ILLINOIS STATE POLICE

Division of Forensic Services
Forensic Sciences Command
TRAINING MANUALS

TABLE OF CONTENTS
DNA EVIDENCE TECHNICIANS

INTRODUCTION TO THE
DNA EVIDENCE TECHNICIAN TRAINING MANUAL

The DNA evidence technician training program has been designed to teach the DNA evidence technician the skills necessary to support the DNA analysis section/analysts. Good working habits, technical skills, and the theory andmethodology of the procedures and instrumentation will be covered. Also included in this training are quality assurance and DNA guidelines which provide the framework forensuring the high quality of DNA testing. Much of this training program has been modeled after the training program designed for DNA analysts. Only the number of exercises and the written requirements have been modified. It should be noted that several modules of the DNA Evidence Technician Training program are optional. Depending on the needs of the laboratory, the duties of the DNA Evidence Technicians can be limited in scope to the modules they have successfully completed. It is up to each laboratory to determine what modules they want their DNA Evidence Technician to complete and design their training program to include those modules.

Note: Only those modules successfully completed define the DNA Evidence Technician's scope of duties. Additionally, it is assumed that all evidence technicians entering this training program have been through a formal employee orientation program, covering the subjects of facility safety and security, blood borne pathogens and chemical hygiene, basic evidence handling and CALMS training.

For the DNA Evidence Technician, goals are set by position description. The DNA Evidence Technician training program is designed to train an SPET II to preparereagents, perform quality control on critical reagents for analyst's review and to perform non-interpretive analysis under direct analyst supervision. In general, training will include lecture and laboratory exercises with practical examinations. Training willbe provided by a certified DNA analyst.

In keeping with the educational goals of the training program, it is essential that each individual devote his or her full efforts to studies and assignments. Progress will be evaluated through assignments, student demonstration, practical tests, and proficiency samples. Training is divided into modules which will be covered in distinct blocks of time. The goals and objectives to be covered during each module will be listed at the beginning of each chapter. DNA Evidence Technicians who fail to maintainan acceptable level of academic progress will be appropriately counseled. DNA Evidence Technicians who fail to remedy their academic standing after counseling shall be recommended for elimination from the training program.

In order to evaluate progress, an evaluation of performance will be made at appropriate intervals using the performance evaluation document, CMS 201, if appropriate. For the individual in trainee status, monthly evaluations will be performed to ensure both the supervisor and the DNA Evidence Technician are aware of expectations, progress, and goals set for the DNA Evidence Technician.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

MODULE: CLEAN TECHNIQUE

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

PROCEDURAL REFERENCE

Forensic Biology/DNA Procedures Manual Section FB-I-A, Appendix IV-A and Appendix IV-B

UNIT ESTIMATED TIME

1 Day

GOAL

Provide the evidence technician with the information necessary to understand the importance of and the practice of clean technique utilized during the biology/DNA procedures.

OBJECTIVES

1. The evidence technician will demonstrate competency in the use of clean technique. This module may be covered several times if the needs of the laboratory dictate that the modules on analytical techniques will be covered at a later time.

2. The evidence technician will demonstrate sufficient knowledge and skills required for proper clean technique during all phases of the training. Successful completion will be determined by instructor observation.

LESSON 1

Estimated Time: 1 Day

Purpose: To familiarize the evidence technician with the clean technique procedures.

Lectures: Clean Technique – Overview of Topics

- Decontamination of the General Laboratory and Individual Work Areas
- Cleaning and Sterilization Procedures of Laboratory Equipment
- Forensic Biology/DNA Procedures Manual, FB-I-A Clean Technique Procedures, Initial Steps Prior to Starting Analysis
- Policies for Amplification Set Up and Post PCR Product Processing Rooms
- Use of Autoclave (if used by laboratory)

Exercise:

1. Read Forensic Biology/DNA Procedures Manual, FB-I-A Clean Technique; Forensic Biology/DNA Procedures Manual, FB-App IV-A - Forensic Biology Quality Assurance, Sample Handling and Facility Requirements; Forensic Biology/DNA Procedures Manual, FB-App IV-B - DNA Quality Assurance, Sample Handling and Facility Requirements; and the laboratory's facility operations manual policy on clean technique.
2. Review where gloves, sleeve covers, disposable lab coats, bleach,bleach bottles, etc. are stored. Set up individual work area withappropriate materials.

3. Decontaminate general laboratory and individual work areas under direct supervision. Review bleach log and make appropriate entries.
4. Review how to operate ultraviolet (UV) light in hoods and what must be exposed to UV light before and after use. Under direct supervision, set up tubes, Microcons and/or disposable beakers for 30 minute UV exposure.
5. Read operating manual for autoclave. Under direct supervision, run the autoclave through a dry cycle and a liquid cycle.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

MODULE: QUALITY ASSURANCE

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PROCEDURAL REFERENCE

Forensic Biology/DNA Procedures Manual Appendix IV-A and Appendix IV-B

UNIT ESTIMATED TIME

3 to 5 Days

GOAL

Provide the information necessary for the evidence technician to understand and adhere to the Illinois State Police Command and Federal quality assurance standards.

OBJECTIVES

1. Participate in quality assurance procedures. The following are examples of quality assurance activities for which the evidence technician can be responsible: temperature recording for waterbaths, refrigerators and freezers; thermal cycler temperature verification and uniformity tests: quality control tests for reagents; chemical inventory tracking; and monitoring of facility bleaching. Successful completion will be determined by instructor observation.

   The lessons in this module may be covered several times, as determined by the needs of the laboratory.

LESSON 1

Estimated Time: 0.5 Day

Purpose: To familiarize the evidence technician with the quality assurance procedures.

Lectures: Quality Assurance – Overview of Topics
- Goals and Objectives
- Sample Handling and Facility Requirements – also reviewed in the Clean Technique Module
- Evidence Control
- Analytical Procedures – also reviewed in the Reagent Preparation Module
- Reagents/Chemicals – also reviewed in the Reagent Preparation Module
- Critical Reagents
- Annual System Verification with Standard Reference Material (SRM)
- Proficiency Testing
- Audits

Exercise:
1. Read the appropriate sections listed in the overview of topics in the Forensic Biology/DNA Procedures Manual.

LESSON 2

Estimated Time: 1 Day

Purpose: To familiarize the evidence technician with the procedures for equipment function checks and maintenance.

Lectures: Equipment Function Checks and Maintenance – Overview of Topics

- Equipment Function Check Information: Procedure, Frequency, Results, and Course of Action
- Balance and Oven Checks
- Freezer/Refrigerator Temperature Checks
- Waterbath Temperature Recording
- Microscope Cleaning
- Thermal Cycler Function Check – temperature verification and uniformity tests. Calibration kits tested yearly by outside source.
- NIST and NIST Traceable Thermometer Function Checks

Exercises:

1. Read the sections listed in the overview of topics in the Forensic Biology/DNA Procedures Manual, FB-App IV-A and IV-B.
2. Review logbooks. Perform monthly quality assurance checks with instructor.

LESSON 3

Estimated Time: 1 to 3 Days – dependent on the number of critical reagents and control tests included in training.

Purpose: To familiarize the evidence technician with the procedure to prepare and run quality control tests on critical reagents.

Lectures: Quality Assurance – Overview of Topics

- Quality Control Tests
- Standards and Controls

Exercises:

1. Read appropriate analytical procedures section***s*** of the Forensic Biology/DNA Procedures Manual.
2. Prepare critical reagents and run quality control tests on the following critical reagents: DNA quantification kit, and/or STR amplification kits.
3. Prepare critical reagent documentation and review critical reagent logbook.
4. Identify standards and controls for DNA procedures.

LESSON 4

Estimated Time: 0.5 Day

Purpose: To familiarize the evidence technician with the Quality Assurance Standards for Forensic DNA Testing Laboratories and DNA Databasing Laboratories.

Exercise:

1. With the instructor, review the appropriate audit document and discuss how the laboratory satisfies each standard.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

MODULE: REAGENT PREPARATION/CHEMICAL USE

Reviewed by:

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Director of Training

PROCEDURAL REFERENCE

Forensic Biology/DNA Procedures Manual Appendix IV-A and Appendix IV-B

UNIT ESTIMATED TIME

2 Days

GOAL

To learn how to properly prepare reagents for the Forensic Biology/DNA laboratory.

OBJECTIVES

1. The evidence technician will demonstrate sufficient knowledge and skill required for proper reagent preparation and tracking. Successful completion will be determined by instructor observation of reagent preparation on a pass/fail basis.

2. Learn the safety hazards and requirements of safe handling for Forensic Biology/DNA chemicals and reagents. Successful completion will be determined by instructor observation.

3. The evidence technician will demonstrate competency in the use of the laboratory pH meter and balances by completing a practical test for each instrument. Successful completion of the practical test will be determined by instructor observation on a pass/fail basis.

LESSON 1

Estimated Time: 2 Days

Purpose: To familiarize the evidence technician with the procedures to prepare and track Forensic Biology/DNA laboratory reagents.

Exercise:

1. Read the Analytical Procedures section of the Forensic Biology/DNA Quality Assurance Manual.
2. Identify and become familiar with hazardous chemicals found under safety considerations of each analytical technique in the Forensic Biology/DNA Procedures Manual.
3. Review how to properly label reagents using National Fire Protection Agency (NFPA) codes.
4, Review the location and use of Material Safety Data Sheets (MSDS), for the section and for the laboratory.
5. Review the reagent logbook, chemical logbook and individual logbook for Forensic Biology/DNA reagents.
6. Review the operating manual for the pH meter.
7. Practice the use of the pH meter.
8. Complete a practical test for the use of the pH meter. See Appendix B.
9. Review the operating manuals for laboratory balances.

10. Practice the use of balances.
11. Complete a practical test for the use of balances. See Appendix B.
12. Prepare and track reagents under the direct supervision of the instructor.
13. Complete a practical test for reagent preparation and tracking. See Appendix B.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

MODULE: PREPARATION OF AMPLIFIED DNA SAMPLES

Reviewed by:

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Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

PROCEDURAL REFERENCE

Forensic Biology/DNA Procedures Manual, FB-IIIC-1

UNIT ESTIMATED TIME

0.5 - 1 Day

GOAL

To provide the necessary information for the evidence technician to successfully perform preparation of amplified samples of CE analysis using the Illinois State Police, ForensicSciences Command STR Analysis procedures.

OBJECTIVES

1. The evidence technician will demonstrate sufficient knowledge and skill in the Illinois State Police, Forensic Sciences Command procedures for amplified DNA sample preparation by completing practical exercises. A practical test consisting of unknown samples must be completed with the correct single source STR/DNA profile exhibited in each sample. This module may be completed in conjunction with the module on CE data analysis.

LESSON 1

Estimated Time: 0.5 – 1 Day

Purpose: To familiarize the evidence technician with sample preparation procedures for the capillary electrophoresis instrument (CE).

Demonstration: Sample Preparation

Exercises:

1. Read relevant portions of the Forensic Biology/DNA Procedures Manual, FB-IIIC-1.
2. Prepare a known sample set for CE analysis, under direct supervision. Each sample set should contain ten (10) samples which have been previously analyzed on the CE. All appropriate standards and controls must be included. After CE analysis, the instructor will compare the DNA profiles of the sample set against the known DNA profiles. The samples must exhibit the correct single source DNA profile and RFU values comparable to the known data.
3. Practice preparation of known sample sets, the number of sets to be determined by the instructor. Each sample set should contain ten (10) samples which have been previously analyzed on the CE. All appropriate standards and controls must be included. Evaluation of the exercise results will be done by the instructor as in Exercise 2.
4. Complete practical examination for preparation of amplified DNA samples. See Appendix B, Part A and Part B.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

MODULE: AMPLIFICATION OF STRs USING THE POLYMERASE CHAIN REACTION (PCR)

Reviewed by:

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Approved by:

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PROCEDURAL REFERENCE

Forensic Biology/DNA Procedures Manual, FB-IIIC-1

UNIT ESTIMATED TIME

3 Days

GOAL

To provide the necessary information for the evidence technician to successfully perform amplification of STRs using the Illinois State Police, Forensic Sciences command PCR amplification procedures.

OBJECTIVES

1. The evidence technician will demonstrate competency in the Illinois State Police, Forensic Sciences Command PCR Amplification procedure by completing a practical exercise and a practical test. Successful completion will be determined by instructor evaluation on a pass/fail basis.

LESSON 1

Estimated Time: 3 Days

Purpose: To familiarize the evidence technician with the procedure for PCR amplification.

Lectures: Amplification of STRs – Overview of Topics

- ISP PCR amplification procedure for STRs – Forensic Biology/DNA Procedures Manual, FB-IIIC-1
- Amplification Kits
- Standards/Controls
- ISP Thermal Cycler Amplification Conditions
- Contamination Issues During PCR Amplification
- Documentation - Worksheets

Demonstration: PCR Amplification Procedure

Exercises:

1. Read the ISP PCR Amplification Procedure for STRs – Forensic Biology/DNA Procedures Manual, FB-IIIC-1.
2. Perform PCR amplification procedures on quantitated samples of known STR types, including all appropriate controls, under direct supervision. After analysis of the data, the instructor will compare the DNA profiles from the sample set to the known DNA profiles. Each DNA sample should exhibit the correct single source profile and RFU values comparable to the known data.

3. Practice PCR amplification procedures on quantitated samples, including all appropriate controls, minimum number of amplification sets determined by the instructor. Comparison results will be completed by the instructor as in Exercise 1.
4. Complete practical examination for amplification of STRs using the polymerase chain reaction. See Appendix B, Part A and Part B.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

MODULE: CAPILLARY ELECTROPHORESIS UNIT MAINTENANCE

Reviewed by:

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Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

PROCEDURAL REFERENCE

Forensic Biology/DNA Procedures Manual Appendix IV-B
Relevant Capillary Electrophoresis Unit's User's Manual

UNIT ESTIMATED TIME

0.5 Day

GOAL

To provide the necessary information for the evidence technician to successfully perform capillary electrophoresis maintenance using the Illinois State Police, Forensic Sciences Command procedures.

OBJECTIVES

1. The evidence technician will demonstrate sufficient knowledge and skills in using the Illinois State Police, Forensic Sciences Command procedure for CE maintenance. The evidence technician may reference the Forensic Biology/DNA Procedures Manual or relevant instrumentation user's manual while performing maintenance procedures. Successful completion will be determined by instructor evaluation on a pass/fail basis.

LESSON 1

Estimated Time: 0.5 Day

Purpose: To familiarize the evidence technician with maintenance and set up procedures for the Genetic Analyzer (also termed the capillary electrophoresis instrument or CE).

Demonstration: CE Maintenance

Exercises:

1. Read relevant portions of the Forensic Biology/DNA Procedures Manual and Capillary Electrophoresis Unit's User's Manual.
2. Practice maintenance procedures.
3. Perform maintenance procedure under direct supervision of the instructor.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

MODULE: CAPILLARY ELECTROPHORESIS MATRIX CREATION OR SPECTRAL AND SPATIAL RUNS

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Director of Training

PROCEDURAL REFERENCE

Forensic Biology/DNA Procedures Manual Appendix IV-B
Relevant Portions of the Capillary Electrophoresis Unit's User's Manual

UNIT ESTIMATED TIME

0.5 Day

GOAL

To provide the necessary information for the evidence technician to successfully perform matrix creation or to perform spectral and spatial runs using the Illinois State Police, Forensic Sciences Command procedures.

OBJECTIVES

1. The evidence technician will demonstrate sufficient knowledge and skills in using the Illinois State Police, Forensic Sciences Command procedure for matrix creation or for performing spectral and spatial runs by completing practical exercises. Successful completion will be determined by instructor evaluation on a pass/fail basis.

   Note: The DNA Evidence Technician will not be responsible for the interpretation of the matrix, spectral or spatial data. The duties under this module are restricted to the preparation of sample, and the creation of the matrix or performing a spectral or spatial run. Interpretation data will be the responsibility of a qualified DNA analyst.

LESSON 1

Estimated Time: 0.5 Day

Purpose: To familiarize the evidence technician with creating a matrix or for performing a spectral or spatial run for the CE. In addition, the evidence technician will gain familiarity with computer usage and CE set up.

Demonstration: Matrix, Spectral and Spatial Run Procedure

Exercises:

1. Read manufacturer's insert for the matrix standards.
2. Read relevant portions of the Capillary Electrophoresis Unit's User's Manual.
3. Perform matrix or spectral and spatial run exercise.
4. Provide data to instructor for evaluation.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

MODULE: CAPILLARY ELECTROPHORESIS DATA ANALYSIS

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Director of Training

PROCEDURAL REFERENCE

Forensic Biology/DNA Procedures Manual Section IIIC-1
Relevant Portions of the Capillary Electrophoresis Unit's User's Manual

UNIT ESTIMATED TIME

0.5 Day

GOAL

To provide the necessary information for the evidence technician to successfully perform CE data analysis using the Illinois State Police, Forensic Sciences Command STR analysis procedures.

OBJECTIVES

1. The evidence technician will demonstrate sufficient knowledge and skill in the Illinois State Police, Forensic Sciences Command procedures for CE data analysis by completing practical exercises. Successful completion will be determined by instructor evaluation.

   Note: The DNA Evidence Technician will not be responsible for the interpretation of the CE data. The duties under this module are restricted to the creation of sample sheets and injection lists or plate records and use of the appropriate software to analyze the data. Interpretation of the data will be the responsibility of a qualified DNA analyst.

LESSON 1

Estimated Time: 0.5 Day

Purpose: To familiarize the evidence technician with computer data analysis procedures for CE data.

Demonstration: Data Analysis

Exercises:

1. Read the following portion of the Forensic Biology/DNA Procedures Manual: Capillary Electrophoresis Data Collection.
2. Read relevant portions of the Capillary Electrophoresis Unit's User's Manual.
3. Practice data analysis procedures. The minimum number of data analyses to be performed will be determined by the instructor.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

MODULE: DNA PRESERVATION

Reviewed by:

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Training Coordinator

Approved by:

William E. Demuth II
Director of Training

PROCEDURAL REFERENCE

Forensic Biology/DNA Procedures Manual Appendix IV-B – DNA Quality Assurance, Evidence Control

UNIT ESTIMATED TIME

1 Day

GOAL

To provide the necessary information for the evidence technician to successfully preserve DNA from forensic samples utilizing the Illinois State Police, Forensic Sciences Command policies for preserving DNA samples.

OBJECTIVES

1. The evidence technician will demonstrate sufficient knowledge and skill in the Illinois State Police, Forensic Sciences command procedures for DNA preservation by completing practical exercises. Successful completion will be determined by instructor evaluation on a pass/fail basis.

LESSON 1

Estimated Time: 1 Day

Purpose: To familiarize the evidence technician with the process of drying down extracted DNA for preservation purposes.

Demonstration: Use of Speed Vac to Dry Down DNA Samples

Exercises:

1. Read the laboratory's procedure for DNA sample dry down.
2. Perform dry down procedure on extracted DNA samples under direct supervision of instructor.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

MODULE: COURTROOM TRAINING

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Lisa M. Fallara
Training Coordinator

Approved by:

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Director of Training

PROCEDURAL REFERENCE

None

UNIT ESTIMATED TIME

1 Day

GOAL

To achieve the necessary knowledge, skill, and ability to successfully perform courtroom testimony.

OBJECTIVES

1. Demonstrate effective DNA Evidence Technician expert witness testimony that is simple, concise, and accurate by participating in at least one mock trial. Successful completion will be determined by instructor observation on a pass/fail basis with the followingcriteria graded satisfactory: truthful, technically accurate, understandable, believable, evidence handling, and no defensive responses to questions.

2. Attend the one day session on courtroom performance training designed for evidence technicians.

LESSON 1

Estimated Time: 1 Day

Purpose: To learn how to be an effective DNA Evidence Technician expert witness.

Exercise:
1. Participate in Courtroom Demeanor Training for Evidence Technicians.

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

APPENDIX A: DNA EVIDENCE TECHNICIAN TRAINING CHECKLIST

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DNA EVIDENCE TECHNICIAN
TRAINING CHECKLIST

Name: ________________________________

Date Started: ________________________

Authorization for release from training:

Date Released: ________________________

Name/Signature: ______________________________

Unit of Instruction		Date/Initials of Student	Date/Initials of Instructor
Clean Technique			
	Read and understand ISP procedures and appropriate equipment operating manuals.		
	Review location of PPE, bleach, etc. Set up individual work area with appropriate materials.		
	Under direct supervision, decontaminate work areas and make appropriate log entries.		
	Under direct supervision, practice UV decontamination.		
	Under direct supervision, practice proper operation of autoclave.		
Quality Assurance			
	Read and understand procedures.		
	Review logbooks (bleaching, critical reagent, temperature, equipment). Perform monthly checks with instructor.		
	Prepare and perform quality control checks on critical reagents (DNA quantification kit, STR amplification kits).		
	Prepare critical reagent documentation and review critical reagent logbook.		
	Identify DNA standards and controls.		
	With instructor, review appropriate audit document and discuss how the laboratory satisfies each standard.		
Reagent Preparation/Chemical Use			
	Read and understand procedures.		
	Identify hazardous chemicals used in Biology / DNA procedures.		

	Review NFPA codes and proper labelling requirements.		
	Review location and use of MSDS for the section.		
	Review section reagent, chemical and individual logbooks.		
	Review operation and use of the pH meter.		
	Practical Criterion Test – pH Meter		
	Review operation and use of balances.		
	Practical Criterion Test – Balances		
	Under direct supervision, properly prepare and track reagents.		
	Practical Criterion Test – Reagent Preparation and Tracking		
Preparation of Amplified DNA Samples			
	Read and understand procedures.		
	Under direct supervision, prepare a known sample set for CE analysis.		
	Practice independent preparation of known sample sets for CE analysis.		
	Practical Criterion Test – Preparation of Amplified DNA Samples		
Amplification of STRs Using the PCR			
	Read and understand procedures.		
	Under direct supervision, perform PCR on quantitated samples of known STR type.		
	Practice independent PCR amplification of quantitated samples of known STR type.		
	Practical Criterion Test – Amplification of STRs Using the PCR		
CE Unit Maintenance			
	Read and understand ISP procedures and appropriate CE unit user's manual.		
	Practice maintenance procedure.		
	Under direct supervision, demonstrate ability to perform proper maintenance procedures.		
CE Matrix Creation or Spectral and Spatial Runs			
	Read and understand ISP procedures, matrix standard insert, and appropriate CE unit user's manual.		
	Perform matrix or spectral and spatial runs.		
	Provide data from matrix or spectral and spatial runs to instructor for evaluation.		

STR Analysis / CE Data Analysis			
	Read and understand ISP procedures and appropriate CE unit user's manual.		
	Practice data analysis procedures. Minimum number of data sets to be determined by instructor.		
DNA Preservation			
	Read and understand laboratory's DNA sample dry down procedure.		
	Under direct supervision, perform DNA sample dry down procedure.		
Courtroom Training			
	Participate in Courtroom Demeanor Training for Evidence Technicians.		

