Evidence from Rapes and Sodomies</td>
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<td>A Comparison of Ionization Techniques for Gas Chromatography/Mass Spectroscopy Analysis of Dye and Lachrymator Residues from Exploding Bank Security Devices</td>
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<tr>
<td>Chemical and Elemental Composition Comparison of Two Formulations of Oleoresin Capsicum</td>
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<tr>
<td>Identification of Dog Repellant in the Clothes of an Assault Suspect Using Gas Chromatography/Mass Spectrometry</td>
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<tr>
<td>An Assessment of Four Solvents for the Recovery of 2-chlorobenzylidenemalononitrile and Capsaicins from “CS” and “Pepper” Type Lachrymator Sprays, and an Examination of Their Persistence on Cotton Fabric</td>
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<td>Analysis of Chemical Protection Sprays by Gas Chromatography/Mass Spectroscopy</td>
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<td>Increased Discrimination in the Analysis of Oleoresin Capsicum (OC) Defense Sprays</td>
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<td>The Identification of Capsaicinoids in Tear-Gas Spray</td>
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<td>Quantitative Analysis of Capsaicinoids in Fresh Peppers, Oleoresin Capsicum, and Pepper Spray Products</td>
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### 2.3 Practical Exercises

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<tr>
<td>Analyze solid samples using the various techniques in unknown substance analysis</td>
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<tr>
<td>Analyze liquid samples using the various techniques in unknown substance analysis</td>
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## TE-TM-UNK-01: Unknown Substances Examination

<table>
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<tr>
<td>Identify contaminants in household items and food products</td>
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<td>Identify residues on clothing</td>
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<tr>
<td>Perform technical reviews on non-reviewed case folders</td>
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<tr>
<td>Observe actual testimony by an experienced unknowns substance examiner</td>
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### 2.4 Practical Examination

- Analyze and identify unknown substance samples

### 2.5 Written Exercises

- Provide written responses to all questions

### 3 CONCLUSION

#### 3.1 Assessment

- Satisfactory completion of written/practical exercises and practical examination assessed by trainer

#### 3.2 Evaluation

- Evaluation of training module and trainer by trainee

### OTHER

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