ILLINOIS STATE POLICE

DNA EVIDENCE TECHNICIAN TRAINING MANUAL

APPENDIX B: DNA EVIDENCE TECHNICIAN TRAINING PRACTICAL EXAMINATIONS

Reviewed by:

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Approved by:

William E. Demuth II
Director of Training

pH Meter Practical Examination

The instructor should provide the evidence technician with a reagent of known pH which the student must demonstrate has the correct value through proper use of the pH meter.

Balance Practical Examination

The evidence technician is asked to weigh out two dry chemicals, one on each balance. One chemical should be weighed out in grams. The second chemical should be weighedout in milligrams.

Reagent Preparation Practical Examination

The evidence technician will prepare and track a reagent which requires using the balance and the pH meter (20X SSC, 1.0M Tris, pH 8.0, Citrate buffer, etc.) The instructor will confirm the pH of the reagent upon completion of the examination.

Preparation of Amplified DNA Samples Practical Examination

Part A – The instructor will provide the evidence technician with a set of serial dilutions (1ng, 0.5ng, 0.25ng, 0.125ng, 0.063ng) which have been previously analyzed. The evidence technician will prepare the serial dilution set for CE analysis, including all propercontrols. Upon completion of the CE run, the instructor will analyze the data and comparethe unknown serial dilution set to the known DNA profiles from the previous run. Each DNA sample must exhibit the correct single source profile and RFU values comparable to the known (previously analyzed data) for successful completion of the practical examination.

Part B – The instructor will provide the evidence technician with a set of ten (10)unknowns (previously analyzed amplified DNA samples). The evidence technician will prepare the unknowns for CE analysis, including all proper controls. Upon completion of the CE run, the instructor will analyze the data and compare the DNA profiles obtained from the unknown sample set to the known DNA profiles from the previous run. Each DNA sample must exhibit the correct single source DNA profile and RFU values comparable to the known (previously analyzed data) for successful completion of the practical examination.

> Note: If this module is administered with the module on CE data analysis, then the evidence technician will be responsible for analyzing the data from the CE run.

Amplification of STRs using PCR Practical Examination

Part A – The instructor will provide the evidence technician with a set of serial dilutions (1ng, 0.5ng, 0.25ng, 0.125ng, 0.063ng) which have been previously analyzed. The evidence technician will prepare the serial dilution set for amplification, including all proper controls. Upon completion of analysis on the CE, the instructor will analyze the data and compare the unknown serial dilution set to the known DNA profiles from the previous run. Each DNA sample must exhibit the correct single source profile and RFU values comparable to the known (previously analyzed data) for successful completion of the practical examination.

Part B – The instructor will provide the evidence technician with a set of ten (10)unknowns (previously analyzed DNA samples). The evidence technician will prepare the unknowns for amplification, including all proper controls. Upon completion of analysis on the CE, the instructor will analyze the data and compare the DNA profiles obtained from the unknown sample set to the known DNA profiles from the previous run. Each DNA sample must exhibit the correct single source DNA profile and RFU values comparable to the known (previously analyzed data) for successful completion of the practical examination.

> Note: If the evidence technician has been qualified in preparation of amplified DNA for CE analysis and/or CE data analysis, or this module is being administered in conjunction with those modules, then the evidence technician will be responsible for completing those steps.

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FORENSIC BIOLOGY

APPENDICES

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: CLEAN TECHNIQUE

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DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

5 Days

GOAL

To understand the importance and practice of clean technique utilized during the Forensic Biology/DNA Procedures.

OBJECTIVES

1. The trainee will demonstrate competency in the use of clean technique in the steps prior to starting analysis and the steps of sample processing by completing a practical criterion test with no less than 100% of the steps performed to training coordinator's satisfaction.

2. The trainee will demonstrate sufficient knowledge and skills required for proper clean technique during all phases of the forensic biology/DNA training. Successful completion will be determined by ongoing training coordinator observation on a pass/fail basis.

LESSON

Lectures:

Clean Technique - Overview of Topics:

- Decontamination of the General Laboratory and Individual Work Areas
- Cleaning and Sterilization Procedures of Laboratory Equipment
- Clean Technique - Initial Steps Prior to Starting Analysis
- Clean Technique - Sample Processing
- Policies for Amplification Set up and Post PCR Product Processing Rooms
- Use of Autoclave

Clean Technique Demonstration

Exercises:

1. Read assigned materials.
2. Prepare general laboratory and individual work areas for sample analysis.
3. Become familiar with use of autoclave.
4. Practice preparing for and processing a series of observation and independent mock exercises.

Required Reading:

1. Relevant portions of the Forensic Biology/DNA Procedures Manual.

2. Operating manual for autoclave.

3. Scherczinger, C. A., Ladd, C., Bourke, M. T., Adamowics, M. S., Johannes, P. M., Scherczinger, R., Beesley, T., Lee, H. C., “A Systematic Analysis of PCR Contamination.” JFS, 1999, Vol. 44, No. 5, pp. 1042-1045.

4. As assigned.

CLEAN TECHNIQUE MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration			
Observation			
Independent exercises			
Practical exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: REAGENT PREPARATION

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Approved by:

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William E. Frank
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William E. Demuth
Director of Training

UNIT ESTIMATED TIME

4 Days

GOAL

To achieve the necessary knowledge, skill and ability to properly prepare reagents for the Forensic Biology/DNA laboratory.

OBJECTIVES

1. The trainee will demonstrate sufficient knowledge and skills required for proper reagent preparation. Successful completion will be determined by training coordinator observation on a pass/fail basis.

LESSON 1

Estimated time: 1 Day

Purpose: To familiarize the trainee with the pH meter usage and performance checks.

Lecture: Use of pH Meter and Performance Checks

Exercises:
1. Read assigned materials.
2. Practice performance checks and measurement with pH meter.

Required Reading:
1. Operating Manual for pH meter.

LESSON 2

Estimated time: 1 Day

Purpose: To familiarize the trainee with the proper use and performance checks of the laboratory balances.

Lecture: Use and Performance Checks of the Laboratory Balances

Exercises:
1. Read assigned materials.
2. Practice performance checks and use of the balances.

Required Reading:
1. Operating Manual for each laboratory balance.

LESSON 3

Estimated time: 1 Day

Purpose: To familiarize the trainee with the procedures to prepare Forensic Biology/DNA laboratory reagents.

Lecture: Reagent Preparation

Exercises:
1. Review chemical storage for the Forensic Biology/DNA section.
2. Review location of MSDS sheets.
3. Review reagent logbook for the Forensic Biology/DNA section.

LESSON 4

Estimated time: 1 Day

Purpose: To familiarize the trainee with the procedures to prepare Forensic Biology/DNA laboratory reagents.

Lecture: Documentation and Labeling Requirements of Prepared Reagents

Exercise:
1. Prepare Forensic Biology/DNA reagents utilized for training.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: EVIDENCE SCREENING QUALITY ASSURANCE

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

3 Days

GOAL

To achieve the necessary knowledge, skill and ability to meet Illinois State Police Command quality assurance standards and guidelines.

OBJECTIVES

1. The trainee will demonstrate knowledge of the ISP quality control program by passing the comprehensive written criterion assessment test with a score of no less than 80%.

2. The trainee will demonstrate knowledge in all aspects of quality assurance control checks and documentation in the Forensic Biology/DNA laboratory by implementing all quality assurance measures. Successful completion will be based upon training coordinator observation on a pass/fail basis.

LESSON 1

Estimated time:	3 Days
Purpose:	To familiarize the trainee with quality assurance issues relating to the forensic biology section.
Lecture:	Quality Assurance Topics
Exercises:	1. Review log books for applicable instrumentation and equipment. 2. Conduct performance checks as assigned by the training coordinator.
Required Reading:	1. Checklist for ISO17025 and related assessment documents.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: EVIDENCE HANDLING

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

4 Days

GOAL

To achieve the necessary knowledge, skill and ability to properly handle evidence.

OBJECTIVES

1. The trainee will demonstrate proper use of evidence tracking forms by preparation of forms using mock evidence. These forms will then be evaluated by the training coordinator on a pass/fail basis.

2. The trainee will demonstrate proper note taking by preparation of notes using mock evidence. These notes will then be evaluated by the training coordinator on a pass/fail basis.

3. The trainee will demonstrate proper debris removal techniques by using mock evidence. The trainee's technique will be evaluated by the training coordinator on a pass/fail basis.

LESSON 1

Estimated time: 1 Day

Purpose: To familiarize the trainee with proper evidence handling procedures.

Lecture: Evidence Tracking and Handling

Exercises:
1. Read assigned materials.
2. Observe evidence sign in and return.
3. Prepare mock evidence receipt, and evidence.
4. Review case folder items and evidence.

LESSON 2

Estimated time: 2 Days

Purpose: The trainee will learn to prepare proper examination notes.

Lecture: Note Taking in the Forensic Biology/DNA Section

Exercises:
1. Practice taking notes on at least five different exhibits.
2. Correct any deficiencies pointed out by training coordinator.
3. Read assigned materials.

LESSON 3

Estimated time: 1 Day

Purpose: The trainee will learn proper debris removal techniques.

Lecture: Debris Removal

Exercises:
1. Practice debris removal techniques on various types of items.
2. Practice proper labeling and packaging of removed debris.
3. Demonstrate to the training coordinator proper debris removal.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: HAIR TRAINING

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

2 Days

GOAL

The trainee will be expected to accomplish objective that will lead to determination of suitability as well as the preparation of hairs and hair roots for nuclear DNA analysis.

OBJECTIVES

1. The trainee will demonstrate a knowledge of characteristics that differentiate human versus animal hairs.

2. The trainee will be able to select appropriate samples for nuclear DNA testing.

3. The trainee will demonstrate how to use the wet mount technique to mount hairs temporarily for identification of suitability for nuclear DNA testing.

4. By the end of the unit, the trainee will demonstrate the ability to determine the suitability for nuclear DNA testing, temporary mounting of hairs and preparation of hair roots for subsequent nuclear DNA testing. Evaluation of ability will be determined by successful completion of written criterion test with a score of no less than 80%.

LESSON 1

Estimated time: 1 Day

Purpose: Introduce the general morphology of skin, the anatomical parts of hair, definitions, types of hair, and identification of hairs suitable for nuclear DNA analysis.

Lecture: Hair Examination-for-DNA PowerPoint and accompanying lecture

Exercise:
1. Become familiar with determining hairs suitable for nuclear DNA analysis using the Hair Picture Practical Handout and Hair DNA Written Criterion Test.

LESSON 2

Estimated time: 1 Day

Purpose: Demonstration of mounting hairs on slides using the wet mount technique and preparation of hairs of subsequent nuclear DNA testing.

Lecture: None

Exercises: 1. Wet mounting method and practical demonstration of mounting hairs by trainee.

Required Reading:

1. Federal Bureau of Investigation (1977) Microscopy of Hair, A Practical Guide and Manual, pp. 1-7, 19-24, 38-39.
2. Saferstein, R. (1982) Forensic Science Handbook, pp. 184-189, 191-192, 195-200.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: BLOOD STAIN SCREENING

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

9 Days

GOAL

To achieve the necessary knowledge, skill and ability to properly analyze blood stain evidence.

OBJECTIVES

1. The trainee will demonstrate knowledge and skill in the use and maintenance of the stereomicroscope to the satisfaction of the training coordinator on a pass/fail basis.

2. The trainee will demonstrate collection and preservation techniques for blood evidence by passing a practical criterion test with a score of no less than 100%. This may be offered in combination with the criterion tests on other body fluid screening.

3. The trainee will demonstrate proficiency in the use of preliminary tests for blood by successfully completing all exercises and written exercise results. Successful completion will be based upon training coordinator evaluation on a pass/fail basis.

4. The trainee will demonstrate a comprehensive understanding of the materials by successfully passing the biology screening assessment module.

LESSON 1

Estimated time: 1 Day

Purpose: The trainee will learn proper use and maintenance of the stereomicroscope.

Lecture: Stereomicroscope Care and Usage

Exercises:
1. Read assigned materials.
2. Practice cleaning of microscope.
3. Practice using the microscope.

Required Reading
1. Saferstein, R., Forensic Science Handbook, Vol. 1, pp. 417-436.

LESSON 2

Estimated Time: 1 Day

Purpose: The trainee will learn techniques for collection and preservation of blood evidence.

Lecture: Collection and Preservation of Blood Evidence

Exercises:
1. Read assigned materials.
2. Practice collection and preservation techniques.

LESSON 3

Estimated time: 1 Day

Purpose: The trainee will receive information regarding how bloodstain pattern evidence relates to stain collection decision making.

Lecture: Bloodstain Pattern Evidence

Exercises:
1. Read assigned materials.
2. Observe, discuss and study examples of bloodstain patterns through training presented by Illinois State Police Crime Scene personnel.

Required Reading:
1. Lecture handout materials.

Supplemental Reference:
1. Eckert, W., and James, S.; Interpretation of Bloodstain Evidence at Crime Scenes.
2. Laber, T. and Epstein, B.; Experiments and Practical Exercises in Bloodstain Pattern Analysis.
3. McDonell, H.; Flight Characteristics and Stain Patterns of Human Blood.

LESSON 4

Estimated time: 6 Days

Purpose: The trainee will learn how to perform preliminary testing for blood.

Lectures: Blood Constituents
Preliminary Tests for Blood

Exercises:
1. Read the assigned materials.
2. Review procedure for preparing Kastle-Meyer reagent.
3. Perform aged stain study.
4. Perform body fluid study.

5. Conduct tests on fresh vegetables.
6. Test catalase and peroxidase.
7. Perform dilution series study.
8. Perform stain size study.
9. Turn in write up of lab exercises.

Required Reading:

1. Gaensslen, R.E.: Sourcebook in Forensic Serology, Immunology and Biochemistry, pp. 101-116, 221-224.

2. Deforest, P., Gaensslen, R., and Lee, H.; Forensic Science, An Introduction to Criminalistics, Chapters 9 and 10.

3. Saferstein, R.; Forensic Science Handbook, Volume 1, pp. 271-297.

4. Forensic Biology Procedures Manual and appropriate sections of Report Wording and Standards and Controls.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: SEMEN STAIN SCREENING

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

6 Days

GOAL

To achieve the necessary knowledge, skill and ability to properly analyze semen stain evidence.

OBJECTIVES

1. The trainee will demonstrate competency in the use of various light sources and stain observation techniques. Successful completion will be determined by training coordinator evaluation on a pass/fail basis.

2. The trainee will demonstrate competency in the use of preliminary testing for semen stains by completing assigned exercises and submission of a report. Successful completion will be determined by training coordinator evaluation on a pass/fail basis.

3. The trainee will demonstrate competency in the use of the compound microscope. Successful completion will be determined by training coordinator evaluation on a pass/fail basis.

4. The trainee will demonstrate competency in the use of the microscope to find spermatozoa. Successful completion will be determined by training coordinator evaluation on a pass/fail basis.

5. The trainee will demonstrate a comprehensive understanding of the material by successfully passing the biology screening assessment module.

LESSON 1

Estimated time: 2 Days

Purpose: To familiarize the trainee with preliminary testing for seminal material.

Lectures:
Male Reproductive System
Alternate Light Sources
Preliminary Testing for Semen

Exercises:
1. Read assigned materials.
2. Prepare semen stains on various materials. Observe using ALS, UV and visual exam.
3. Prepare semen dilution stains and dry on various materials. Observe using ALS, UV and visual exam.
4. Prepare AP test reagents.

5. Conduct aged stain study.
6. Conduct size of stain study.
7 Conduct dilution stain study.
8. Test various body fluids.
9. Test fresh mushrooms.

Required Reading

1. Duenhoelter, J.H., Stone, I.C. and Scott, D.E.; "Detection of Seminal Fluid Constituents After Alleged Sexual Assault," Journal of Forensic Science, Oct. 1978, pp. 824-827.

2. Davies, Anne and Wilson, Elizabeth; "The Persistence of Seminal Constituents in the Human Vagina," Forensic Science, 3, (1974), pp. 45-55.

3. Schiff, A.F.; "Reliability of the Acid Phosphatase Test for the Identification of Seminal Fluid," Journal of Forensic Science, Oct. 1978, pp. 883-884.

4. McClosky, K.L., Muscillo, G.C., and Noordewier, B.; "Prostatic Acid Phosphatase Activity in the Postcoital Vagina," Journal of Forensic Science, Oct. 1975, pp. 630-636.

5. DeForest, P., Gaensslen, R., and Lee, H.; Forensic Science an Introduction to Criminalistics, Chapter 10.

6. Gaensslen, R.E.; Sourcebook in Forensic Serology, Immunology and Biochemistry, pp. 149-180.

7. Standefer, J.C., and Street, E.W.; ""Post Mortem Stability of Prostatic Acid Phosphatase," Journal of Forensic Science, Jan. 1977, pp. 165-172.

LESSON 2

Estimated time: 2 Days

Purpose: To familiarize the trainee with microscopic techniques of semen identification.

Lectures: Compound Microscopy
Microscopic Identification of Semen

Exercises:

1. Read assigned materials.
2. Practice, use and maintenance of the compound microscope.
3. Conduct microscopic examination of various sperm cells.

4. Record results of the microscopic examinations.

Required Reading:

1. Weaver, R.L., Lappas, N.T., and Rowe, W.R.; "Utilization of Medically Obtained Evidence in Cases of Sexual Assault; Results of a Survey," Journal of Forensic Science, Oct. 1978, pp. 809-823.

2. Enos, W.R., Beyer, J.C., and Mann, G.T.; "The Medical Examination of Cases of Rape," Journal of Forensic Science, Jan. 1972, Volume 17, Number 1, pp. 50-55.

3. Enos, W.F., and Beyer, J.C.; "Spermatozoa in the Anal Canal and Rectum and in the Oral Cavity of Female Rape Victims," Journal of Forensic Science, Jan 1978, pp. 231-233.

4. Adelman, MM.; "Sperm Morphology," Laboratory Medicine, January 1986, Volume 7, Number 1, pp. 32-34.

5. Adelman, M.M., and Cahill, E.M.; Atlas of Sperm Morphology.

6. Saferstein, R.; Forensic Science Handbook, pp. 416-475.

7. Owen, G.W., and Smalldon, K.W.; "Blood and Semen Stains on Outer Clothing and Shoes Not Related to Crime," Journal of Forensic Science, April 1975, pp. 291-403.

8. Willot, G.M., and Crosse, M.A.; "The Detection of Spermatozoa in the Mouth," Forensic Science Society, 1986, pp. 125-128.

LESSON 3

Estimated time: 2 Days

Purpose: To familiarize the trainee with the use of the P30 test **strip** for the indication of semen.

Lectures:
Monoclonal Antibodies
P30 in Semen
P30 Test Strip for the Indication of Semen

Exercises:
1. Read assigned materials.
2. View video training tapes on sexual assault evidence collection.
3. Conduct aged semen stain study.
4. Conduct semen dilution stain study.
5. Conduct body fluid specificity study.

Required Reading:

1. P30 test strip manufacturer information sheet.

2. ISP Validation Studies.

3. Graves, H.C.B et. al.; "Post Coital Detection of a Male-Specific Semen Protein: Application to the Investigation of Rape," New England Journal of Medicine, 1985, Volume 312 (6), pp. 338-343.

4. Sensabaugh, G. G.; "Isolation and Characterization of a Semen-Specific Protein from Human Seminal Plasma: A Potential New Marker for Semen Identification," Journal of Forensic Science, Jan. 1978, pp. 106-115.

5. Hochmeister, M., Budowle, B., Rudin, O., Gehrig, C., Thali, M., and Dirnhofer, R.; "Evaluation of Prostate-Specific Antigen Membrane Test Assay for the Forensic Identification of Seminal Fluid," Journal of Forensic Sciences, 1999.

6. 720 ILCS - Sex Offenses.

7. Denison, et. al.; "Positive Prostate-Specific Antigen (PSA) Results in Semen-Free Samples," Can. Soc. Forensic Sci J, Vol. 37, No. 4, pp. 197-206.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: SALIVA STAIN SCREENING

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

1 Day

GOAL

To achieve the necessary knowledge, skill and ability to properly analyze saliva evidence.

OBJECTIVES

1. The trainee will demonstrate competency in the use of preliminary tests for saliva by completion of exercises and submission of a report. Successful completion will be determined by training coordinator evaluation on a pass/fail basis.

2. The trainee will demonstrate a comprehensive understanding of the material by successfully passing the biology screening assessment module.

LESSON 1

Estimated time: 1 Day

Purpose: To familiarize the trainee with techniques used to indicate saliva stains.

Lecture: Preliminary Testing for Saliva Stains

Exercises:

1. Read assigned materials
2. Conduct an aged stain study.
3. Conduct a specificity study with various body fluids.

Required Reading:

1. Gaensslen, R.E.; Sourcebook in Forensic Serology, Immunology, and Biochemistry, pp. 1838-189.

2. Auvdel, M.J.; "Amylase Levels in Semen and Saliva Stains," Journal of Forensic Science, April 1986, pp. 426-430.

3. Wilot, G.M., Griffiths, M.; "A New Method for Locating Saliva Stains; Spotty Paper for Spotting Spit," Forensic Science International, 1980, Volume 15, pp. 79-83.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: BIOLOGY SCREENING ASSESSMENT

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

5 Days

GOAL

To demonstrate the knowledge, skill and ability necessary to identify biological stain evidence.

OBJECTIVES

1. The trainee will demonstrate practical knowledge and skill of biological stain identification by completing a series of unknowns as a practical criterion test with a score of 100%.

2. The trainee will demonstrate practical knowledge of biological stain identification by completing a final comprehensive written criterion test with a score of at least 80%.

LESSON 1

Estimated time: 5 Days

Purpose: The trainee will successfully demonstrate the knowledge, skill and ability to identify biological stains.

Lecture: None

Exercise: 1. Complete the written test.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: COURTROOM TRAINING (BIOLOGY SCREENING)

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

7 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully perform courtroom testimony.

OBJECTIVES

1. The trainee will demonstrate a knowledge of the court system as it applies to a forensic scientist by passing a written criterion test with a score of no less than 80%.

2. The trainee will participate in at least one mock trial during their training period which will be evaluated on a pass/fail basis.

LESSON 1

Estimated time: 5 Days

Purpose: To familiarize the trainee with the state court system.

Lecture: Courtroom Demeanor Class

Exercise: 1. As assigned in courtroom demeanor class.

Required Readings: 1. As assigned in courtroom demeanor class.

LESSON 2

Estimated time: 2 Days

Purpose: To prepare the trainee for the court proceedings and presentations.

Lecture: None

Exercise: 1. Participate in a mock trial setting on a biology screening case.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: SUPERVISED CASEWORK (BIOLOGY SCREENING)

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

60 Days

GOAL

To achieve the necessary knowledge, skill and ability to conduct casework in the Forensic Biology Laboratory.

OBJECTIVES

1. The trainee will demonstrate the knowledge, skill and ability to determine the proper course of action when confronted with a biology case by completing an interview on each case with his/her training coordinator prior to working the case.

2 The trainee will demonstrate the knowledge, skill and ability to process casework by working the case under the direction of the training coordinator.

3. The trainee will demonstrate the knowledge, skill and ability to conduct casework independently by successfully completing at least twenty cases which include a majority of sexual assault cases.

4. The trainee will demonstrate the knowledge, skill and ability to write a report based on the examination conducted by successfully completing a review process with the training coordinator.

5. Successful completion of supervised casework will require that proper casework approach was followed; appropriate evidence was examined; appropriate stains tested, and appropriate stains selected for DNA analysis; no erroneous stain identifications or indications reported; no failure to report stains that were clearly demonstrated by the test results, as determined by the training coordinator; and clean technique was followed. In addition, all standards listed in Command Directives TRN 14 must be met.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: INTRODUCTION TO DNA

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

2 Days

GOAL

To achieve the necessary knowledge and thorough understanding of DNA as it relates to forensics.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of DNA as it relates to forensics by successfully passing a written criterion test with a score of no less than 80%.

LESSON

Lectures: Introduction of DNA - Overview of Topics
- What is DNA?
- Where DNA is found?
- Structure
- Nomenclature
- Function
- Forensic DNA analysis

Exercises:
1. Read assigned materials.
2. Intro to DNA written exercise.

Required Reading:
1. Butler, J. M., Forensic DNA Typing, 2nd Edition, Chapters 1 and 2.
2. NRC II, Chapters 1 and 2.
3. As assigned.

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

INTRODUCTION TO DNA MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Written exercises			
Written exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: ORGANIC DNA ISOLATION

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

18 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully isolate DNA from forensic samples utilizing the Illinois State Police Command Organic DNA Extraction procedures.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of DNA extraction/ isolation by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate competency in the Illinois State Police Command Extraction/Isolation Procedures by completing a practical criterion test with a score of no less than 100%.

LESSON

Lectures:

DNA Extraction/Isolation - Overview of Topics
- Purpose of Extraction
- Theory
- ISP Organic DNA Extraction Procedures
- Reagents
- Minimum standards and controls
- QA/QC
- Casefile documentation and technical review requirements

Demonstration

Exercises:

1. Read assigned materials.
2. Observation extraction exercise.
3. Independent extraction exercises.
4. Theory written exercise.

Required Reading:

1. Relevant portions of the Forensic Biology/DNA Procedures Manual.

2. Butler, J. M., <u>Advanced Topics in Forensic DNA Typing: Methodology, Chapter 2.</u>

3. Relevant ISP Validation Studies.

4. As assigned.

ORGANIC DNA ISOLATION MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration: non-semen			
Observation: non-semen			
Independent exercises: non-semen			
Demonstration: semen			
Observation: semen			
Independent exercises: semen			
Practical exam			
Written exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: DNA ISOLATION UTILIZING THE DNA IQ™ SYSTEM WITH THE MAXWELL® INSTRUMENT

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

15 Days

GOAL

To achieve the necessary knowledge, skill, and ability to successfully complete automated DNA isolation from forensic samples utilizing the DNA IQ™ System with the Maxwell® instrument as outlined in the Illinois State Police Command DNA Isolation Procedures.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of DNA isolation using the DNA IQ™ System and Maxwell® instrument by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate competency in the Illinois State Police Command DNA Maxwell® Isolation Procedure by completing a practical criterion test with a score of no less than 100%.

LESSON

Lectures: DNA Isolation Utilizing the DNA IQ™ System with the Maxwell® Instrument
- Purpose of Extraction
- Function of Reagents
- Function of Each Step
- Comparison to Organic Extraction
- Maxwell® instrument
- Quality Assurance and Quality Controls
- ISP DNA Isolation with the DNA IQ™ System Procedures
- Casefile and technical review requirements

Non-semen and semen isolation demonstration

Exercises:
1. Read assigned materials.
2. Observation and Independent non-semen and semen samples.

Required Reading:
1. Promega Corporation. Introducing The Maxwell™ 16 Instrument: A Simple, Robust and Flexible Tool for DNA Purification. *Promega Notes* [Online]. (January 2006; 92).

2. Promega Corporation. Forensic Application of the Maxwell™ 16 Instrument. *Profiles in DNA* [Online]. (February 2006:9).

3. Promega Corporation. The Maxwell® 16 Low Elution Volume System for Forensic Casework. *Profiles in DNA* [Online]. (September 2007; Vol. 10, No. 2, pp. 10-12).

4. Greenspoon SA, Ban JD, Sykes K, Ballard EJ, Edler SS, Baisden M, Covington BL. Application of the Biomek® 2000 Laboratory Automation Workstation and the DNA IQ™ System to the Extraction of Forensic Casework Samples. *J. Forensic Sci,* 2004; 49(1):29-39.

5. Promega Corporation. The Maxwell® 16 Low Elution Volume System for Forensic Casework: Implementation and Routine Use in a Forensic Laboratory. *Profiles in DNA* [Online]. (September 2008; Vol. 11, No. 2, pp. 9-11).

6. ISP Validation Studies for Maxwell® 16.

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

DNA IQ™ ISOLATION WITH MAXWELL®
MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration: non-semen			
Observation: non-semen			
Independent exercises: non-semen			
Demonstration: semen			
Observation: semen			
Independent exercises: semen			
Practical exam			
Written exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: DNA QUANTITATION

Reviewed by:

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Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

15 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully perform DNA quantitation analysis and interpretation using the Illinois State Police Command DNA Quantitation Procedures.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of DNA quantitation by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate competency in the Illinois State Police Command Quantitation procedures by completing a practical criterion test with a score of no less than 100%.

LESSON

Lectures:

1. Real Time Quantitation (qPCR) – Topics:
   - Purpose of quantitation
   - qPCR Theory
   - Components of PowerQuant kit
   - ISP procedures
   - Interpretation
   - Quality Assurance and Quality Controls
   - Casefile and technical review requirements
2. Demonstration
   - Quantitation plate preparation
   - Analysis

Exercises:

1. Observation exercise: Prepare a standard serial dilution and quantitate and analyze a minimum of 16 previously quantitated samples under observation.
2. Independent exercise: Quantitate and analyze a minimum of two plates with a minimum of 16 previously quantitated samples on each.
3. Quantitation theory written exercise.
4. Review current validation and complete written exercise.
5. Interpretation exercise.

Required Reading:

1. ISP R&D Internal Validation: A comparison of Next Generation Quantification Kits.

2. ISP R&D Project: Amplification of Low Level and Not Detected Samples (2018-01).

3. Ewing, M.M, et. al. "Human DNA quantification and sample quality assessment: Developmental validation of the PowerQuant™ System." Forensic Science International: Genetics. 23(2016) 166-177.

4. Butler, J.M., Forensic DNA Typing Methodology, Chapter 3, pp 49-67.

5. Ewing, M. M., et. al. "The PowerQuant™ System: A New Quantification Assay for determining DNA Concentration and Quality." Promega Corporation, 2014.

6. Green R. L., et. al. "Developmental Validation of Quantifiler Real Time PCR Kits for the Quantification of Human Nuclear DNA Samples". *Journal of Forensic Sciences*. July 2005, Vol 50, No 4, pp 809-825.

7. Richard, M. L. et. al. "Developmental Validation of a Real Time Quantitative PCR Assay for Automated Quantification of Human DNA." *Journal of Forensic Sciences*. September 2003, Vol 48, No5, pp. 1041-1046.

8. Andreasson H. and Allen, M. "Rapid Quantification and Sex Determination of Forensic Evidence Materials." *Journal of Forensic Sciences.* September 2003, Vol 48, No5, pp 936-944.

9. Van der horst, E.H., et. al. "Taq-Man®-based Quantification of Invasive Cells in the Chick Embryo Metastasis Assay." *Biotechniques*. 2004, Vol 37, No 6, pp 940-945.

10. Barbisin, M, et.al. A multiplexed system for quantification of human DNA and male DNA and detection of PCR inhibitors in biological samples. *Forensic Science International: Genetics Supplement Series 1*. August 2008, pp 13-15.

11. PowerQuant™ System Technical Manual.

12. Thermo Fisher Scientific; Real-time PCR handbook.

13. Applied Biosystems® 7500 Real-Time PCR System manuals.

14. Relevant portions of the Bio/DNA Procedures Manual.

DNA QUANTITATION MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration			
Observation			
Independent exercises			
Quantitation theory written exercise			
Validation written exercise			
Interpretation written exercise			
Written exam			
Practical exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: PCR AMPLIFICATION

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

6 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully perform PCR amplification utilizing the Illinois State Police Command PCR Amplification Procedures.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of PCR amplification by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate technical skills in the Illinois State Police Command PCR Amplification procedures by successfully completing a practical criterion test with a score no less than 100%. This criterion test may be given in conjunction with the STR Analysis practical.

LESSON

Lectures:

1. PCR Amplification - Overview of Topics:
   - Purpose
   - Theory
   - Procedure
   - Amplification kit components
   - QA/QC
   - Casefile documentation requirements
2. Calculations - Target Amount of DNA
3. Laboratory Demonstration

Exercises:

1. Observation exercise
2. Independent exercise
3. Theory written exercise
4. Amplification target exercise
5. Read assigned materials

Required Reading:

1. Relevant portions and references of the Illinois State Police Forensic Biology/DNA Procedures Manual.

2. Butler, J. M., Topics in Forensic DNA Typing: Methodology, Chapter 4.
3. Bell, J., "The Polymerase Chain Reaction," Immunology Today, 1989, Vol. 10, No. 10.

4. Mullis, K. B., “The Unusual Origin of the Polymerase Chain Reaction,” Scientific American, 1990, April, pp. 56-65.

5. Brownstein, M. J., Carpten, J. D., Smith, J. R., “Modulation of Non Templated Nucleotide Addition by *Taq* DNA Polymerase: Primer Modifications that Facilitate Genotyping,” Biotechniques, 1996, Vol. 20, No. 6, pp. 1005-1010.

6. Henegariu, O., et. al. “Multiplex PCR: Critical Parameters and Step by Step Protocols”, Biotechniques, 1997 Vol. 23, pp 504-511.

7. Promega Corporation. PowerPlex® Fusion System Technical Manual.

8. Applied Biosystems® GeneAmp PCR System 9700™ User’s Manual.

9. Applied Biosystems® ProFlex™ PCR System User Guide.

10. ISP R&D Internal Validation: Thermal Cycler Model 480 and 9700 Comparisons.

11. ISP R&D Internal Validation: Applied Biosystems® 9700™ vs ProFlex™ (2016-10).

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

PCR AMPLIFICATION MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration			
Observation			
Independent exercises			
Theory written exercise			
Amplification target written exercise			
Written exam			
Practical exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: STR ANALYSIS

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

10 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully perform STR analysis utilizing the Illinois State Police Command STR Analysis Procedures.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of STR analysis and capillary electrophoresis by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate sufficient knowledge and skill in the Illinois State Police Command STR Analysis procedures by completing a practical criterion test covering capillary electrophoresis and data analysis with a score no less than 100%.

3. The trainee will demonstrate sufficient knowledge and skills in the maintenance procedure for capillary electrophoresis instrumentation. Successful completion will be determined by completing a practical criterion test with a score no less than 100%.

LESSON

Lectures:

1. STR Analysis/Capillary Electrophoresis - Overview of Topics
   - Short Tandem Repeats (STR) Characteristics
   - Repeat and Sequence Polymorphisms
   - Advantages/Usefulness
   - Repeat Motifs
   - Allele designation
   - Multiplex
2. Capillary Electrophoresis Theory and Instrumentation:
   - Theory
   - Instruments and components
   - Data Collection
   - Matrix and Spectral
   - Procedure
   - Quality Assurance and Quality Control
   - Casefile documentation
3. Capillary Electrophoresis Demonstration
4. Capillary Electrophoresis Instrument Maintenance Demonstration
5. Data Analysis Theory and Software
6. GeneMapper ID-X Demonstration

Exercises:

1. Read assigned materials.
2. Observation sample set.
3. Practice sample sets: CE and data analysis for two runs with a minimum of 10 samples.
4. Data analysis on the yearly sensitivity samples.
5. Maintenance practice.

Required Reading:

1. Forensic Biology/DNA Procedures Manual IIIC-12- Amplification and Electrophoresis of STRs: PowerPlex® Fusion.

2. Promega Corporation. PowerPlex® Fusion System Technical Manual, Part #TMD039, Revised 3/15.

3. Applied Biosystems® 3500/3500xL Genetic Analyzer User Bulletin, June 2011.

4. GeneMapper® ID-X Software, v 1.0 Getting Started Guide, PN 4375574.

5. GeneMapper® ID-X Software, v 1.5 user Bulletin, PN 100031708 Rev.A, 18 May 2015.

6. ISP R&D Internal Validation: Evaluation of Peak Window Size and Polynomial Degree (07B-09).

7. ISP R&D Project: Capillary Life Study (IP05-03).

8. Oostdik, K., et al. Developmental validation of the PowerPlex Fusion System for analysis of casework and reference samples: A 24-locus multiplex for new database standards. Forensic Science International: Genetics 12 (2014) 69-76.

9. Butler, J. M., <u>Advanced Topics in Forensic DNA Typing: Methodology</u>, Chapters 5 and 6.

10. Moretti, T. R., Baumstark, A. L., Defenbaugh, D. A., Keys, K. M., Smerick, J. B., Budowle, B., "Validation of Short Tandem Repeats (STRs) for Forensic Usage: Performance Testing of Fluorescent Multiplex STR Systems and Analysis of Authentic and Simulated Forensic Samples," Journal of Forensic Sciences, 2001, Vol. 46, No. 3, pp. 647-660.

11. As assigned.

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

STR ANALYSIS
MODULE CHECKLIST

Trainee: ______________________________ Trainer: ______________________________

Training Start Date: ____________________ Training End Date: ______________________

Task	Completion Date	Trainee Initials	Trainer Initials
Lectures			
Required readings			
Demonstration			
Observation			
Independent exercises			
Theory Written exercise			
Written exam			
Practical exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: TECAN FREEDOM EVO® 150 AND THE PROMEGA METHODS®: THEORY

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

2 Days

GOAL

To achieve the necessary knowledge and thorough understanding of the processing of non-semen and semen samples from preparation through amplification using the TECAN Freedom EVO® 150 Automated Workstation in order to author and peer reports.

OBJECTIVES

1. The trainee will demonstrate comprehensive understanding of DNA sample processing as it relates to the TECAN Freedom EVO® 150and the Promega Methods® by successfully passing a written criterion test with a score of no less than 80%.

LESSON

Lecture: TECAN Freedom EVO® 150 and the Promega Methods® Validation and Theory

Exercises:

1. Read assigned materials.
2. Review lecture material.
3. Complete TECAN deck layout exercise.
4. Observe TECAN procedures: Sample Extraction, Quantification, Normalization and Amplification.

Required Reading:

1. Relevant portions of the Forensic Biology/DNA Procedures Manual.
2. Tecan Trading AG. Tecan Freedom EVO 150® Operating Manual. Version 3.1 or above [CD], 2006.
3. Illinois State Police Internal Validation of the TECAN Freedom EVO® 150 and the Promega Methods®.
4. Illinois State Police TECAN EVO® 150: Performance Check: Guanidine Isothiocyanate Inhibition, 19-BIO-03.
5. Illinois State Police PowerPlex Fusion Performance Check: Concentration Methods, 20-BIO-08.
6. Welts, F., et al. DNA IQ High Throughput Method Testing on the TECAN Freedom EVO®. Scientific Applications Report, 08/18.

7. Stangegaard, M., et al. Automated extraction of DNA and PCR setup using a TECAN Freedom EVO® liquid handler. Forensic Science International: Genetics Supplement Series 2 (2009) 74-76.

8. Fregeau, C. J., et al. Validation of a DNA IQ-based extraction method for TECAN robo9tic liquid handling workstations for processing casework. Forensic Science International: Genetics 4 (2010) 292-304.

9. Morf, N.V., et al. Internal validation of TECAN robots (Freedom EVO® 150 and 75) for PCR and capillary electrophoresis setup. Forensic Science International: Genetics Supplement Series 3 (2011) e89-e90.

TECAN AND THE PROMEGA METHODS: THEORY MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration			
Deck layout exercise			
Written exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: DNA QUALITY ASSURANCE

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

5 Days

GOAL

To achieve the necessary knowledge and thorough understanding of the FBI Quality Assurance Standards as well as the skill and ability to adhere to Illinois State Police Command Quality Assurance Standards.

OBJECTIVES

1. The trainee will demonstrate sufficient knowledge and skill required for adhering to quality assurance standards during all phases of the biology/DNA training. Successful completion will be determined by training coordinator observation on a pass/fail basis.

   The trainee will participate in quality assurance procedures by routinely monitoring, identifying, documenting, and correcting any problems in the DNA testing being conducted. The following quality assurance activities may take place throughout the duration of training: temperature rotation for water baths/refrigerator/freezers, thermal cycler temperature verification and uniformity tests, quality control tests for reagents, chemical inventory tracking, facility bleach monitoring.

2. The trainee will demonstrate a comprehensive understanding of quality assurance standards by successfully passing a written criterion test with a score of no less than 80%.

LESSON

Lectures: DNA Quality Assurance - Overview of Topics
- History of DNA Guidelines and Organizations
- FBI Quality Assurance Standards
- Accreditation
- Standards vs. Guidelines
- ISP DNA Quality Assurance

Exercises:
1. Read assigned materials.
2. Complete quality assurance written exercise.

Required Reading:
1. Quality Assurance Standards for Forensic DNA Typing Laboratories, current version.
2. Quality Assurance Standards for Forensic DNA Databasing Laboratories, current version.

3. Relevant SWGDAM Quality Assurance Guidelines.

4. Forensic Biology/DNA Procedures Manual, Appendix IV-B.

5. Butler, J. M., Forensic DNA Typing: Methodology, Chapter 7.

6. Butler, J. M., Forensic DNA Typing: Interpretation, Appendix 2.

7. As assigned.

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

DNA QUALITY ASSURANCE MODULE CHECKLIST

Trainee: ______________________________ Trainer: ______________________________

Training Start Date: ____________________ Training End Date: ______________________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Written exercise			
Written exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: AUTOSOMAL STR INTERPRETATION

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

30 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully interpret data obtained from autosomal STR analyses using the Illinois State Police Command Procedures.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of STR interpretation as it relates to forensics by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate sufficient knowledge and skill in the autosomal Illinois State Police Command STR Interpretation procedures by completing an interpretation practical criterion test that covers an arrange of samples routinely encountered in casework with a score of no less than 100%.

LESSON

Lectures: Interpretation- Overview of topics:

- Electropherogram evaluation
- ISP Validations
- Analytical and Stochastic Thresholds
- Peak Height Ratio
- Artifacts
- Microvariants
- Genetic Anomalies
- Mixtures
- Degradation
- Low template and off-scale data
- Electropherogram documentation
- Standards and Controls
- Casefile documentation and Technical Review

Exercises:

1. Read assigned materials.
2. Written exercise: Interpretation.
3. Written exercise: Validation.
4. Interpretation exercises: single source, artifacts, degraded profiles, partial profiles, mixed contributor profiles, low template profiles.

Required Reading:

1. Relevant portions and references of the Forensic Biology/DNA Procedures Manual.

2. Clayton, T. M., Whitaker, J. P., Sparkes, R. Gill, P., "Analysis and Interpretation of Mixed Forensic Stains Using DNA STR Profiling," FSI, 1998, Vol. 91, pp. 55-70.

3. Butler, J.M., <u>Forensic DNA Typing: Interpretation</u>, Chapters 1-8.

4. Illinois State Police Internal Validation: PowerPlex Fusion and and Applied Biosystems 3500 Genetic Analyzer (Project #2014-08).

5. Oostdik, K., et al. (2014) Developmental validation of the PowerPlex Fusion System for analysis of casework and reference samples: A 24-locus multiplex for new database standards. Forensic Science International: Genetics 12, 69-76.

6. Katsanis, S.H., Wagner, J.K. (2013) Characterization of the Standard and Recommended CODIS markers. Journal of Forensic Sciences, 58 Supp1, S169-72.

7. Buckleton, J., et al. (2005) Forensic DNA Evidence Interpretation. Washing, DC: CRC Press..

8. Scientific Working Group on DNA Analysis Methods (SWGDAM) (2010) SWGDAM Interpretation guidelines for autosomal STR typing by forensic DNA testing laboratories.

9. Gill, P., et al. (2006). DNA Commission of the International Society of Forensic Genetics: Recommendations on the interpretation of mixtures. Forensic Science International. 160: 90-101.

10. Gill, P., et al. (2008) National recommendations of the technical UK DNA working group on mixture interpretation for the NDNAD and for court going purposes. Forensic Science International: Genetics, 2, 76-82.

11. Schneider, P. M., et al. (2009). The German Stain Commission: recommendations for the interpretation of mixed stains. International Journal of Legal Medicine, 123, 1-5 (originally published in German in 2006- Rechtsmedizin 16: 401-404).

12. Budowle, B., et al. (2009) Mixture interpretation: defining the relevant features for guidelines for the assessment of mixed DNA profiles in forensic casework. Journal of Forensic Sciences, 54, 810-821.

13. Moretti T., et al. (2001) Validation of short tandem repeats (STRs) for forensic usage: performance testing of fluorescent multiplex STR systems and analysis of authentic and simulated forensic samples. Journal of Forensic Sciences 46: 647-660.

14. Bright, J., et al. (2013). Degradation of forensic DNA profiles. Australian Journal of Forensic Sciences, 45:4, 445-449.

15. Chung, D. T., et al. (2004). A study on the Effects of Degradation and Template Concentration on the Amplification Efficiency of the STR Miniplex Primer Sets. Journal of Forensic Sciences, 49, 733-40.

16. Bregu, J., et al. (2013). Analytical Thresholds and Sensitivity: Establishing RFU Thresholds for Forensic DNA Analysis. Journal of Forensic Sciences, 58, 120-129.

17. Monich, U., et al. (2015). Probabilistic characterization fo baseline noise in STR profiles. Forensic Science International: Genetics, 19, 107-122.

18. Estimate Analytical Thresholds Using STR-validator, July 7, 2016, version 1.2.

19. Gilder, J. R., et al. (2007). Run-specific limits of detection and quantitation for STR-based DNA testing. Journal of Forensic Sciences, 52, 97-101.

20. Rakay, C. et al. (2012). Maximizing allele detection. Effects of analytical threshold and DNA levels on rates of allele and locus drop-out. Forensic Science International: Genetics, 6, 723-728.

21. Kelly, H., et al. (2012). Modeling heterozygote balance in forensic DNA profiles. Forensic Science International: Genetics, 6, 729-734.

22. Taylor, D., et al. (2016). Factors affecting peak height variability for short tandem repeat data. Forensic Science International: Genetics, 21, 126-133.

23. Gill, P., Buckleton, J. (2010). A universal strategy to interpret DNA profiles that does not require a definition of low-copy number. Forensic Science International: Genetics, 4, 221-227.

24. Gill, P., et al. (2009). The low-template DNA (stochastic) threshold- Its determination relative to risk analysis for national DNA databases. Forensic Science International: Genetics, 3, 104-111.

25. Buckleton, J. (2009). Validation issues around DNA typing of low level DNA. Forensic Science International: Genetics, 5, 255-260.

26. Taylor, D., Buckleton, J. (2015). Do low template DNA profiles have useful quantitative data? Forensic Science international: Genetics, 16, 13-16.

27. Bright, J., et al (2012) A comparison of stochastic variation in mixed and unmixed casework and synthetic samples. Forensic Science International: Genetics, 6, 180-184.

28. Gill, P., et al. (1998) Interpretation of simple mixtures when artifacts such as stutter are present-with special reference to multiplex STRs used by the Forensic Science Service. Forensic Science International, 95, 213-224.

29. Bright, J., et al. (2014) Variability of mixed DNA profiles separated on a 3130 and 3500 capillary electrophoresis instrument. Australian Journal of Forensic Sciences, 46:3, 304-312.

30. Brookes, C., et al. (2012) Characterizing stutters in forensic STR multiplexes. Forensic Science International: Genetics, 6, 58-63.

31. Sailus, J., et al. Considerations for the evaluation of plus stutter for AmpFℓSTR PCR amplification kits in human identification laboratories. Forensic News: February 2012.

32. Clayton, T.M. et al. (2004). A genetic basis for anomalous band patterns encountered during DNA STR profiling. Journal of Forensic Sciences, 49, 1207-1214.

33. Bright, J., Coble, M. (2020) Forensic DNA Profiling- A Practical Guide to Assigning Likelihood Ratios. Chapter 1. CRC Press.

34. As assigned.

AUTOSOMAL INTERPRETATION MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Written exercise			
Validation written exercise			
Interpretation exercises			
Written exam			
Practical exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: STATISTICS: Random Match Probability

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

5 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully generate random match probability statistics for autosomal STR analyses using the Illinois State Police Command Procedures.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of the random match probability method for calculating statistics as it relates to forensics by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate sufficient knowledge and skill in the Illinois State Police Command procedure for calculating and applying the random match probability by completing a statistics practical criterion test that covers an arrange of samples routinely encountered in casework with a score of no less than 100%.

LESSON

Lectures: Statistics/Population Genetics
- Statistics programs utilized by ISP
- ISP procedures
- Casefile documentations and technical review

Exercises:
1. Read assigned materials.
2. Written exercise.
3. Statistics practical exercise.

Required Reading:
1. Relevant portions of the Forensic Biology/DNA Procedures Manual.
2. NRC I, Chapter 3.
3. NRC II, Chapters 4 and 5.
4. Budowle, B., Moretti, T., Baustark, A. L., Defenbaugh, D.A., "Population Data on the Thirteen CODIS Core Short Tandem Repeat Loci in African Americans, U. S. Caucasians, Hispanics, Bahamians, Jamaicans, and Trinidadians," Journal of Forensic Sciences, 1999, Vol. 44, No. 6, pp. 1277-1286.

5. Budowle, B., Brendan, S., Niezgoda, S., Chakraborty, R., "CODIS STR Loci Data from 41 Sample Populations," Journal of Forensic Sciences, 2001, Vol. 46, No. 3, pp. 453-489.

6. Chakraborty, R., "Samples Size Requirements for Addressing the Population Genetic Issues of Forensic Use of DNA Typing," Human Biology, 1992, Vol. 64, No. 2, pp. 141-159.

7. Moretti, T., et al. (pending) Population data on the expanded CODIS core STR loci for eleven populations of significance for forensic DNA analyses in the United States. Forensic Science International: Genetics XXX.

8. Illinois State Police STR Calculator version 4 (Project #2016-05)

9. Butler, J.M., (2015). Advanced Topics in Forensic DNA Typing: Interpretation. San Diego: Elsevier Academic Press. Chapters 9-13, 16 and Appendixes 1-4.

10. Walsh B., et al. (2008) joint match probabilities for Y Chromosome markers. Forensic Science International, 174, 234-238.

11. As assigned.

STATISTICS: RANDOM MATCH PROBABILITY MODULE CHECKLIST

Trainee: ______________________________ Trainer: ______________________________

Training Start Date: ____________________ Training End Date: ______________________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Written exercise			
Practical exercise			
Written exam			
Practical exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: COMBINED DNA INDEX SYSTEM (CODIS)

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

5 Days

GOAL

To achieve the necessary knowledge, skill and ability to adhere to the NDIS and Illinois State Police Command procedures for sample entry, profile searching, and documentation for the Combined DNA Index System (CODIS) program.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of CODIS by successfully passing the NDIS Eligibility test and a written criterion test with a score of no less than 80%.

LESSON

Lectures: CODIS:

- Purpose
- DNA Index Systems
- Profile Eligibility
- Indices
- Upload and searching
- Casefile documentation

CODIS Software Demonstration

Exercises:

1. Read assigned materials.
2. Complete the NDIS Eligibility Test
3. Profile eligibility exercise
4. Disposition exercise
5. Keyboard search exercise

Required Reading:

1. Relevant portions of the Forensic Biology/DNA Procedures Manual.
2. National DNA Index System (NDIS) Operational Procedure Manual.
3. Butler, J. M., <u>Methodology</u>, Chapter 8.
4. Biology/DNA LIMS User's Guide.
5. As assigned.

CODIS
MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________________ Training End Date: ______________________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Software demonstration			
Profile eligibility written exercise			
Disposition written exercise			
Keyboard search exercise			
Written exam			
NDIS Eligibility test			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: COURTROOM TRAINING & LEGAL ISSUES FOR DNA ANALYSIS

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

8 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully testify in court and to become familiar with the legal aspects of forensic DNA analysis.

OBJECTIVES

1. The trainee will become familiar with the legal aspects of forensic DNA casework. Successful completion will be determined by training coordinator evaluation on a pass/fail basis.

2. The trainee will demonstrate effective DNA expert witness testimony that is simple, concise, and accurate by participating in a DNA mock trial practical criterion test with a score no less than 100%. The following criteria must be graded satisfactory: truthful, technically accurate, understandable, believable, evidence handling, and no defensive responses to questions.

LESSON

Lectures:

Legal Aspects of DNA:
- Court Decisions
- Discovery and Evidence Laws
- ISP Procedures for Discovery
- Subpoenas

Court Preparation:
- Conduct
- Qualifying and Direct Questions

Exercises:

1. Read assigned materials.
2. Prepare DNA qualifying and direct court questions
3. Participate in practice sessions for DNA court testimony
4. Courtroom visit and/or review of DNA testimony transcripts

Required Reading:

1. Relevant portions of Command Directives Manual

2. Butler, J.M., <u>Forensic DNA Typing: Methodology</u>, Chapter 18 & Appendix 4.

3. NRC II, Chapter 6: DNA Evidence in Legal System.

4. Provided transcripts from DNA court testimonies

5. As assigned.

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

COURTROOM TRAINING & LEGAL ISSUES FOR DNA ANALYSIS MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lectures			
Required readings			
Qualifying & Direct Questions			
Court testimony practice			
DNA testimony review			
Practical exam: Mock Trial			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: ORAL BOARD EVALUATION

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

10 Days

GOAL

To demonstrate the necessary knowledge, skill and ability to show competency in discussing, defending and explaining the DNA/STR methods, interpretation and statistical procedures utilized within the Illinois State Police Command.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of all facets of the materials presented and practiced during the DNA portion of the forensic biology/DNA training program by successfully passing an oral criterion test with a score of no less than 80%.

ORAL BOARD EVALUATION MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Oral criterion exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: DNA MOCK CASEWORK & REPORT WRITING

Reviewed by:

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Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

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William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

50 Days

GOAL

To achieve the necessary knowledge, skill and ability by way of practical experience for working DNA casework and adhering to the Illinois State Police Command Procedures.

OBJECTIVES

1. The trainee will demonstrate sufficient knowledge and skill required to conduct DNA casework according to the Illinois State Police Forensic Biology/DNA Procedures Manual.

    A. A minimum of ten mock cases must be completed from extraction through report. Additional cases may be required if the trainee demonstrates a difficulty with any aspect of casework including but not limited to interpretation, analytical work, productivity, case management, and excessive technical review points.

    B. Three of the ten cases will count as practical criterion test to demonstrate competency in the DNA procedures, interpretation, statistical and report writing procedures.

    C. The trainee will demonstrate sufficient knowledge and skill required to complete a thorough technical review by reviewing his/her own casework casefile and by completing technical review on a minimum of five mock casefiles of his/her peer during the peer review process.

    D. The trainee will develop the knowledge and skill required for casework management.

LESSON

Lectures: Report Writing & Technical Review
- LIMS documentation requirements
- Statistics and CODIS casefile documentation
- Data upload to LIMS
- Report wording
- Technical review requirements

Required Reading:
1. Relevant portions of the Forensic Biology/DNA Procedures Manual.
2. Relevant portions of the Biology/DNA LIMS User's Guide.

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

DNA MOCK CASEWORK & REPORT WRITING MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Mock DNA cases			
Technical Review (minimum of 5)			
Practical criterion test (3 mock cases)			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: SUPERVISED DNA CASEWORK

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

UNIT ESTIMATED TIME

60 Days

GOAL

To achieve the necessary knowledge, skill and ability to conduct DNA casework and adhering to the Illinois State Police Command Procedures.

OBJECTIVES

1. The trainee will demonstrate sufficient knowledge and skill required to conduct DNA casework in an independent manner according to the Illinois State Police Forensic Biology/DNA Procedures Manual. Successful completion will require that major and minor profiles were accurately determined; artifacts were correctly identified and accounted for; no erroneous profile identifications or exclusions were made; statistics were calculated correctly; and clean technique was followed. In addition, all standards listed in Command Directive TRN 14 must be met.

    A. Interpretation and reporting for a ~~A~~ minimum of twelve DNA cases must be completed. The twelve cases should include a minimum of eight DNA cases, a minimum of two Direct to DNA Sexual Assault cases and a minimum of one COIDS hit report. Additional cases may be required if the trainee demonstrates a difficulty with any aspect of casework including, but not limited to, interpretation, analytical work, productivity, case management, and excessive technical review points. Competency will be demonstrated with three of the twelve cases counting as a practical criterion test.

    B. The trainee will demonstrate sufficient knowledge and skill required to complete a thorough technical review on his/her own casework.

    C. The trainee will develop and demonstrate the knowledge and skill required to effectively manage in a productive manner all facets of forensic biology/DNA casework, which includes, but is not limited to, analysis/interpretation/report generation, participating in the quality control/quality assurance procedures in the laboratory, responding to legal/discovery issues, and other duties required for casework management.

    D. The trainee will maintain favorable public relations with user agencies and testify in court concerning the procedures and results of their forensic biology/DNA analysis.

Lectures: CODIS Hit Reports

DNA SUPERVISED CASEWORK MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Supervised Casework			
Practical: 3 Supervised Cases			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: BONE EXTRACTION

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

Estimated Time: 6 Days (2 days per week for 3 weeks)

Purpose: To understand bone extraction and the adaptation of the biology/DNA procedures to produce DNA data from bone submission.

Objectives:

1. The trainee will demonstrate competency in the extraction of human DNA from a minimum of one of three samples provided.

2. The trainee will demonstrate sufficient knowledge and skills required for proper bone preparation and isolation techniques during bone extraction training. Successful completion will be determined by training coordinator observation on a pass/fail basis.

Part I:

Estimated Time: 2 Days (3 day lapse time for extraction)

Purpose: To familiarize the trainee with the femur bone extraction procedures.

Lectures: Bone Extractions – Overview of Topics
Safety Procedures

Exercises:

1. Extract one femur bone.
2. qPCR will be performed to ensure high molecular weight DNA has been obtained.
3. Amplification and typing will be performed to ensure proper results.

Reading Assignments:

1. *Anatomy of the Human Body*, Bone Physiology section by Henry Gray. 20th ed., re-edited by Warren H. Lewis, Philadelphia: Lea & Febiger, 1918. OTHER AUTHOR: Lewis, Warren Harmon, ISBN: 1-58734-102-6., Bartleby.com, 2000.

2. Frank, W. E., Llewellyn, B. E., "A Time Course Study on STR Profiles Derived from Human Bone, Muscle, and Bone Marrow", *Journal of Forensic Sciences*, 1999, Vol. 4, pp. 778-782.

Part II

Estimated Time: 2 Days (3 day lapse time for extraction)

Purpose: To familiarize the trainee with a rib bone extraction procedure.

Lectures: Bone Extractions - Equipment and Techniques
Bone Physiology

Exercises:

1. Each trainee will extract one rib bone.
2. qPCR will be performed to ensure high molecular weight DNA has been obtained.
3. Amplification and typing will be performed to ensure proper results.

Part III:

Estimated Time 2 Days (3 day lapse time for extraction)

Purpose: To familiarize the trainee with bone extraction procedure.

Lecture: Sources of Error and Interpretation of Results

Exercises:

1. Each trainee will extract any type of available bone.
2. qPCR will be performed to ensure high molecular weight DNA has been obtained.
3. Amplification and typing will be performed to ensure proper results.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: BONE EXTRACTION – FREEZER MILL

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

Estimated Time: 5 Days

Purpose: To familiarize the forensic scientist with the concepts of bone extraction.

Lectures:
Bone Extraction Procedure Using the Spex Freezer Mill
ISP Bone Extraction Procedure
QIAquick Silica Filtration for Inhibitor Removal
QIAquick Filter Validation and Procedures

Exercises:

1. Extract one environmentally exposed bone sample. Bone dust will be collected using the Spex Freezer Mill.
2. Quantify extracted DNA by qPCR. Extraction results will be graded as passing if a minimal total of 2ng is obtained from the extraction and no PCR inhibition is identified based on qPCR results.
3. Filter 50µL of the bone extract using a QIAquick filter. Recover the filtered sample in 50µL. Quantify each sample by qPCR. Note removal of inhibitor if identified by qPCR. Identify the approximate recovery efficiency for these filters.
4. Read assigned materials.
5. Review lecture materials.

Required Reading

1. Relevant portions of the ISP Forensic Biology/DNA Procedures Manual.

2. QIAquick handbook.

3. ISP Research and Development Laboratory Bone Extraction Validation Summary.

Supplemental Reference:

1. Spex Freezer Mill Operating Manual.

2. Technical Note: Improved DNA Extraction from Ancient bone Using Silica-Based Spin Columns, DY Yang, et. al., American Journal of Physical Anthropology, 1998, 105: 539-543.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: DNA Isolation from Non-Semen Samples (Excluding Tissue, Hair and Bone)

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

DNA ISOLATION FROM NON-SEMEN SAMPLES (EXCLUDING TISSUE, HAIR, AND BONE) USING THE DNA IQ™ SYSTEM

Estimated Time: 5 Days

Purpose: To familiarize the forensic scientist/trainee with the concepts of DNA isolation using the DNA IQ™ System and ISP Procedures.

Lectures: DNA Isolation - Overview of Topics:

- Purpose of Extraction
- Function of Reagents
- Function of Each Step
- Comparison to Organic Extraction
- Limitations of the DNA IQTM System
- Controls Used During Isolation
- Contamination Awareness During Isolation
- ISP DNA Isolation with the DNA IQTM System Procedures

Exercises:

1. Read assigned materials.
2. Review lecture material.
3. Prepare extraction reagents.
4. Perform manual extraction and qPCR quantitation on blood standards, minimum of 9 samples total, to include:
   A. Three replicates of ¼ stain from a filter paper blood card.
   B. Three replicates of ⅛ stain from a filter paper blood card.
   C. Three replicates of $^{1}/_{16}$ stain from a filter paper blood card.
5. Perform manual extraction and qPCR quantitation on buccal standards, minimum of 6 samples total, to include:
   A. Three replicates of ½ buccal swab.
   B. Three replicates of ¼ buccal swab.
6. Perform manual extraction and qPCR quantitation on a dilution series using blood:
   A. For example, dilute liquid blood 1/5 and spot a varying series of volume onto material (e.g. 30µL, 20µL, 10µL, 5µL, 2µL, and 1µL).
   B. Extract the generated dilution series of minimally 6 volumes in duplicate, for a minimum of 12 samples total.
7. Perform manual extraction and qPCR quantitation on a dilution series using saliva:
   A. For example, dilute fresh saliva ½ and spot a varying series of volume onto material (e.g. 30µL, 20µL, 10µL, 5µL, 2µL, and 1µL).
   B. Extract the generated dilution series of minimally 6 volumes in duplicate, for a minimum of 12 samples total.

8. Perform manual extraction and qPCR quantitation on forensic casework type non-semen samples (e.g. cigarette butts, blood or saliva stain on blue jeans, etc.), minimum of 6 samples total, to include but not be limited to:
   A. Three replicates of portions of cigarette butts.
   B. Three replicates of blood or saliva stain from black-dyed material (the material can be generated using a black dye such as RIT).
9. Record all results and observations.
10. Complete a written report based on the recorded results and observations. This may be done as a group exercise if deemed appropriate.

Required Reading:

1. Relevant portions of the ISP Forensic Biology/DNA Procedures Manual.

2. Relevant ISP Validation Studies.

3. Promega Corporation Technical Bulletin No. 296: DNA IQTM System - Small Sample Casework Protocol.

4. As assigned.

Supplemental Reference:

1. Relevant scientific literature.

Competency Test:

1. Initial competency will be demonstrated by: a.) completion of extraction exercises to training coordinator's satisfaction, and b.) achieving a minimum score of 80% on a written criterion test.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: SILICA FILTRATION

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

SILICA FILTRATION

Estimated Time: 2 Days

Purpose: To familiarize the forensic scientist with the concepts of silica filtration.

Lectures: QIAquick Silica Filtration for Inhibitor Removal and MinElute Silica Filtration for Post PCR Purification Topics:

- QIAquick Filter Validation and Procedures
- MinElute Filter Validation and Procedures

QIAquick Exercise:

1. Prepare a serial dilution of TE-4 saturated hematin. Prepare a DNA standard at approximately 5ng/µL with each point in the hematin series. Filter 50µL of each mixture using a QIAquick filter. Recover the filtered sample in 50µL. Quantify each sample by qPCR. Note removal of inhibitor in the filtered sample set. Identify the approximate recovery efficiency for these filters. Results are expected to meet those identified in the validation study for inhibitor removal and recovery efficiency.

MinElute Exercises:

1. Create a serial dilution ranging from 0.25ng/µL to approximately 0.0078ng/µL and amplify two 5µL aliquots of each sample using the current autosomal STR amplification chemistry. Filter one replicate dilution in the series with the MinElute filter. Analyze all data based on a 50 rfu threshold. Identify allele/locus drop-out. Compare results to validation study reports identifying stochasm as affecting amplifications of less than 0.125 ng.
2. Forensic Scientists trained in Y-STR analysis will complete the same studies using the current Y-STR amplification system.
3. Read assigned materials.
4. Review lecture materials.

Required Reading:

1. Relevant portions of the ISP Forensic Biology/DNA Procedures Manual.

2. QIAquick and MinElute handbooks.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: AUTOMATED ANALYSIS OF DNA USING THE TECAN FREEDOM EVO® 150 AND THE PROMEGA METHODS: OPERATION

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Demuth II
Director of Training

PREREQUISITE

Successful completion of the Tecan Freedom EVO 150 and the Promega Methods: Theory training module.

UNIT ESTIMATED TIME

20 Days

GOAL

To achieve the necessary knowledge, skill, and ability to successfully complete automated DNA isolation, quantitation and amplification normalization of forensic samples utilizing the DNA IQ™ System with the Tecan instrument as outlined in the Illinois State Police Command DNA automation procedures.

OBJECTIVES

1. The trainee will demonstrate competency in the Illinois State Police Command DNA isolation, quantitation and amplification normalization utilizing the DNA IQ System with the Tecan instrument and critical regent quality control of DNA IQ™ resin by completing three practical criterion tests with a score of no less than 100%.

LESSON 1

Lectures: Tecan Operation and Automated Analysis Workflow
Automated Analysis Troubleshooting

Exercises:

1. Demonstration(s)
2. Water run
4. Checkerboard plate
5. Mock casework

Criterion tests:

1. Practical criterion test; minimum of one full column
2. Supervised casework; 1 unknown, 1 standard plate

Required reading:

1. Relevant portions of the Forensic Biology/DNA Procedures Manual.

2. Relevant portions of the Bio/DNA LIMS User's Guide
3. Tecan Freedom EVO Operating Manual

LESSON 2

Lecture: Critical Reagent Quality Control of DNA IQ™ Resin

Exercises:
1. Demonstration
2. Mock sample set

Criterion test:
1. Practical criterion test; 1 sample, 1 blank

Required reading:
1. Relevant portions of the Forensic Biology/DNA Procedures Manual.
2. Relevant portions of the Bio/DNA LIMS User's Guide
3. DNA IQ™ System-Small Sample Casework Protocol Technical Bulletin

AUTOMATED ANALYSIS OF DNA USING THE TECAN FREEDOM EVO 150® & THE PROMEGA METHODS: OPERATION
MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration			
Exercise: water run			
Exercise: checkerboard			
Exercise: mock casework			
Practical #1: instrument			
Supervised casework			
Practical #2: supervised casework			
QC: DNA IQ resin			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: AmpFℓSTR MINIFILER

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

AmpFℓSTR MINIFILER

LESSON 1

Estimated Time: 2 Days

Purpose: To familiarize the forensic scientist with relevant mini-STR literature, validation study results and ISP procedures.

Lectures: Mini-STR Analysis Topics:
- Multiplex Systems
- Forensic Validation Studies
- ISP Forensic Biology/DNA Procedures Manual

Exercises:
1. Read assigned materials.
2. Review lecture materials.

Required Reading.
1. Relevant portions of the Forensic Biology/DNA Procedures Manual.

Supplemental Reference:
1. Assigned literature.

LESSON 2

Estimated Time: 5 Days

Purpose: Develop practical competency in amplification using the AmpFℓSTR Minifiler PCR Amplification Kit.

Exercises:
1. Extract, purify, isolate and quantify DNA from five previously profiled degraded samples.
2. Amplify extracted DNAs and control samples using the AmpFℓSTR Minifiler PCR Amplification Kit.
3. CE analysis of amplification set.
4. Samples and control results will be reviewed by training coordinator. For results to be accepted:
   A. Positive control results must be correct and complete.

B. Alleles identified in each practice sample must be correct. As samples are degraded complete genotypes are not required for all loci.

Required Reading:

1. Relevant portions of the Forensic Biology/DNA Procedures Manual.

Competency Test:

1. Initial competency will be demonstrated by achieving a minimum score of 80% on a written criterion test.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: Y-STR AMPLIFICATION AND THEORY

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

LESSON 1

Estimated Time:	3 Days
Purpose:	To familiarize the forensic scientist/trainee with the relevant Y-STR literature, validation study results and ISP procedures.
Lectures:	Y-STR Analysis – Overview of Topics Applications Mutation Rates Multiplex Systems Population Genetics Forensic Validation Studies

Exercises:

1. Read assigned materials.
2. Review lecture material.
3. Complete written criterion test by achieving 80% minimum passing score.

Required Reading:

1. Relevant portions of the Forensic Biology/DNA Procedures Manual.

2. Sinha, S. K., Budowle, B., Arcot, S. S., Richey, S. L., Chakraborty, R., Jones, M. D., Wojtkiewicz, P. W., Schoenbauer, D. A., Gross, A. M., Sinha, S.K., Shewale, J. G., “Development and Validation of a Multiplexed Y-Chromosome STR Genotyping System, Y-Plex¤ 6, for Forensic Casework,” Journal of Forensic Sciences, 2003, Vol. 48, No. 1, pp. 93-103.

3. Sinha, S. K., Nasir, H., Gross, A. M., Budowle, B., Shewale, J. G., “Development and Validation of the Y-Plex¤ 5, a Y-Chromosome STR Genotyping System, for Forensic Casework,” Journal of Forensic Sciences, 2003, Vol. 48, No. 5, pp. 985-1000.

4. Krenke, B. E., et. al., “Validation of a Male Specific, 12-Locus Fluorescent Short Tandem Repeat (STR) Multiplex,” Forensic Science International, 2005, Vol. 148, No. 1, pp. 1-14.

5. Thompson, J.M., Ewing, M.M., Frank, W.E., et.al., “Developmental Validation of the PowerPlex Y23: A Single Multiplex Y-STR Analysis System for Casework and Database Samples,” Forensic Science International: Genetics 2013.

6. Promega Inc. PowerPlex® Y23 Kit User’s Manual.

Supplemental Reference:

1. Frank, W. E, Ellinger, E. R., Kirshack, P. A., "Y-Chromosome STR Haplotypes and Allele Frequencies in Illinois Caucasian, African American and Hispanic Males," Journal of Forensic Sciences, 2006, Vol. 51, No. 5, pp. 1207-1215.

2. Assigned literature.

LESSON 2

Estimated Time: 3-5 Days (5 days if samples need extraction and quantification)

Purpose: To introduce amplification using Y-STR amplification kit components and demonstrate inter-laboratory reproducibility with respect to haplotype results.

Lecture: Amplification Set Up and PCR Product Evaluation

Exercises:

1. Extraction, purification, isolation and quantitation of DNA from six previously profiled samples.

2. Amplification of extracted DNAs and control samples using Y-STR amplification kit components.
3. PCR product genotype analysis using capillary electrophoresis.

Required Reading:

1. Relevant portions of the Forensic Biology/DNA Procedures Manual.

Supplemental Reference:

1. Assigned literature.

LESSON 3

Estimated Time: 5 days (5 days if samples need extraction and quantification)

Purpose: To evaluate amplification sensitivity using Y-STR amplification kit components.

Lectures: Amplification Set Up and PCR Product Evaluation
Y-STR Sensitivity Limits

Exercises:

1. Amplification of a 2 - 0.031ng serial dilution of one previously quantified DNA using Y-STR amplification kit components.
2. PCR product genotype analysis using capillary electrophoresis.

Required Reading: 1. Relevant portions of the Forensic Biology/DNA Procedures Manual.

Supplemental Reference: 1. Assigned literature.

LESSON 4

Estimated Time: 5 Days

Purpose: To complete the analysis of non-probative casework samples and a Y-STR analysis competency test.

Lecture: None

Exercises:

1. Amplify seven non-probative casework samples.
2. PCR product genotype analysis using capillary electrophoresis.
3. Extract, purify, isolate and quantitate 5 competency samples.
4. Amplify competency samples using Y-STR amplification kit components.
5. PCR product genotype analysis using capillary electrophoresis.
6. Validation summary based on results produced by analyst in training.
7. Complete competency test by achieving 100% minimum passing score.

Required Reading: 1. Relevant portions of the Forensic Biology/DNA Procedures Manual.

Supplemental Reference: 1. Assigned literature.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: PARENTAGE

Reviewed by:

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Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

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DNA Technical Leader

William E. Frank
DNA Technical Leader

William E. Demuth II
Director of Training

PARENTAGE ANALYSIS

Estimated Time: 2 Days

Purpose: To familiarize the forensic scientist with the concepts of and statistical basis for parentage analysis.

Lectures: Parentage Analysis Topics:
- ISP Case Acceptance Policies
- Likelihood Ratios
- Parentage, Combined Parentage and Reverse Combined Parentage Indices
- Probability of Paternity
- Probability of Exclusion
- Report Wording Guidelines

Exercises:
1. Hand calculation of parentage, combined parentage and reverse combined parentage indices.
2. Demonstration of the parentage module within Popstats.

Required Reading:
1. Relevant portions of the Forensic Biology/DNA Procedures Manual.
2. Relevant portions of the Command Directives.
3. As assigned.

Competency Test:
1. Initial competency will be demonstrated by: a.) achieving a score of 100% on a practical criterion test consisting of mock parentage trio sets, and b.) achieving a minimum score of 80% on a written criterion test.

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: STRmix™ Analysis- PowerPlex® Fusion

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Demuth II
Laboratory Director

UNIT ESTIMATED TIME

51 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully use the STRmix™ software utilizing the Illinois State Police Command STRmix™ Procedures.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of STRmix analysis by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate sufficient knowledge and skill in the Illinois State Police Command STRmix™ analysis procedures by completing a practical criterion test consisting of a minimum of three cases with a score no less than 100%.

LESSON

Lectures:

1. STRmix™ Introductory Training

    Develop an understanding of probabilistic genotyping (semi, full) as compared to historical DNA mixture interpretation models

    Build familiarity with the STRmix™ biological model and its components

    Build familiarity with the Markov Chain Monte Carlo and Metropolis-Hastings statistical algorithms used by the STRmix™ software

2. Likelihood Ratio

    Develop an understanding of likelihood ratios and proposition formation

    Build familiarity with the means by which STRmix incorporates Identity by Descent (IBD) and the Highest Posterior Density (HPD)

    Develop an understanding of how likelihood ratio behavior is affected by the number of contributors in a DNA mixture

3. Validation

Build familiarity with Illinois State Police validation information for STRmix

4. Procedure and Workflow

Build familiarity with Illinois State Police STRmix™ procedure

Develop an understanding of how to determine the number of contributors in a DNA mixture

Build familiarity with utilizing the STRmix™ software, including the import files, software settings, and proposition formation

Develop an understanding of the analytical diagnostics built into the STRmix™ software and advanced reports, to include primary and secondary diagnostics

5. Reports, Technical Review & Testimony

Develop an understanding of STRmix™ interpretation report format, proposition formation, conclusion statements, and verbal scale.

Prepare for testimony regarding STRmix analysis (prepare courtroom explanations, explanation for STRmix™ validity, and explanation of provided training, understanding of fallacies)

Exercises:

1. Proposition exercise
2. STRmix™ Demonstration and Observation
3. Mock casework

Required Reading:

<u>Foundational Knowledge</u>

ISP Validation documents

SWGDAM Validation Guidelines for Probabilistic Genotyping Systems

Developmental validation of STRmix™, expert software for the interpretation of forensic DNA profiles. Bright et al. FSI: Genetics 23 (2016) 226-239

Internal Validation of STRmix™; A multi laboratory response to PCAST. Bright et al. FSI: Genetics 34 (2018) 11-24

Probabilistic genotyping software: An overview. Coble, M. and Bright, J-A. FSI: Genetics 38 (2019) 219-224

The Probabilistic Genotyping Software STRmix™: Utility and Evidence for its Validity. Buckleton et al. Journal of Forensic Sciences 64 Issue 2 (2018) 393-405.

Internal Validation of STRmix™ for the interpretation of single source and mixed DNA profiles. Moretti et al. FSI: Genetics 29 (2017) 126-144

A series of recommended tests when validating probabilistic DNA profile interpretation software. Bright et al. FSI: Genetics 14 (2015) 125-131

Commentary: A "source" of error: Computer Code, Criminal Defendants, and the Constitution. Taylor et al. Frontiers in Genetics March 2017, Volume 8, Article 33

A guide to results and diagnostics within a STRmix™ report. Russell et al. WIREs Forensic Sci. 2019; e1354

Forensic DNA Profiling, A Practical Guide to Assigning Likelihood Ratios. Coble and Bright. Chapter 8

<u>Interpretation and Proposition Formation</u>

The effect of uncertainty in the number of contributors to mixed DNA profiles on profile interpretation. Bright et al. FSI: Genetics 12 (2014) 208-214

The interpretation of single source and mixed DNA profiles. Taylor et al. FSI: Genetics 7 (5) (2013) 516-528

Uncertainty in the number of contributors in the proposed new CODIS set. Coble et al. FSI: Genetics 19 (2015) 207-211

Distinguishing between donors and their relatives in complex DNA mixtures with binary models. Slooten, K. FSI: Genetics 21 (2016) 95-109

Forensic DNA Profiling, A Practical Guide to Assigning Likelihood Ratios. Coble and Bright. Chapter 2

A Practical Guide for the Formulation of Propositions in the Bayesian Approach to DNA Evidence Interpretation in an Adversarial Environment. Gittleson et al. Journal of Forensic Sciences 61 Issue 1 (2016) 186-195

Biological Model

Statistical model for degraded DNA samples and adjusted probabilities for allelic drop out. Tvedebrink et al. FSI: Genetics 6 (2012) 91-101

Degradation of forensic DNA profiles. Bright et al. Australian Journal of Forensic Sciences 45:4, 445-449

Modelling heterozygote balance in forensic DNA profiles. Kelley et al. FSI: Genetics 6 (2012) 729-734

Developing allelic and stutter peak height models for a continuous method of DNA interpretation. Bright et al. FSI: Genetics 7 (2013) 296-304

Characterizing stutter in forensic STR multiplexes. Brookes et al. FSI: Genetics 6 (2012) 58-63

Sequence based analysis of stutter at STR loci: Characterization and Utility. Aponte et al. FSI: Genetics 5 (2015) e456-e458

Factors affecting peak height variability for short tandem repeat data. FSI: Genetics 21 (2016) 126-133

Likelihood Ratios

Using continuous DNA interpretation methods to revisit likelihood ratio behavior. Taylor, D. FSI: Genetics 11 (2014) 144-153

An investigation into the performance of methods for adjusting for sampling uncertainty in DNA likelihood ratio calculations. Curran, J. and Buckleton, J. FSI: Genetics 5 (2011) 512-516

The variability in likelihood ratios due to different mechanisms. Bright et al. FSI: Genetics 14 (2015) 187-190

An illustration of the effect of various sources of uncertainty on DNA likelihood ratio calculations. Taylor et al. FSI: Genetics 11 (2014) 56-53

On the interpretation of likelihood ratios in forensic science evidence: Presentation formats and the weak evidence effect. Martire et al. FSI: Genetics 240 (2014) 61-68

The effect of varying the number of contributors in the prosecution and alternate propositions. Buckleton et al. FSI: Genetics 38 (2019) 225-231

Forensic DNA Profiling, A Practical Guide to Assigning Likelihood Ratios. Coble and Bright. Chapters 3, 4, 5, 7

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

STRmix™ Analysis- PowerPlex® Fusion

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lectures			
Required readings			
Demonstration			
Observation			
Independent exercise: Propositions			
Independent exercise: Mock casework			
Practical exam			
Written exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: STRmix™-CODIS Suite for Analysts

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Demuth II
Laboratory Director

UNIT ESTIMATED TIME

5 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully generate CODIS eligible profiles from STRmix™ data using the POPSTR and FORESTR software programs in the STRmix-CODIS Suite while following the Illinois State Police Command procedures and workflow.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of the STRmix™-CODIS Suite by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate sufficient knowledge and skill to successfully generate CODIS eligible profiles from STRmix™ data using the POPSTR and FORESTR software programs while following the Illinois State Police Command workflow and procedure by successfully passing a practical competency test with a score no less than 100%

LESSON

Lectures:
1. Introduction to the STRmix-CODIS Suite
2. POPSTR-Foundation, Parameters & Validation
3. FORESTR- Foundation, Parameters & Validation
4. DATABSR- Introduction for non-CODIS Administrators
5. ISP Procedure, Workflow, LIMS documentation and Technical Review
6. Summary
7. STRmix-CODIS Suite Demonstration

Exercises:
1. Read assigned materials
2. Practice sample set

Required Reading:
1. Relevant portions of the Forensic Biology/DNA Procedures Manual
2. Internal Validation of POPSTR v0.94
4. Internal Validation of FORESTR v0.8
5. Internal Validation of DATABSR
6. Relevant portions of the Biology/DNA LIMS User's Guide

STRmix^{TM}-CODIS Suite for Analysts
MODULE CHECKLIST

Trainee: ________________________ Trainer: ________________________

Training Start Date: ________________ Training End Date: ________________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration			
Observation			
Independent exercise			
Written exam			
Practical exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: DATABSR for CODIS Administrators

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Demuth II
Laboratory Director

PREREQUISITE

CODIS Administrator or CODIS Alternate and successful completion of the STRmix™ CODIS Suite for Analysts module.

UNIT ESTIMATED TIME

2 Days

GOAL

To achieve the necessary knowledge, skill and ability to successfully use the DATABSR software program in the evaluation of candidate matches generated from POPSTR STRmix™ profiles while following the Illinois State Police Command procedures and workflow.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of the DATABSR software program by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate sufficient knowledge and skill to successfully manage CODIS eligible profiles from STRmix™ data using the DATABSR software program while following the Illinois State Police Command workflow and procedure by successfully passing a practical competency test with a score no less than 100%

LESSON

Lectures:

1. DATABSR for CODIS Administrators
2. DATABSR Demonstration

Exercises:

1. Read assigned materials
2. Observation

Required Reading:

1. Relevant portions of the Forensic Biology/DNA Procedures Manual
2. Internal Validation of DATABSR v0.3c
3. Relevant portions of the Biology/DNA LIMS User's Guide

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

**DATABSR for CODIS ADMINISTRATORS
MODULE CHECKLIST**

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration			
Observation			
Written exam			
Practical exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: Maxprep™ Automation: Theory

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Demuth II
Director of Training

PREREQUISITE

DNA Isolation, DNA Isolation Utilizing the DNA IQ System- Maxwell Instrument, DNA Quantitation, PCR Amplification modules.

UNIT ESTIMATED TIME

2 Days

GOAL

To achieve the necessary knowledge and thorough understanding of the processing of non-semen and semen samples from preparation through capillary electrophoresis using the Maxprep™ Liquid Handler/Portal Software in order to author and peer reports.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of DNA sample processing as it relates to the Maxprep™ Liquid Handler/Portal Software by successfully passing a written criterion test with a score of no less than 80%.

Lectures:
Maxprep™ Theory: Introduction
Maxprep™ Liquid Handler
Maxprep™ Validation
ISP Maxprep™ Procedure and Technical Review

Required Reading:

1. Illinois State Police Internal Validation: Maxwell® RSC 48 Instrument/Maxprep™ Liquid Handler/Portal Software using methods for purification thru Capillary Electrophoresis Preparation

2. Illinois State Police Forensic Biology/DNA Procedures Manual: Maxwell® RSC 48 Instrument/Maxprep™ Liquid Handler/Portal Software using methods for sample preparation through Capillary Electrophoresis

3. Relevant areas of the Biology/DNA LIMS User Guide

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

MAXPREP ™ AUTOMATION: THEORY MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture 1: Introduction			
Lecture 2: Maxprep™ Liquid Handler			
Lecture 3: Validation			
Lecture 4: Procedure & Technical Review			
Required readings			
Written test			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: Maxprep™ Automation: Operation

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Demuth II
Director of Training

PREREQUISITE

Successful completion of the Maxprep Automation: Theory training module.

UNIT ESTIMATED TIME

15 Days

GOAL

To achieve the necessary knowledge, skill, and ability to successfully complete automated DNA isolation of non-semen and semen samples from preparation through capillary electrophoresis using the Maxprep™ Liquid Handler as outlined in the Illinois State Police Command DNA automation procedures.

OBJECTIVES

1. The trainee will demonstrate competency by completing a practical competency test with a score of no less than 100%

Lectures: Maxprep™ Operation and Automated Analysis Workflow - Demonstration
Maxprep™ Maintenance and Quality Control - Demonstration

Exercises:
1. Water run
2. Checkerboard batch
3. Mock casework

Required Reading:
1. Relevant portions of the Forensic Biology/DNA Procedures Manual.
2. Relevant portions of the Bio/DNA LIMS User's Guide
3. Maxprep™ Liquid Handler Operating Manual. [Online, 11/21]
4. Maxprep™ Liquid Handler Method for Preprocessing of Maxwell® FSC DNA IQ™ Casework Kit Samples in Tubes. [Online, 11/19]
5. Preprocessing Methods for the MaxprepTM Liquid Handler Protocol. [Online, 12/21]
6. Maxwell® RSC 48 Instrument Operating Manual. [12/22]
7. PowerQuant® System Setup Method for the MaxprepTM Liquid Handler.[Online, 02/21]
8. Promega DNA Normalization and STR Setup Method for the MaxprepTM Liquid Handler Technical Manual. [Online, 12/21]
9. Capillary Electrophoresis Sample Setup Method for the MaxprepTM Liquid Handler Technical Manual. [Online, 10/21]
10. Portal Access Technical Manual. [Online, 08/21]
11. Illinois State Police Internal Validation: Maxwell® RSC 48 Instrument/MaxprepTM Liquid Handler/Portal Software using methods for purification thru Capillary Electrophoresis Preparation.

12. Loten et al. Developmental Validation of the Maxwell® FSC DNA IQTM Casework Kit on the Maxwell® RSC 48 Instrument. March 2018 [Promega White Paper]

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

MAXPREP ™ AUTOMATION: OPERATION MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration			
Exercise: Water run			
Exercise: Checkerboard			
Exercise: Mock Casework			
Practical Competency Test			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

MODULE: FIRED CARTRIDGE CASE PREPROCESSING FOR IQ™ EXTRACTION

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Demuth II
Laboratory Director

PREREQUISITE

DNA IQ™

UNIT ESTIMATED TIME

5 Days

GOAL

To achieve the necessary knowledge, skill, and ability to successfully recover DNA and preprocess cellular material from fired cartridge cases or similar substrates utilizing the Promega DNA IQ™ System as outlined in the Illinois State Police Command procedure.

OBJECTIVES

1. The trainee will demonstrate a comprehensive understanding of the process of recovering and preprocessing DNA from fired cartridge cases utilizing the Promega DNA IQ™ System by successfully passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate competency in the Illinois State Police Command procedure for fired cartridge case preprocessing for DNA IQ™ extraction by completing a practical criterion test with a score of no less than 100%.

LESSON

Lectures: Fired Cartridge Case Preprocessing for DNA IQ™ Extraction
- Foundation
- Validation
- Procedure, workflow & quality assurance
- Technical review

Demonstration

Exercises:
1. Read assigned materials.
2. Review lecture material.

3. Observation and Independent mock samples

Required Reading:

1. ISP Research Project: Method to collect cellular material from fired cartridge cases for DNA analysis (2022-01)

2. Bille et al. An improved process for the collection and DNA analysis of fired cartridge cases. Forensic Sci Int Genet. 2020 May; 46:102238

3. Relevant portions of the Forensic Biology/DNA Procedures Manual

4. Relevant portions of the Biology/DNA LIMS User Guide

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

FIRED CARTRIDGE CASE PREPROCESSING
for DNA IQ™ EXTRACTION
MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture			
Required readings			
Demonstration			
Observation			
Independent exercise			
Written exam			
Practical exam			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA
TRAINING MANUAL

MODULE: RAPID DNA BUCCAL SWAB PROFILING

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Demuth II
Director of Training

PREREQUISITE

Successful completion of core DNA modules.

UNIT ESTIMATED TIME

5 days

GOAL

To achieve the necessary knowledge, skill, and ability to successfully profile buccal swab standards using the Applied Biosystems™ RapidHIT™ DNA System with the RapidLink Software as outlined in the Illinois State Police Command procedure.

OBJECTIVES

1. The trainee will demonstrate competency in the Illinois State Police Command Buccal Swab Standard Profiling Using the Applied Bioystems™ RapidHIT™ DNA System procedure by passing a practical criterion tests with a score of no less than 100%.

2. The trainee will demonstrate a comprehensive understanding of the RapidHIT™ DNA System by successfully completing a written criterion test with a score of no less than 80%.

LESSON 1

Lectures: Rapid DNA Foundation and Instrument Validation
ISP Procedure and Technical Review

Exercises:
1. Demonstration
2. Observation
3. Mock casework

LESSON 2

Lecture: Quality Control

Exercises:
1. Demonstration

Required Reading:

1. RapidHIT™ ID System v1.0 Site Preparation Guide.

2. RapidHIT™ ID System v1.3.2 User Guide

3. Applied Biosystems RapidHIT™ ID System Internal Validation Report.

4. Tan, E., et al. Fully integrated, fully automated generation of short tandem repeat profiles. Investigative Genetics 2013; 4:16.

5. Turingan, R., et al. Rapid DNA analysis for automated processing and interpretation of low DNA content samples. Investigative Genetics 2016; 7:2.

6. Manna, A., et al. Developmental validation of the DNAscan Rapid DNA Analysis™ instrument and expert system for reference sample processing. Forensic Science International: Genetics 2016; 25: 145-156

7. Grover, R., et al. FlexPlex27- highly multiplexed rapid DNA identification for law enforcement, kinship, and military applications. International Journal of Legal Medicine. 03 March 2017.

8. Relevant portions of the Illinois State Police Forensic Biology/DNA Procedures Manual.

9. Relevant portions of the DNA LIMS User Guide.

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

RAPID DNA
BUCCAL SWAB PROFILING
MODULE CHECKLIST

Trainee: ______________________ Trainer: ______________________

Training Start Date: ______________ Training End Date: ______________

Task	Completion Date	Trainee Initials	Trainer Initials
Lecture 1: Foundation & Instrument			
Lecture 2: Validation			
Lecture 3: Procedure & Technical Review			
Demonstration			
Observation			
Required readings			
Written test			
Practical test			

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

APPENDIX A-1: FORENSIC BIOLOGY TRAINING CHECKLIST

Reviewed by:

Lisa M. Fallara
Training Coordinator

Tabithah L. Marcacci
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

INITIAL FORENSIC SCIENCE TRAINING CHECKLIST
FORENSIC BIOLOGY

Trainee: ______________________________ Coordinator: ______________________________

Training Start Date: ____________________ Training End Date: ______________________

Module	Completion Date	Trainee Initials	Coordinator Initials
General Forensic Science			
Ethics in Forensic Science			
Clean Technique			
Reagent Preparation			
Evidence Screening Quality Assurance			
Evidence Handling			
Blood Stain Screening			
Semen Stain Screening			
Saliva Stain Screening			
Biology Screening Assessment			
Courtroom Training-for Forensic Biology			
Supervised Forensic Biology Casework			
Final Forensic Biology Mock Trial			

If a module was not completed, mark it as “NC” (“Not completed”).

ILLINOIS STATE POLICE

FORENSIC BIOLOGY/DNA TRAINING MANUAL

APPENDIX A-2: DNA TRAINING CHECKLIST

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

William E. Demuth II
Director of Training

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

INITIAL FORENSIC SCIENCE TRAINING CHECKLIST
DNA

Trainee: ________________________________ Coordinator: ________________________________

Training Start Date: ____________________ Training End Date: ________________________

Module	Completion Date	Trainee Initials	Coordinator Initials
Clean Technique			
Reagent Preparation			
Introduction to DNA			
DNA Isolation (Organic Extraction)			
DNA Isolation (DNA IQ™ with Maxwell® 16)			
DNA Quantitation			
PCR Amplification			
STR Analysis			
DNA Quality Assurance			
DNA Guidelines			
STR Interpretation / Statistics / Report Writing			
Combined DNA Index System (CODIS)			
Courtroom Training / Legal Issues for DNA Analysis			
Oral Board Evaluation			
DNA Mock Casework			
Supervised DNA Casework			
Final DNA Mock Trial			
Supplemental DNA Training Modules:			

If a module was not completed, mark it as "NC" ("Not completed").

ILLINOIS STATE POLICE

FORENSIC BIOLOGY TRAINING MANUAL

APPENDIX A-3: FORENSIC BIOLOGY/DNA AUTHORIZATIONS BASED ON SCOPE

Reviewed by:

Tabithah L. Marcacci
Training Coordinator

Lisa M. Fallara
Training Coordinator

Approved by:

Jeanne M. Richeal
DNA Technical Leader

William E. Demuth II
Director of Training

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

AUTHORIZATIONS BASED ON SCOPE

Field of Testing: Forensic Testing Forensic Scientist: ______________________
Category: Biology

Sub Category: Biological Screening

Analytical Technique	Authorized
1.1 Screening Test: Immunoassay	
1.2 Screening Test: Color	
4.1 Physical Examination: Physical Measurements	
5.1 Microscopy: Optical	
6.4 General Laboratory Procedures: General Laboratory Techniques	

Sub Category: DNA Analysis in Forensic Casework

Analytical Technique	Authorized
6.4 General Laboratory Procedures: General Laboratory Techniques	
7.1.1 Genetic Analysis: DNA-PCR: Autosomal STR – Fusion	
7.1.2 Genetic Analysis: DNA-PCR: Y STR – PowerPlex Y23	
7.1.3 Genetic Analysis: DNA-PCR: Quantitation – qPCR	
7.2 Genetic Analysis: Data Analysis	
7.3 Genetic Analysis: Population Database	
7.4.1 Genetic Analysis: DNA Extraction: Manual Methods – PCI	
7.4.1 Genetic Analysis: DNA Extraction: Manual Methods – DNA IQ	
7.4.2 Genetic Analysis: DNA Extraction: Automated Methods – DNA IQ/Maxwell 16	
8.1 Electrophoresis: Capillary	

These are the areas under which I am authorized to conduct casework.

____
Forensic Scientist / Date

____
Training Coordinator / Date

____
Director of Training / Date

TABLE OF CONTENTS
FOOTWEAR/TIRE TRACKS

Appendices

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS
TRAINING MANUAL

MODULE: GENERAL INFORMATION AND HISTORY

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

NONE

UNIT ESTIMATED TIME

5 Days*

* *Unit estimated time is not stated as concurrent or complete days. A study of the general information and history of footwear and tire track identification will be performed in conjunction with additional units of instruction and application.*

GOAL

The trainee will acquire a basic knowledge of the general information and history regarding the forensic field of footwear and tire track identification and the acceptance of such evidence in courts of law.

OBJECTIVES

1. The trainee will demonstrate a familiarity with the history and how interest in the use of footwear and tire track evidence has evolved over the years by successfully completing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a knowledge of the value of footwear and tire track evidence in criminal investigations by successfully completing a written criterion test with a score of no less than 80%.

LESSON 1 –Historical Background on Use of Footwear and Tire Track Evidence

Estimated Time: 3 Days

Purpose: To acquire a basic knowledge of the history of footwear and tire track identification.

Introduction: A basic knowledge of the history of footwear and tire track evidence will help give the trainee a perspective of what role they will have in the criminal justice system and how the science has progressed to its current state. Footwear and tire track impression identification has progressed from an "aid to investigation" to a science which has been accepted in court as proof positive that a shoe or tire was present at a crime scene.

An understanding of the history of the science will construct a solid foundation for the trainee to build upon as they progress from training and into a career as a footwear and tire track examiner.

Lecture: A Historical Overview of Footwear and Tire Track Examination

Exercise: 1. Read selected sources.

Suggested Readings:

1. Abbott, John R., *Footwear Evidence*, A. c. Germann, Ed., Charles C. Thomas, Springfield, IL, 1964, pp. 8-12.
2. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 1-26, 413-458.
3. Cassidy, Michael J., *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Ottawa, Ontario, 1987, pp. 109-125.
4. Hamm, Ernest D., "Track Identification: An Historical Overview," Journal of Forensic Identification, 39:6 (1989).
5. McDonald, Peter, *Tire Imprint Evidence*, CRC Press, Inc., Boca Raton, FL, 1993, pp. 1-14, 147-161.

LESSON 2 – Significant Court Decisions Regarding Footwear and Tire Track Evidence

Estimated Time: 2 Days

Purpose: To acquire a familiarity with court decisions regarding footwear and tire track evidence and the impact those decisions have had on the field being accepted in court as an identification science.

Introduction: Numerous significant court decisions have helped footwear and tire track evidence progress to the accepted identification science it is considered today. It is not necessary for an examiner to become a law expert on court decisions regarding impression evidence; however, a familiarity with some of these opinions will help the trainee understand the importance of the evidence they will be examining.

Lecture: Discussion of Court Decisions Regarding Footwear and Tire Track Evidence

Exercise:

1. Read selected court decisions.

Suggested Readings:

1. People vs. Campbell, 146 ILL. 2d. 363, 586 N.E. 2d 1261 (1992).
2. People vs. Henne, 165 ILL. App. 3d 315, 518 N.E. 2d 1276 (1988).
3. People vs. Robbins, 21 ILL. App. 3d 317, 315 N.E. 2d 198 (1974).
4. People vs. Hanson, 31 ILL. 2d 31, 198 N.E. 2d 815 (1964).
5. People vs. Diaz, 169 ILL. App 3d 66, 522 N.E. 2d 1386 (1988).
6. People vs. Stanberry, 126 ILL. App. 2d 244, 261 N. E. 2d 765 (1970).
7. People vs. Ferguson, 172 ILL. App. 3d 1, 526 N.E. 2d 525 (1988).

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS TRAINING MANUAL

MODULE: MANUFACTURING PROCESSES

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

NONE

UNIT ESTIMATED TIME

10 Days*

* *Unit estimated time is not stated as concurrent or complete days. Training on various manufacturing processes will be performed in conjunction with additional training units of instruction and application. Tours of shoe and tire manufacturing plants will be conducted at a time convenient for the manufacturer and may occur at any time during the training period.*

GOAL

The trainee will acquire a working knowledge of various processes used by shoe and tire manufacturers to assemble their products and how these processes affect class and individualizing characteristics.

OBJECTIVES

1. The trainee will demonstrate a familiarity with the basic footwear outsole and tire construction methods by successfully completing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a knowledge of the different types of shoe outsole construction and tire construction and the importance of these processes in the identification process by successfully completing a written criterion test with a score of no less than 80%.

3. The trainee will demonstrate a knowledge of terminology used in various aspects of the footwear and tire manufacturing processes by successfully completing a written criterion test with a score of no less than 80%.

4. The trainee will demonstrate a practical skill in demonstrating how features in footwear outsole and tire tread design are used in the comparison process based upon training coordinator observation and review on a pass/fail basis.

LESSON 1 –Shoe Manufacturing Processes

Estimated Time: 5 Days

Purpose: To acquire a basic working knowledge of the history of the various manufacturing processes involved in producing shoes and how these processes can affect the comparison process.

Introduction: The specific method of manufacture of a pair of shoes may have an influence on the design and size characteristics of those shoes and subsequently be of importance in the comparison process. Class characteristics of outsoles are usually shared by all other shoes from that manufacturer of that particular size and design. However, depending on the manufacturing process, class characteristic differences can exist even within the same size and design from the same manufacturer. Some methods of manufacture of some types of shoes can create certain features which are unique even before the shoes are worn. Knowledge of these manufacturing processes and the ability to recognize class characteristics and individualizing characteristics generated during the manufacturing process may assist the examiner's ability to identify or eliminate a pair of shoes when compared to an unknown impression.

Lecture: Shoe Manufacturing Processes

Exercise:

1. Tour of shoe manufacturing plant or plants to see various methods of manufacture of shoes.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 1-26, 413-458.

2. Bodziak, William J., "Manufacturing Processes of Athletic Shoe Outsoles and Their Significance in the Examination of Footwear Impression Evidence," Journal of Forensic Sciences, Vol. 31, No. 1, January 1986, pp. 153-176.

3. Cassidy, Michael J., *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Ottawa, Ontario, 1987, pp. 67-89.

4. Hamm, Ernest D., "The Individuality of Class Characteristics in Converse All Star Footwear," Journal of Forensic Identification, 39:5 (1989) 277-292.

5. Music, Doreen K. and William J. Bodziak, "A Forensic Evaluation of the Air Bubbles present in Polyurethane Shoe Outsoles as Applicable in Footwear Impression Comparisons," Journal of Forensic Sciences, 33:5 (1988) pp. 1185-1197.

LESSON 2 – Tire Manufacturing Processes

Estimated Time: 5 Days

Purpose: To acquire a basic working knowledge of the manufacturing processes involved in producing tires and how these processes can affect the comparison process.

Introduction: Although the number of methods of production of tires may not be as many as those for producing shoes, a basic knowledge of the manufacturing process can still aid the examiner in the comparison process. Class characteristics of tires are exhibited by the tire size, width, and tread design and are usually shared by all tires produced by that manufacturer in that particular size and model. Tires display fewer class characteristic variations that are created by the manufacturing process than shoes and fewer still that make a tire unique before it becomes used. Knowledge of the manufacturing process and the ability to recognize elements of class characteristics can help the examiner identify or eliminate a tire when compared to an unknown impression.

Lecture: Tire Manufacturing Processes

Exercise:

1. Tour of tire manufacturing plant or plants to see methods of manufacture of tires.

Suggested Readings:

1. McDonald, Peter, *Tire Imprint Evidence*, CRC Press, Inc., Boca Raton, FL, 1993, pp. 1-36, 67-76, 81-110, 117-124, 171-176.

2. Nause, S/Sgt. Lawren, *Forensic Tire Impression Identification*, Canadian Police Research Center, NRC Publication, 2001; pp. 105-216.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS
TRAINING MANUAL

MODULE: CLASS AND INDIVIDUALIZING CHARACTERISTICS

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

NONE

UNIT ESTIMATED TIME

10 Days*

* *Unit estimated time is not stated as concurrent or complete days. Discussion and demonstration of class and identifying characteristics will be conducted in conjunction with additional units of instruction on impression development, photography, analysis, comparison, and evaluation exercises.*

GOAL

The trainee will attain the necessary skills to recognize class characteristics and to make a determination of what constitutes identifying (or individual) characteristics of footwear and tire track evidence.

OBJECTIVES

1. The trainee will demonstrate the practical skills required to recognize class characteristics of footwear and tire track evidence upon observation and evaluation by the training coordinator on a pass/fail basis.

2. The trainee will demonstrate the practical skills required to recognize identifying (or individual) characteristics of footwear and tire track evidence upon observation and evaluation by the training coordinator on a pass/fail basis.

LESSON 1 – Class Characteristics

Estimated Time: 3 Days

Purpose: To learn the importance and recognition of class characteristics and to successfully compare class characteristics between known and unknown footwear and tire track impressions.

Introduction: Class characteristics are defined as a feature or a group of features which are common to a group of objects. Class characteristics of footwear and tire track impressions can include such things as the shapes and sizes of elements of the pattern design, the spatial relationship of elements of the pattern design, and the number of elements present in the pattern design. These features serve to include or eliminate known standards as having made evidence impressions. The ability to recognize class characteristics and to successfully compare those features between knowns and unknowns is the first step in the comparison process of footwear and tire track evidence.

Lecture: Class Characteristics

Exercise: 1. Practical exercises in recognition and comparison of class characteristics.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 179-196, 329-335, 357-374, 413-458.

2. Cassidy, Michael J., *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Ottawa, Ontario, 1987, pp. 91-96.

3. Music, Doreen K. and William J. Bodziak, "A Forensic Evaluation of the Air Bubbles in Polyurethane Shoe Outsoles as Applicable in Footwear Impression Comparisons," Journal of Forensic Sciences, 33:5 (1988), pp. 1185-1197.

4. McDonald, Peter, *Tire Imprint Evidence* CRC Press, Inc., Boca Raton, FL, 1993, pp. 1-14, 73-80, 117-124.

LESSON 2 – Individualizing Characteristics

Estimated Time: 7 Days

Purpose: To learn the importance and recognition of individualizing characteristics and their role in the identification process when used to compare known and unknown footwear and tire track impressions.

Introduction: Individualizing characteristics are defined as a feature or group of features which are unique to an individual or specific item. These features are caused by the everyday wear and use of shoes and tires. They can be represented by cuts, tears, holes, wear marks, randomly placed debris, and flaws acquired after the shoe or tire was manufactured. Individualizing characteristics are used to establish similar size, shape, design, and manufacture. Careful observation and recognition is required because some features produced during the manufacturing process, such as air bubbles, can easily be mistaken for individualizing characteristics.

Lecture: Individualizing Characteristics

Exercise: 1. Practical exercises in recognition and comparison of individualizing characteristics.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 1307-328, 335-356.

2. Cassidy, Michael J., *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Ottawa, Ontario, 1987, pp. 96-108.

3. McDonald, Peter, *Tire Imprint Evidence*, CRC Press, Inc., Boca Raton, FL, 1993, pp. 21-26, 79-80-134-146.

4. Music, Doreen K. and William J. Bodziak, “A Forensic Evaluation of the Air Bubbles in Polyurethane Shoe Outsoles as Applicable in Footwear Impression Comparisons,” <u>Journal of Forensic Sciences</u>, 33:5 (1988), pp. 1185-1197.

5. Nause, S/Sgt. Lawren, *Forensic Tire Impression Identification*, Canadian Police Research Centre, NRC Publication, 2001, pp. 217-252.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS TRAINING MANUAL

MODULE: SPECIALIZED PROCESSING TECHNIQUES - CHEMICAL PROCESSING - POROUS

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

FW-IA; LP-IA

UNIT ESTIMATED TIME

16 Days*

* *Unit estimated time is not stated as concurrent or complete days. Impression visualization by chemical processing of porous items will be performed in conjunction with additional units of instruction and application as well as evidence impression analysis, comparison, and evaluation. Trainees who have already completed training in these techniques as part of the training in a different forensic specialty (such as Latent prints) may not need to receive training on some or all of these techniques. Application of these techniques to footwear/tire track evidence will be discussed regardless of the trainee's experience.*

GOAL

The objectives of this unit are to instruct the trainee in approved methods of physical processing of porous evidence items for the development, enhancement, and the preservation of evidence impressions. Upon completion of this training unit, the trainee will have an understanding of all processing protocols currently in use by the ISP Forensic Science Command Footwear/Tire Track section. The trainee will obtain and demonstrate the skills needed for the proper application of these procedures. This will be accomplished through practical exercises to demonstrate the appropriate skills have been obtained and by a final written criterion test covering all processing protocols.

OBJECTIVES

1. The trainee will demonstrate a satisfactory understanding of factors which contribute to the proper selection of chemical processing methods. Evaluation of this understanding will be by completing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a working knowledge of the chemical processing techniques, their interdependence, and how they relate to the sequential processing protocol. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

3. The trainee will demonstrate a complete understanding of the general and specialized chemical formulae utilized. Demonstrated competency will be based upon successful preparation of reagents and training coordinator observation and review on a pass/fail basis.

4. The trainee will attain a practical working knowledge of preservation procedures using photography. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

5. The trainee will demonstrate comprehensive knowledge and skills of all processing procedures through practical exercise based upon training coordinator observation and review on a pass/fail basis.

LESSON 1 – Physical Developer

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of physical developer on porous surfaces suspected of containing evidence impressions.

Introduction: Physical developer is a product of British Home Office research and was devised specifically for the examination of wetted or water soaked porous items. This technique utilizes silver nitrate in an unstable ferrous/ferric redox solution in combination with a detergent solution. Physical developer deposits freed silver from the solution on any non-water soluble waxy, oily, or fatty material that may be present in the footwear impression. Physical developer is not affected by prior treatment with and can be used sequentially with iodine fuming, potassium Thiocyanate, or ammonium Thiocyanate. Physical developer is usually used after those methods have been employed.

Physical developer requires special care and exact adherence to procedures. Some glassware and utensils must be dedicated to the technique and reagent contamination must be avoided. Several chemicals must be purchased from sole source vendors due to required purity. In spite of these obstacles, the results often obtained from physical developer can be productive.

Lecture: Impression Visualization Chemical Processing Porous – Physical Developer

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct application procedures on a variety of porous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 147-152.

2. Phillips, Clarence E., Douglas, O. Cole and Gary W. Jones, "Physical Developer: A Practical and Productive Latent Print Developer," Journal of Forensic identification, 1990, 40(3):135-147.

Additional Resources:

1. Lee, Henry C. and R. E. Gaensslen, Eds., *Advances in Fingerprint Technology*, Elsevier Science Publishers, NY, 1991.

2. Lennard, Christopher J., and Pierre A. Margo, "Sequencing of Reagents for the Improved Visualization of Latent Fingerprints," Journal of Forensic Identification, September/October 1988, 38(5): 197-210.

LESSON 2 – Zinc Chloride

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of zinc chloride on porous surface suspected of containing evidence impressions.

Introduction: While numerous metal salt solutions will cause a color change of ninhydrin-developed impressions, zinc chloride is selected when laser examination is indicated. Zinc emits a weak but observable fluorescence when illuminated with the 488 nm or 514.5 nm lines from a forensic light source or laser, or when exposed to filtered light from a xenon arc lamp. The best results are obtained using the 488 nm line. Zinc chloride treated ninhydrin-developed impressions when photographed with a Wratten #48 or Wratten #44A may reveal greater detail and contrast than the untreated ninhydrin impression. However, due to the damage potential of the zinc chloride application, suitable ninhydrin-developed impressions are to be treated only after photographic preservation and only when the possibility of increased contrast is essential.

Lecture: Impression Visualization Chemical Processing Porous – Zinc Chloride

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of porous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Lee, Henry C., R. E. Gaensslen, Eds., *Advances in Fingerprint Technology*, Second Edition, CRC Press 2001; pp. 130-131, 135, 190, 191, 212.

2. Lennard, Christopher J. and Pierre A. Margo, "Sequencing of Reagents for the Improved Visualization of Latent Fingerprints," Journal of Forensic Identification, September/October 1988, 38(5): 197-210.

3. Herod, D. w., and E. Roland Menzel, "Laser Detection of Latent Fingerprints: Ninhydrin Followed by Zinc Chloride," Journal of Forensic Science, 1982, 27:3, pp. 513-518.

4. Kent, Terry, Ed., *Fingerprint Development Techniques*, Heanor Gate Publisher, Derbyshire, England, 1993.

5. Menzel, E. Roland, Fingerprint Detection with Lasers, Second Edition, Marcel Dekker, NY, 1999; pp. 3, 180, 199.

LESSON 3 – Silver Nitrate

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of silver nitrate on porous surfaces suspected of containing evidence impressions.

Introduction: Silver nitrate reacts with sodium and potassium chloride to form silver chloride, a compound more photosensitive than silver nitrate. This procedure is particularly destructive in both general chemical reaction and the amount of water immersion required. Silver nitrate does not yield consistently high success on porous items, is expensive, and prohibits effective laser examinations and therefore should be avoided when processing routine paper or porous items. Yet with certain surfaces, such as raw or unfinished wood and wax-impregnated papers it is one of the most effective procedures currently available.

Lecture: Impression Visualization Chemical Processing Porous – Silver Nitrate

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct application procedures on a variety of porous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William, J., *Footwear Impression Evidence*, Elsevier Science Publishing Co. Inc., New York, New York, p. 146.

2. Abbot, John R., "Reproduction of Footprints," RCMP Quarterly, 1941, 9(2):186-193.

3. Davis, Roger J., Notes on the use of chemical reagents for footwear-mark enhancement, presented at the Florida Department of Law Enforcement Seminar on Footwear Impression Evidence, Tallahassee, FL, 1988.

4. Davis, Roger, J., "A Systematic Approach to the Enhancement of Footwear marks," Canadian Society Forensic Science Journal, 1988, 21(3):98-105.

5. Keedwell, E., J. Birkett and R. J. Davis, "Chemical Methods for the Enhancement of Footwear Marks," Metropolitan Forensic Science Laboratory Report, January, 1988.

6. Loveridge, F. H., "Shoe Print Development by Silver Nitrate," Fingerprint Whorld, 1984, 10(38):58.

Additional Resources:

1. Lee, Henry C., R. E. Gaensslen, Eds., *Advances in Fingerprint Technology*, Elsevier Science Publishers, NY, 1991.

2. Kent, Terry, Ed., *Fingerprint Development Techniques*, Heanor Gate Publisher, Derbyshire, England, 1993.

3. Olson, Robert, *Scott's Fingerprint Mechanics*, Charles C. Thomas Publisher, Springfield, IL, 1978.

LESSON 4 – Potassium Thiocyanate

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of potassium thiocyanate on porous surfaces suspect of containing evidence impressions.

Introduction: Iron is sometimes present in the residue of footwear/tire track impressions, particularly if these impressions resulted from soil on the shoes/tires. Iron will react with thiocyanate ions in an acid solution. This procedure works well for wet residue impressions and muddy impressions.

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct application procedures on a variety of porous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations ad they appear in Footwear/Tire Track Procedures Manual.

3. Demonstrate the correct use of all instruments involved with this procedure including equipment used in the appropriated preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., "Footwear Impression Evidence: Detection, Recovery, and Examination,´2nd Edition, CRC Press LLC, Boca Raton, FL, 200, pp. 145-147.

LESSON 5 – Ammonium Thiocyanate

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of ammonium Thiocyanate on porous surfaces suspected of containing evidence impressions.

Introduction: Iron is sometimes present in the residue of footwear/tire track impressions, particularly if these impressions resulted from soil on the shoes/tires. Iron will react with thiocyanate ions in an acid solution. This procedure works well for wet residue impressions and muddy impressions.

In some instances, the ammonium thiocyanate application has been found to be more sensitive and produce better enhancement than potassium thiocyanate.

Lecture: Impression Visualization Chemical Processing Porous – Ammonium Thiocyanate

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct application procedures on a variety of porous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instruments involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection*, Recovery, and Examination," 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 145-147.

LESSON 6 – Ninhydrin

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of ninhydrin on porous surfaces suspected of containing evidence impressions.

Introduction: Ninhydrin, or triketo-hydrindene hydrate, is an extremely sensitive indicator of alpha-amino acids, proteins, peptides, and polypeptides. The reaction produces a violet to blue-violet coloring of these substances and is effective with older deposits with even minute amounts of amino acids. While ninhydrin can be used on any surface, normally processing is confined to porous items which have not subsequently become water-soaked or do not contain inherent animal proteins.

Lecture: Impression Visualization Chemical Processing Porous – Ninhydrin

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct application procedures on a variety of porous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instruments involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., Footwear Impression Evidence: Detection, Recovery, and Examination," 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 145-147.

2. Lee, Henry C. and R. E. Gaensslen, Eds., *Advances in Fingerprint Technology*, Second Edition, CRC Press, 2001; pp 38, 107, 127-131, 177-180, 184, 186, 187, 188-189, 243.

LESSON 7 – 8-Hydroxyquinoline

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of 8-Hydroxyquinoline on porous surfaces suspected of containing evidence impressions.

Introduction: 8-Hydroxyquinoline reacts with various metal ions that may be present in small amounts in evidence impressions. The reaction causes fluorescence which is detectable under ultraviolet light. Sometimes, the evidence impression may not contain reactive metal ions, but the substrate does.

In this instance, the evidence impression will be present as a dark impression on a fluorescing background. However, if both the evidence impression and the substrate have a chemical composition which fluoresces, enhancement results may be interfered with. This procedure works well for the enhancement of impressions made by either wet or dry residue as long as the residue contains the reactive metal ions.

Lecture: Impression Visualization Chemical Processing Porous - 8-Hydroxyquinoline

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct application procedures on a variety of porous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instruments involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection*, Recovery, and Examination," 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 157-158.

LESSON 8 – 7,8-Benzoflavone

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of 7,8-benzoflavone to porous surfaces previously processed with iodine and to attain the necessary skill for the preservation of detected evidence impressions.

Introduction: Iodine fuming of oily material may produce faint or incomplete reactions due to the age of the evidence impression. Additional exposure to iodine may fail to intensify such reactions. 7,8-benzoflavone acts as a catalyst which bonds iodine to the detected oily matter and effects a color change from reddish brown to an intense blue-black. Often, added detail is revealed and previously visible impressions are more distinct. The addition of 7,8-benzoflavone negates the transitory characteristics of iodine-developed impressions and is a fixing technique, bonding the iodine to the substrate. It also allows for subsequent processing with ninhydrin, zinc chloride and/or physical developer.

Lecture: Processing Porous/Nonporous – 7,8-Benzoflavone

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.

2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 141-143.

2. Davis, Roger J., Notes on the use of chemical reagents for footwear-mark enhancement. Presented at the Florida Department of Law Enforcement Seminar on Footwear Impression Evidence, Tallahassee, FL, 1988.

3. Davis, Roger J., "A Systematic Approach to the Enhancement of Footwear Marks," Canadian Society Forensic Science Journal, 21(3):98-105, 1988.

4. Keedwell, E., J. Birkett and R. J. Davis, "Chemical Methods for the Enhancement of Footwear Marks," Metropolitan Forensic Science Laboratory Report, January, 1988.

5. Lee, Henry, C. and R. E. Gaensslen, Eds., *Advances In Fingerprint Technology*, Second Edition, CRC Press, 2001, pp.116-117.

Additional Resources:

1. Lennard, C. J. and P. A. Margot, "Sequencing of Reagents for the Improved Visualization of Latent Fingerprints," Journal of Forensic Identification, 38 (5), September/October 1988, pp. 197-210.

2. Mashiko, K. and M. Ishizaki, "Latent Fingerprint Processing iodine 7,8-Benzoflavone Method," Identification News, November 1977, pp. 3-5.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS TRAINING MANUAL

MODULE: SPECIALIZED PROCESSING TECHNIQUES - PHYSICAL PROCESSING - NONPOROUS

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

FW-IIA; LP-IIA

UNIT ESTIMATED TIME

8 Days*

* *Unit estimated time is not stated as concurrent or complete days. Impression visualization by physical processing of nonporous items will be performed in conjunction with additional units of instruction and application as well as evidence impression analysis, comparison, and evaluation. Trainees who have already completed training in these techniques as part of the training in a different forensic specialty (such as Latent Prints) may not need to receive training on some or all of these techniques. Application of these techniques to footwear/tire track evidence will be discussed regardless of the trainee's experience.*

GOAL

The objectives of this unit are to instruct the trainee in approved methods of physical processing of nonporous evidence items for the development, enhancement, and the preservation of evidence impressions. Upon completion of this training unit, the trainee will have an understanding of all processing protocols currently in use by the ISP Forensic Science Command Footwear/Tire Track section. The trainee will obtain and demonstrate the skills needed for the proper application of these procedures. This will be accomplished through practical exercises to demonstrate the appropriate skills have been obtained and by a final written criterion test covering all processing protocols.

OBJECTIVES

1. The trainee will demonstrate a satisfactory understanding of factors which contribute to the proper selection of physical processing methods. Evaluation of this understanding will be by completing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a working knowledge of the physical processing techniques, their interdependence, and how they relate to the sequential processing protocol. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

3. The trainee will demonstrate a complete understanding of the general and specialized chemical formulae utilized. Demonstrated competency will be based upon successful preparation of reagents and training coordinator observation and review on a pass/fail basis.

4. The trainee will attain a practical working knowledge of preservation procedures using photography. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

5. The trainee will demonstrate comprehensive knowledge and skills of all processing procedures through practical exercise based upon training coordinator observation and review on a pass/fail basis.

LESSON 1 – Powders and Particulates

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of powders and particulates on nonporous surfaces suspected of containing evidence impressions.

Introduction: Fingerprint powders and particulate developers are very fine particles with an affinity for moisture throughout a wide range of viscosity. Grease, oil, and most contaminants that coat the surface of footwear or tires possess sufficient moisture and viscosity to attract and bind the fine particles together. Contact between footwear or tires and a nonporous surface will sometimes result in a transfer of the coating to that surface. The non-absorbency of the surface prevents penetration by the deposited moisture. All fingerprint powders and particulate developers are indiscriminate in adhesion to moisture. Surfaces coated with residue in addition to suspected evidence impressions will attract powders and particulate developers throughout the surface.

Dependent upon the composition of the residue, the deposited moisture will range from a most apparent appearance to the barely perceptible or invisible, even under oblique lighting. Powder or particulate application is the effort to produce or improve the appearance for preservation.

The most effective agent in terms of adherence to moisture, non-adherence to dry surfaces, particle size, shape, uniformity, and intensity of color is carbon. Carbon is black, and as a result, black powders and particulate developers which contain carbon will consistently produce the best results. Other colored powders and particulate developers may be required due to the substrate encountered, but should be restricted to absolute necessity.

Magnetic powders are powder-coated, fine iron filings subject to magnetic attraction. These adhere to moisture to a lesser degree than carbon powders, but can be applied with less destructive force to the surface.

Most commercial black fingerprint powders have a high carbon base. According to the manufacturer's particular formula and production methods, the carbon base may be from a variety of sources, including lamp black, bone, or wood charcoal. Ground carbon alone cannot match the adhesion ability of fine particle carbon soot, but commercial powders contain milled carbon of highly uniform size and shape along with additional ingredients to preserve the milled condition and retard air moisture absorption.

Lecture: Impression Visualization Physical Processing Nonporous – Powders and Particulates

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., Footwear Impression Evidence: Detection, Recovery, and Examination, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 147-152.

Additional Resources:

1. Lee, Henry C. and R. E. Gaensslen, Eds., Advances in Fingerprint Technology, Second Edition, CRC Press, 2001; pp. 38, 107, 108-113.

2. Olson, Robert, Scott's Fingerprint Mechanics, Charles C. Thomas Publisher, Springfield, IL, 1978.

LESSON 2 – Small Particle Reagent

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of small particle reagent on nonporous surfaces suspected of containing evidence impressions.

Introduction: Small particle reagent (SPR) was devised and refined by the British Home Office as an effective procedure for processing wet surfaces. Surfaces, both porous and nonporous, which are wet at the time of an evidence impression deposit or become wet after deposit, seldom retain sufficient water soluble material for conventional processing methods. Nonporous items which have been allowed to dry offer some potential if the deposit contains non-water soluble oily matter, but the drying process lessens the possibility of adequate adhesion for powders or particulates.

Molybdenum disulfide is a lipid-sensitive reagent. Initial efforts to create a suspension of molybdenum disulfide in water used photoflo as a means of reducing surface tension. These met with limited success. Introduction of photoflo to the mixture requires a critical measurement as too much photoflo prevents complete adhesion of the molybdenum disulfide particles to the lipids. Organic solvents can not be used as these solvents may remove the lipid material.

Refinements in the surfactant solution have not only improved the uniformity of suspension but have increased the application of SPR to other surfaces. SPR is very effective in the secondary treatment of cyanoacrylate ester developed impressions by adhering to faint impressions generally better than powders and particulates. Molybdenum disulfide is produced in various particle sizes. Smaller particle size is more effective and Lightning Powder Company provides the proper particle size.

Lecture: Impression Visualization Physical Processing Nonporous – Small Particle Reagent

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Davis, Roger J., Notes on the use of chemical reagents for footwear-mark enhancement, presented at the Florida Department of Law Enforcement Seminar on Footwear Impression Evidence, Tallahassee, FL, 1988.

2. Davis, Roger, J., "A Systematic Approach to the Enhancement of Footwear marks," Canadian Society Forensic Science Journal, 1988, 21(3):98-105.

3. Keedwell, E., J. Birkett and R. J. Davis, "Chemical Methods for the Enhancement of Footwear Marks," Metropolitan Forensic Science Laboratory Report, January, 1988.

Additional Resources:

1. Lee, Henry C., R. E. Gaensslen, Eds., Advances in Fingerprint Technology, Second Edition, CRC Press, 2001: pp.38, 113-115.

2. Onstwedder, John III and Thomas E. Gamboe, Jr., "Small Particle Reagent: Developing Latent Prints on Water-Soaked Firearms and Effect on Firearms Analysis," Journal of Forensic Sciences, 1989, 34(2):321-327.

3. Pounds, C. A. and R. J. Jones, "Physiochemical Techniques in the Development of Latent Fingerprints," Trends in Analytical Chemistry, 1983, 2(8):180-183.

LESSON 3 – Cyanoacrylate Ester Fuming

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of cyanoacrylate esters on nonporous surfaces suspected of containing evidence impressions.

Introduction: Cyanoacrylate esters are the active ingredients in super bond adhesives and are generally available according to the type of alcohols used in manufacturing. Most cyanoacrylates are methyl or ethyl esters. Regardless of type, the esters volatilize into long chain molecules with a positive electrical charge. In an atmosphere of relatively high humidity, the cyanoacrylate ester molecules are attracted to oily residue and polymerize upon the deposit.

Properties of the polymer are dependent upon the type of cyanoacrylate ester used. Both ethyl and methyl esters produce a visible white coating. Ethyl ester polymers are softer and less durable while methyl ester polymers can usually only be removed with solvents. However, the durable, hard property of the methyl ester appears to inhibit dye applications, especially with Rhodamine 6G.

Locktite products contain a cyanoacrylate ethyl ester and have proved to be quite effective for fuming. Locktite 495 Super Bonder provides a liquid useful for heat acceleration techniques while Hard Evidence is a gel which reacts to exposure to air. Any product containing ethyl ester generally will be more effective when subsequent laser dye applications are indicated. Cyanoacrylate ester fuming is highly effective with nonporous items.

Lecture: Impression Visualization Physical Processing Nonporous – Cyanoacrylate Ester Fuming

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Demonstrate the correct application procedures on a variety of porous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., Footwear Impression Evidence: Detection, Recovery, and Examination, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 158-159.

2. Cushman, Barry, Q. and Neal J. Simmons, “A Cyanoacrylate Fuming Method for the Development of Footwear Impressions,” Journal of Forensic Identification, 46:4, 1996.

3. Paine, Noel, “Use of Cyanoacrylate Fuming and Related Enhancement Techniques to Develop Shoe Impressions on Various Surfaces,” Journal of Forensic Identification, 48:5, 1998.

Additional Resources:

1. Lee, Henry C., R. E. Gaensslen, Eds., "Cyanoacrylate Fuming," Identification News, 1984, 34(3):8-14.

2. Lee, Henry C., R. E. Gaensslen, Eds., Advances in Fingerprint Technology, Second Edition, CRC Press, 2001: pp. 38, 91-92, 117-125, 212.

3. Lennard, Christopher J. and Pierce A. Margot, "Sequencing of Reagents for the Improved Visualization of Latent Fingerprints," Journal of Forensic Identification, September/October 1988, 38(5):197-210.

LESSON 4 – Gelatin Lifting

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of gelatin lifters on nonporous surfaces containing evidence impressions.

Introduction: Gelatin lifters permit the lifting of some evidence impressions when the electrostatic lifter is unavailable or is unsuccessful. Gelatin lifters are relatively thick and come in clear, black, or white gelatin on cloth, plastic, or canvas backing with a clear plastic cover sheet. Gelatin lifters can be used on both porous and nonporous surfaces for lifting original impressions or those that have been dusted with powder. If the electrostatic lifter is available, it should be used prior to the gelatin lifter.

Lecture: Impression Visualization Physical Processing Nonporous – Gelatin Lifters

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure the trainee will complete the following exercises:

1. Demonstrate the correct application procedures on a variety of porous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations ad they appear in Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct use of all instruments involved with this procedure including equipment used in the appropriated preservation of all developed evidence impressions.

Suggested Readings:

1. Abbott, John R., "Reproduction of Footprints," RCMP Quarterly, 9(2):186-193, 1941.

2. Bodziak, William J., "Footwear Impression Evidence: Detection, Recovery, and Examination,´2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 16, 24, 116-119, 121-122, 296.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS
TRAINING MANUAL

MODULE: SPECIALIZED PROCESSING TECHNIQUES - CHEMICAL PROCESSING - NONPOROUS

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

FW-IIB; LP-IIB

UNIT ESTIMATED TIME

4 Days*

* *Unit estimated time is not stated as concurrent or complete days. Impression visualization by chemical processing of nonporous items will be performed in conjunction with additional units of instruction and application as well as evidence impression analysis, comparison, and evaluation. Trainees who have already completed training in these techniques as part of the training in a different forensic specialty (such as Latent Prints) may not need to receive training on some or all of these techniques. Application of these techniques to footwear/tire track evidence will be discussed regardless of the trainee's experience.*

GOAL

The objectives of this unit are to instruct the trainee in approved methods of chemical processing of nonporous evidence items for the development, enhancement, and the preservation of evidence impressions. Upon completion of this training unit, the trainee will have an understanding of all processing protocols currently in use by the ISP Forensic Science Command Footwear/Tire Track section. The trainee will obtain and demonstrate the skills needed for the proper application of these procedures. This will be accomplished through practical exercises to demonstrate the appropriate skills have been obtained and by a final written criterion test covering all processing protocols.

OBJECTIVES

1. The trainee will demonstrate a satisfactory understanding of factors which contribute to the proper selection of chemical processing methods. Evaluation of this understanding will be by completing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a working knowledge of the chemical processing techniques, their interdependence, and how they relate to the sequential processing protocol. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

3. The trainee will demonstrate a complete understanding of the general and specialized chemical formulae utilized. Demonstrated competency will be based upon successful preparation of reagents and training coordinator observation and review on a pass/fail basis.

4. The trainee will attain a practical working knowledge of preservation procedures using photography. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

5. The trainee will demonstrate comprehensive knowledge and skills of all processing procedures through practical exercise based upon training coordinator observation and review on a pass/fail basis.

LESSON 1 – Ardrox

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of ardrox on nonporous surfaces suspected of containing evidence impressions.

Introduction: Ardrox P133D is an industrial penetrant manufactured by Ardrox, Limited, of Canada, as 970-P10, and available in the United State from Radiatronics, Incorporated, of Overland Park, Kansas. The stain was developed to detect small fractures in construction materials and possesses certain properties that can be successfully utilized in latent print processing, and can be used similarly on footwear and tire track impressions. Ardrox P133D readily penetrates and remains in minute openings, yet is easily rinsed from surrounding surfaces, and is highly luminescent with long wave, ultra violet light excitation.

Ardrox P133D staining was developed as a means of enhancing cyanoacrylate ester polymerized impressions. The properties of Ardrox are highly complementary to the cyanoacrylate ester process, and may yield results that equal or surpass those of the Rhodamine 6G procedure. However, instances have occurred when Rhodamine 6G revealed impression that were not stained by Ardrox P133D with UV excitation. This lack of consistency currently delegates Ardrox P133D as an additional processing technique, not as a replacement for dye and laser examination.

Ardrox P133D is also luminescent with blue laser or 470 nm xenon arc illumination. The effectiveness of Ardrox P133D and UV excitation may justify the omission of dye and laser examination on a case by case basis when the laser is unavailable. However, since the two procedures are compatible, use of Ardrox staining as an additional technique to be utilized in conjunction with the laser dyes, whenever possible, is recommended.

Lecture: Impression Visualization Chemical Processing Nonporous – Ardrox

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. McCarthy, Mary M., "Evaluation of Ardrox as a Luminescent Stain for Cyanoacrylate Processed Latent Impressions," Journal of forensic Identification, 1990, 40(2):75-80.

2. Gamboe, Melissa and Lisa O'Daniel, "Substitute for Freon-Ardrox Formula," Journal of Forensic Identification, 1999, 49(2):134-141.

3. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 158-159.

4. Cushmann, Barry Q. and Neal J. Simmons, "A Cyanoacrylate Fuming Method for the Development of Footwear Impressions," Journal of Forensic Identification, 46:6, 1996.

LESSON 2 – Rhodamine 6G

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of Rhodamine 6G on nonporous surfaces suspected of containing evidence impressions.

Introduction: Rhodamine 6G, like ardrox and zinc chloride, is a supplemental processing procedure designed to enhance faint or indistinct evidence impressions developed by another technique. Rhodamine 6G is used after cyanoacrylate ester fuming. Rhodamine 6G has an affinity for adhesion to polymerized impressions even at levels below visual observation. Excitation of Rhodamine6G with the 488 nm, 510 nm, or 514.5 nm lines of the laser produces extremely bright fluorescence at about 550 nm.

Lecture: Impression Visualization Chemical Processing Nonporous – Rhodamine 6G

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Masters, Nancy E., "Rhodamine 6G: Taming the Beast," Journal of Forensic Identification, September, October 1990, 40(5):265-270.

2. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 158-159.

3. Cushmann, Barry Q. and Neal J. Simmons, "A Cyanoacrylate Fuming Method for the Development of Footwear Impressions," Journal of Forensic Identification, 46:6, 1996.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS TRAINING MANUAL

MODULE: SPECIALIZED PROCESSING TECHNIQUES - NONDESTRUCTIVE – POROUS/NONPOROUS

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

FW-IIIA; LP-IIIA

UNIT ESTIMATED TIME

6 Days*

* *Unit estimated time is not stated as concurrent or complete days. Impression visualization by chemical processing of nonporous items will be performed in conjunction with additional units of instruction and application as well as evidence impression analysis, comparison, and evaluation. Trainees who have already completed training in these techniques as part of the training in a different forensic specialty (such as Latent Prints) may not need to receive training on some or all of these techniques. Application of these techniques to footwear/tire track evidence will be discussed regardless of the trainee's experience.*

GOAL

The objectives of this unit are to instruct the trainee in approved methods of nondestructive evidence processing for the development of evidence impressions and the preservation of developed evidence impressions on both porous and nonporous items. Upon completion of this training unit, the trainee will have an understanding of all processing protocols currently in use by the ISP Forensic Science Command Footwear/Tire Track section. The trainee will obtain and demonstrate the skills needed for the proper application of these procedures. This will be accomplished through practical exercises to demonstrate the appropriate skills have been obtained and by a final written criterion test covering all processing protocols.

OBJECTIVES

1. The trainee will demonstrate a satisfactory understanding of factors which contribute to the proper selection of nondestructive processing methods for porous and nonporous items including procedures for specialized circumstances. Evaluation of this understanding will be by completing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a working knowledge of the processing procedures, their interdependence, and how they relate to the sequential processing protocol. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

3. The trainee will demonstrate a complete understanding of all aspects of the process including an understanding of any chemical or physical elements involved. Demonstrated competency will be based upon successful preparation of reagents and training coordinator observation and review on a pass/fail basis.

4. The trainee will attain a practical working knowledge of preservation procedures using photography. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

5. The trainee will demonstrate comprehensive knowledge and skills of all processing procedures for porous and nonporous substrates through practical exercise subject to

training coordinator observation and review on a pass/fail basis.

LESSON 1 – Inherent Luminescence

Estimated Time: 3 Days

Purpose: To attain the necessary skills to conduct a nondestructive examination of evidence using inherent luminescence and to attain proficiency in the preservation of luminescent evidence impressions.

Introduction: The use of lasers and alternate/forensic light sources in conjunction with various chemical techniques and dyes have proven very effective in visualizing evidence impressions. Substances found in evidence impression residue may luminesce when illuminated by the proper wavelength of light and viewed with the appropriate filters. Various contaminants may become part of evidence impression residue and may inherently luminesce as well. Additionally, certain materials such as Styrofoam and galvanized or zinc plated metal are observed to consistently produce impression that will luminesce without the application of chemical processing or dyes. This inherent luminesce allows for examination of items that may be altered or destroyed by other procedures.

Lecture: Nondestructive Processing Porous/Nonporous – Inherent Luminescence

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Demonstrate the process on a variety of porous and nonporous substrates that might be encountered in casework. This includes any variations as they appear in the Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 135-140.

LESSON 2 – Iodine Fuming

Estimated Time: 3 Days

Purpose: To attain the skills necessary for effective application of iodine to porous and nonporous surfaces and to attain proficiency in the preservation of iodine detected evidence impressions.

Introduction: Iodine is a sensitive indicator of various waxes and oils which are often present in evidence impression residue. Iodine is absorbed by the oily material which assumes a reddish-brown color. While absorption is quite rapid and can be most pronounced, no chemical change occurs to either substance. When exposure to the iodine ceases, the oily material release the iodine molecules slowly. The color begins to fade and after several hours, the iodine may be completely dissipated. Return exposure will most often repeat the process while maintained exposure prevents dissipation. Generally iodine dissipates with no trace of exposure or damage to the article. Iodine is a good procedure to use on evidence impressions of wet origin and, if used, should be done before physical developer.

Iodine is effective with relatively fresh oily deposits, but for those older than two weeks, the reaction may not occur or be too faint for recognition. A chemical breakdown of the oily material appears to inhibit absorption. Iodine is normally not destructive and may detect deposits with insufficient amino acids for effective ninhydrin reaction. The application of 7,8-benzoflavone may be used to intensify weak iodine discolorations of impression residue, however, the use of 7,8-benzoflavone may be destructive and remain on an item.

Iodine is toxic and very corrosive to nearly all metals. It can be used to process nearly all types of surfaces, but is normally used with porous items.

Lecture: Nondestructive Processing Porous/Nonporous – Iodine Fuming

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 159-160.

2. Davis, Roger J., Notes on the use of chemical reagents for footwear-mark enhancement. Presented at the Florida Department of Law Enforcement Seminar on Footwear Impression Evidence, Tallahassee, FL, 1988.

3. Davis, Roger J., "A Systematic Approach to the Enhancement of Footwear Marks," <u>Canadian Society Forensic Science Journal</u>, 21(3):98-105, 1988.

4. Keedwell, E., J. Birkett and R. J. Davis, “Chemical Methods for the Enhancement of Footwear Marks,” Metropolitan Forensic Science Laboratory Report, January, 1988.

Additional Resources:

1. Cowger, James F., *Friction Ridge Skin Comparison and Identification of Fingerprints*, CRC Press, Boca Raton, FL, 1993.

2. Lee, H. C. and R. E. Gaensslen, Eds., *Advances in Fingerprint Technology*, Second Edition, CRC Press, 2001; pp. 69-70, 73, 107, 115-117, 186.

3. Kent, T., Ed., *Fingerprint Development Techniques*, Heanor Gate Publisher, Derbyshire, England, 1993.

4. Olson, R. D., Sr., *Scott's Fingerprint Mechanics*, Charles C. Thomas Publisher, Springfield, IL, 1978.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS TRAINING MANUAL

MODULE: SPECIALIZED PROCESSING TECHNIQUES - BLOOD PROTEIN ENHANCEMENT – POROUS/NONPOROUS

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

FW-IIIB; LP-IIIB

UNIT ESTIMATED TIME

16 Days*

* *Unit estimated time is not stated as concurrent or complete days. Blood protein evidence impression enhancement will be performed in conjunction with additional units of instruction and application as well as evidence impression analysis, comparison, and evaluation. Trainees who have already completed training in these techniques as part of the training in a different forensic specialty (such as Latent Prints) may not need to receive training on some or all of these techniques. Application of these techniques to footwear/tire track evidence will be discussed regardless of the trainee's experience.*

GOAL

The objectives of this unit are to instruct the trainee in approved methods of evidence processing for the development and preservation of blood protein evidence impressions on porous and nonporous items. Upon completion of this training unit, the trainee will have an understanding of all processing protocols currently in use by the ISP Forensic Sciences Command Footwear/Tire Track Section. The trainee will obtain and demonstrate the skills needed for the proper application of these procedures. This will be accomplished through practical exercises to demonstrate the appropriate skills have been obtained and by a final written criterion test covering all processing protocols.

OBJECTIVES

1. The trainee will demonstrate a satisfactory understanding of factors which contribute to the proper selection of blood enhancement processing methods for porous and nonporous items including procedures for specialized circumstances. Evaluation of this understanding will be by completing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a working knowledge of the chemical processing procedures, their interdependence, and how they relate to the sequential processing protocol. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

3. The trainee will demonstrate a complete understanding of the general and specialized chemical formulae utilized. Demonstrated competency will be based upon successful preparation of reagents and training coordinator observation and review on a pass/fail basis.

4. The trainee will attain a practical working knowledge of preservation procedures using photography. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

LESSON 1 – Ninhydrin

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of ninhydrin on porous and nonporous surfaces suspected of containing evidence impressions in blood protein.

Introduction: Ninhydrin is a protein indicator which reacts with amino acids. Ninhydrin is also sensitive to the proteins present in blood. Ninhydrin can be used on any surface, but should primarily be used on porous items. Nonporous items are in most instances better processed by using one of the other blood protein enhancement techniques. A positive reaction produces a violet to blue-violet coloring and is effective with even minute amounts of blood.

Lecture: Blood Protein Enhancement Porous/Nonporous – Ninhydrin

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Demonstrate the process on a variety of porous and nonporous substrates that might be encountered in casework. This includes any variations as they appear in the Footwear/Tire Track Procedures Manual.
2. Demonstrate the correct application procedures on a variety of porous and nonporous substrates containing potential blood protein that might be encountered in casework and use each of the previously prepared chemical preparations. All application procedures will be demonstrated including any variations as they appear in the Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, p. 169.

2. Lee, H. C. and R. E. Gaensslen, Eds., *Advances in Fingerprint Technology*, Second Edition, CRC Press, 2001; pp. 38, 107, 127-131, 177-180, 184, 186-189, 243.

LESSON 2 – Amido Black

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of amido black on porous and nonporous surfaces suspected of containing evidence impressions in blood protein.

Introduction: Amido black or naphthalene black 10B is a protein indicator particularly sensitive to those proteins present in blood. While other procedures for the enhancement of blood impressions are available, they may pose serious health hazards or display a reaction for short durations. Amido black is a safer, permanent procedure which can be used on porous or nonporous surfaces. Amido black does prevent subsequent serological examination and therefore may only be used after serological examination of the evidence. However, amido black can be applied after cyanoacrylate fuming in many cases.

Lecture: Blood Protein Enhancement Porous/Nonporous – Amido Black

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 165-168.

2. Lee, H. C. and R. E. Gaensslen, Eds., *Advances in Fingerprint Technology*, Second Edition, CRC Press, 2001; pp. 38, 92, 143-144.

Additional Resources:

1. McCarthy, M. M. and D. L. Grieve, "Preprocessing with Cyanoacrylate Ester Fuming for Fingerprint Impressions in Blood," Journal of Forensic Identification, 1989, 39(1):23.

LESSON 3 – Coomassie Staining Solution

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of Coomassie staining solution to porous and nonporous surfaces which may contain evidence impressions in blood protein.

Introduction: Coomassie Brilliant Blue R250 is a protein stain which is sensitive to the proteins in blood. Coomassie may be used to enhance blood impressions on porous or nonporous items. Blood impressions do not require heat fixing of the proteins although residue must be dry prior to application. No serological analysis can be conducted after the staining procedure; however, Coomassie Brilliant Blue R250 can be applied after cyanoacrylate fuming in many cases.

Lecture: Blood Protein Enhancement Porous/Nonporous – Coomassie Staining Solution

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Davis, Roger J., "A Systematic Approach to the Enhancement of Footwear Marks," Canadian Society Forensic Science Journal, 21(3):98-105, 1988.

2. Lee, H. C. and R. E. Gaensslen, Eds., *Advances in Fingerprint Technology*, Second Edition, CRC Press, 2001, pp. 144-145, 147.

Additional Resources:

1. McCarthy, M. M. and D. L. Grieve, "Preprocessing with Cyanoacrylate Ester Fuming for Fingerprint Impressions in Blood," Journal of Forensic Identification, 1989, 39(1):23.

2. Norkus, P. and K. Noppinger, "New Reagent for the Enhancement of Blood Prints," Identification News, 1986, 26(4):5.

LESSON 4 – Crowle's Staining Solution

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of Crowle's Staining Solution to porous and nonporous surfaces which may contain evidence impressions in blood protein.

Introduction: Crowle's staining solution is a protein indicator which reacts with the proteins in blood. It can be used for enhancement of blood prints on both porous and nonporous items. Crowle's solution is similar in reaction to Coomassie but contains no organic solvents. No serological analysis can be conducted after the staining procedure. However, Crowle's staining solution can be applied after cyanoacrylate fuming in many cases.

Lecture: Blood Protein Enhancement Porous/Nonporous – Crowle's Staining Solution

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, p. 169.

2. Davis, Roger J., "A Systematic Approach to the Enhancement of Footwear Marks," Canadian Society Forensic Science Journal, 21(3):98-105, 1988.

Additional Resources:

1. Lee, H. C. and R. E. Gaensslen, Eds., *Advances in Fingerprint Technology*, Second Edition, CRC Press, 2001, p. 145.

2. McCarthy, M. M. and D. L. Grieve, "Preprocessing with Cyanoacrylate Ester Fuming for Fingerprint Impressions in Blood," Journal of Forensic Identification, 1989, 39(1):23.

3. Norkus, P. and K. Noppinger, "New Reagent for the Enhancement of Blood Prints," Identification News, 1986, 26(4):5.

LESSON 5 – Luminol

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of Luminol to porous and nonporous surfaces which may contain evidence impressions in blood.

Introduction: Luminol is a presumptive test for blood to help locate bloodstains. It can also be used to enhance evidence impressions in blood. The luminol reaction produces light instead of a color change. This is advantageous when the background or substrate interfere with other chemical enhancement techniques. The disadvantage is that luminol must be applied in total darkness. Since luminol is a water-based solution and blood is water soluble, this treatment may be destructive. All other blood enhancement techniques should be considered before using luminol. Luminol must be prepared each time its use is desired as it has a very short workability life span. This technique may be considered for detection only of faint blood impressions and when actual enhancement done by another blood enhancement techniques would not work as well.

Lecture: Blood Protein Enhancement Porous/Nonporous – Luminol

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 169-173; 414.

LESSON 6 – Leuco Crystal Violet

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of Diaminobenzidine to porous and nonporous surfaces which may contain evidence impressions in blood.

Introduction: Leuco crystal violet is a clear solution which produces a dark violet color when it comes into contact with even faint traces of blood. This violet colored dye occurs through the catalyzed oxidation by peroxide when leuco crystal violet and hydrogen peroxide come into contact with hemoglobin or its derivatives. Since leuco crystal violet has an affinity for proteinaceous substrates, it will bind to the protein that has been fixed by 5-sulfosalicylic acid. This fixing limits leaching or running of the impression. Leuco crystal violet is capable of enhancing visible impressions an can readily develop undetected blood impressions. Impressions treated with leuco crystal violet will both fluoresce and luminesce under a variety of wavelengths in both the ultraviolet and infra-red spectra.

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.

2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 160-162.

LESSON 7 – Diaminobenzidine (DAB)

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of Diaminobenzidine to porous and nonporous surfaces which may contain evidence impressions in blood.

Introduction: Diaminobenzidine (DAB) (also called 3,3' diaminobenzidine tetra hydrochloride) is very useful for enhancement of blood impressions on both porous and nonporous substrates. DAB has the particular advantage of rarely reacting with the background material. DAB is converted into a dark brown insoluble product in the presence of hydrogen peroxide. The peroxidase activity of hemoglobin in blood produces the reaction, that is why DAB rarely reacts with the substrate. DAB can not be mixed with the fixative (5-sulfosalicylic acid), so the fixative must be applied first, then the DAB can be applied. Cyanoacrylate ester fuming is detrimental to DAB processing and DAB processing must be done <u>before</u> amido black, leuco crystal violet, or luminol processing.

Lecture: Blood Protein Enhancement Porous/Nonporous – Diaminobenzidine

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations as they appear in Footwear/Tire Track Procedures Manual.
3. Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 164-165.

LESSON 8 – 2,2'-Azino-Di-[3-Ethylbenzthiazolinesulfonate(6)] Diamonium Salt (ABTS)

Estimated Time: 2 Days

Purpose: To attain proficiency in the application of ABTS to porous and nonporous surfaces which may contain evidence impressions in blood protein.

Introduction: 2,2'-Azino-Di-[3-Ethylbenzthiazolinesulfonate(6)] Diamonium Salt (ABTS) is an effective and safe noncarcinogenic alternative to diaminobenzidine (DAB) for the development of impressions in blood. ABTS is especially effective on porous surfaces. ABTS produces a bright green color when oxidized and may provide an advantage over DAB on dark colored surfaces. As with DAB ABTS rarely reacts with the substrate because the peroxidase activity of hemoglobin in blood produces the reaction. ABTS processing is also similar to DAB in that the fixative (5-sulfosalicylic acid) is applied separately and ABTS processing must be done before amido black, leuco crystal violet, luminol, or cyanoacrylate ester fuming are performed. ABTS can be used after ninhydrin treatment; however, the reverse is not true.

Lecture: Blood Protein Enhancement Porous/Nonporous – ABTS

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare all chemical preparations involved in this procedure including any variations as they appear in Footwear/Tire Track Procedure Manual.
2. Demonstrate the correct application procedures on a variety of nonporous substrates that might be encountered in casework. All application procedures will be demonstrated including any variations
3. as they appear in Footwear/Tire Track Procedures Manual.
Demonstrate the correct use of all instrumentation involved with this procedure including equipment used in the appropriate preservation of all developed evidence impressions.

Suggested Readings:

1. Caldwell, Jonathan P., William Henderson and Nicholas Kim, "ABTS: A Safe Alternative to DAB for the Enhancement of Blood Fingerprints," <u>Journal of Forensic Sciences</u>, Vol. 45, No. 4, July 2000.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS TRAINING MANUAL

MODULE: TEST IMPRESSION METHODS

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

FW-APP III

UNIT ESTIMATED TIME

4 Days*

* *Unit estimated time is not stated as concurrent or complete days. Training will be performed in conjunction with additional units of instruction and application as well as evidence impression analysis, comparison, and evaluation.*

GOAL

The objectives of this unit are to familiarize the trainee with various methods of making test impressions of shoes and tires as known standards for comparison to evidence impressions. The trainee will learn to use an available reasonable means to make test impressions which will make a reliable standard. Upon completion of this training unit, the trainee will have an understanding of all processing protocols currently in use by the ISP Forensic Sciences Command Footwear/Tire Track Section. The trainee will obtain and demonstrate the skills needed for the proper application of these procedures. This will be accomplished through practical exercises to demonstrate the appropriate skills have been obtained and by a final written criterion test covering all processing protocols.

OBJECTIVES

1. The trainee will acquire a satisfactory understanding of commonly used test impression techniques. Evaluation of this understanding will be by completing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a working knowledge of commonly used test impression techniques. Demonstrated competency will be based upon training coordinator observation and review on a pass/fail basis.

3. The trainee will attain a practical working knowledge of preservation of test impressions. Demonstrate competency will be based upon training coordinator observation and review on a pass/fail basis.

LESSON 1 – Two Dimensional Test Impression Methods

Estimated Time: 2 Days

Purpose: To familiarize the trainee with the more commonly used techniques for making two-dimensional test impression for comparison to evidence impressions.

Introduction: Most evidence impressions received in the laboratory are of the two-dimensional variety. Test impression methods taught in this unit are not intended to be an all inclusive or restrictive list of test impression methods. The occasion may arise where the trainee will need to improvise and use an unusual, new, or seldom used technique to make a reliable comparison between known standards and questioned impressions. The trainee will also learn proper documentation of the test impression method used.

Lecture: Two-Dimensional Test Impression Methods

Exercises: To obtain and demonstrate familiarity with the skills required for the making of two-dimensional test impressions, the trainee will complete the following exercises:

1. Correctly prepare test impressions of standards using black fingerprint ink or printer's ink and create overlays to be used for comparison based upon training coordinator's observation and review on a pass/fail basis.
2. Correctly prepare test impressions of standards using fingerprint powder and create overlays to be used for comparison based upon training coordinator observation and review on a pass/fail basis.
3. Correctly prepare test impressions of standards using petroleum products and create overlays to be used for comparison based upon training coordinator observation and review on a pass/fail basis.

Suggested Readings:

1. Abbot, John R., *Footwear Evidence*, A. C. Germann, Ed., Charles C. Thomas, Springfield, IL, 1964, pp. 63-67.

2. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 285-298; 304-306.

3. McDonald, Peter, *Tire Imprint Evidence*, CRC Press, Inc., Boca Raton, FL, 1993, pp. 111-115.

4. Nause, S/Sgt. Lawren, *Forensic Tire Impression Identification*, Canadian Police Research Centre, NRC Publication, 2001, pp. 23-36.

LESSON 2 – Three-Dimensional Test Impression Methods

Estimated Time: 2 Days

Purpose: To familiarize the trainee with the more commonly used techniques for making three-dimensional test impressions for comparison to evidence impressions.

Introduction: Occasionally, evidence impressions of the three-dimensional variety are received by the laboratory. These are usually depicted by dental stone casts but may be encountered in a variety of media. Comparison can usually be made directly between the standard and the evidence impression; however, sometimes features of the identifiable characteristics may require three-dimensional test impressions to be made. Test impression methods taught in this unit are not intended to be an all inclusive or restrictive list of test impression methods. The occasion may arise where the trainee will need to improvise and use an unusual, new, or seldom used technique to make a reliable comparison between known standards and questioned impressions. The trainee will also learn proper documentation of the test impression method used.

Lecture: Three-Dimensional Test Impression Methods

Exercises: To obtain and demonstrate familiarity with the skills required for the making of three-dimensional test impressions, the trainee will complete the following exercises:

1. Correctly prepare test impressions of standards using silicone casting materials according to specific manufacturer directions based upon training coordinator's observation and review on a pass/fail basis.
2. Correctly prepare test impressions of standards using modeling clay or similar product based upon training coordinator observation and review on a pass/fail basis.
3. Correctly prepare test impressions of standards using biofoam or similar product based upon training coordinator observation and review on a pass/fail basis.
4. Correctly prepare test impressions of standards using dental stone or similar product based upon training coordinator observation and review on a pass/fail basis.

Suggested Readings:

1. Abbot, John R., *Footwear Evidence*, A. C. Germann, Ed., Charles C. Thomas, Springfield, IL, 1964, pp. 68-71.

2. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 293-306.

3. Nause, S/Sgt. Lawren, *Forensic Tire Impression Identification*, Canadian Police Research Centre, NRC Publication, 2001, pp. 37-56.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS TRAINING MANUAL

MODULE: MISCELLANEOUS PROCEDURES

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

FW-IV

UNIT ESTIMATED TIME

4 Days*

* *Unit estimated time is not stated as concurrent or complete days. Training will be performed in conjunction with additional units of instruction and application as well as evidence impression analysis, comparison, and evaluation.*

GOAL

The objectives of this unit are to instruct the trainee in various limited application procedures used for the enhancement, recovery, and preservation of evidence impressions. The trainee is not expected to become proficient in the application of these techniques since they are most often utilized at a crime scene or used infrequently in laboratory processing. Upon completion of this training unit, the trainee will have an understanding of all processing protocols currently in use by the ISP Forensic Sciences Command Footwear/Tire Track Section. The trainee will attain a working knowledge of the application of these techniques and know where further information is available. This will be accomplished through practical exercises to demonstrate the appropriate skills have been obtained and by a final written criterion test covering all processing protocols.

OBJECTIVES

1. The trainee will acquire a satisfactory understanding of limited application procedures. Evaluation of this understanding will be by completing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a working knowledge of limited application procedures. Demonstrated completion will be based upon training coordinator observation and review on a pass/fail basis.

3. The trainee will attain a practical working knowledge of preservation of evidence generated by limited application procedures. Demonstrate competency will be based upon training coordinator observation and review on a pass/fail basis.

LESSON 1 – Dental Stone Casting

Estimated Time: 1 Day

Purpose: To become familiar with the application of dental stone to cast footwear and tire track impressions.

Introduction: Dental stone casting allows the convenience of having a three-dimensional impression for comparison to shoes or tires. Although photography of the cast can be done to preserve what was visualized, it is not necessary in order to perform a comparison. Dental stone is a gypsum cement which has been modified for use in the dental industry and has become the preferred material to use for impression evidence casting. it has the useful qualities of being hard, durable, easy to clean without loss of detail, inexpensive, and it does not have a limited shelf life. The primary use of dental stone would be at a crime scene to collect evidence impressions. However, it may be necessary for the footwear examiner to make casts of test impressions for comparison to a submitted cast. Footwear examiners may also be called upon to assist at crime scenes; therefore, it is important to know how to use dental stone properly.

Lecture: Dental Stone Casting

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare a quantity of dental stone casting materials based upon training coordinator observation and review on a pass/fail basis.
2. Demonstrate the correct application of the previously prepared quantity of dental stone to footwear and tire track impressions in various outdoor substrates based upon training coordinator observation and review on a pass/fail basis.
3. Demonstrate correct preservation of cast evidence impressions based upon training coordinator observation and review on a pass/fail basis.

Suggested Readings:

1. Abbot, John R., *Footwear Evidence*, A. C. Germann, Ed., Charles C. Thomas, Springfield, IL, 1964, pp. 63-67.

2. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 59-97.

3. Cassidy, Michael J. *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Ottawa, Ontario, 1987, pp. 18-31.

4. McDonald, Peter, *Tire Imprint Evidence*, CRC Press, Inc., Boca Raton, FL, 1993, pp. 147-51.

LESSON 2 – Silicone Casting

Estimated Time: 1 Day

Purpose: To become familiar with the application of silicone casting materials to footwear and tire track impressions.

Introduction: Sometimes, conventional lifting tapes and films are not suitable for lifting impressions from textured or uneven surfaces because they do not allow a complete lift to be made. In these instances, some silicone-based casting materials work well, especially for lifting powdered impressions. As discussed in Appendix III of the Footwear/Tire Track Procedures Manual, silicone casts can also be useful for making test impressions of known standards (shoes or tires). Silicone casting materials are available in a variety of different colors and textures. Proper use of fingerprint powders and colors of silicone can provide good contrast and enhancement of evidence impressions for comparison. Examples of casting materials are Mikrosil, Dow Corning Silicone Rubber, Silmark, Durocast, and Reprosil, or similar extrusion gun products.

Lecture: Silicone Casting

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare a quantity of silicone casting material according to the manufacturer's directions based upon training coordinator observation and review on a pass/fail basis.
2. Demonstrate the correct application of the previously prepared impressions in various substrates based upon training coordinator observation and review on a pass/fail basis.
3. Demonstrate correct preservation of cast evidence impressions based upon training coordinator observation and review on a pass/fail basis.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 65-68, 122-124, 302-303.

LESSON 3 – Electrostatic Dust Lifting

Estimated Time: 1 Day

Purpose: To become familiar with the application of the electrostatic dust print lifter to footwear and tire track impressions.

Introduction: In 1970, Kato Masao, a Shikoku, Japan police office, developed a machine which used static electricity to assist lifting latent footwear impressions. This machine was somewhat cumbersome and required being plugged into a main current source to operate. In 1981, England's Metropolitan Police Laboratory developed a portable high-voltage electrostatic lifting device that could operate on rechargeable batteries.

When the high voltage source is turned on, it creates a static charge on the lifting film. Some of the dust or residue particles of the evidence impression transfer to the lifting film. Since the film is in direct contact with the evidence impression, the transferred impression on the lifting film will be the same size as original impression. It is important to remember that the electrostatic lift must be turned over to be photographed and as such is a <u>reverse</u> image of the original impression.

Lecture: Electrostatic Dust Print Lifting

Exercises: To obtain and demonstrate the appropriate skills required for the use of this procedure, the trainee will complete the following exercises:

1. Correctly prepare the electrostatic dust print lifter to lift evidence impressions from a variety of surfaces based upon training coordinator observation and review on a pass/fail basis.
2. Demonstrate the correct application of the electrostatic dust print lifter to various impressions and satisfactorily lift the impressions based upon training coordinator observation and review on a pass/fail basis.
3. Demonstrate correct preservation and photography of lifted evidence impressions based upon training coordinator observation and review on a pass/fail basis.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 101-115.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS
TRAINING MANUAL

MODULE: DIGITAL PHOTOGRAPHY

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

NONE

UNIT ESTIMATED TIME

17 Days*

* *Unit estimated time is not stated as concurrent or complete days. Digital photography will be performed in conjunction with additional training units. Trainees who have completed photography training as part of a different forensic discipline may not need to complete some or all of this training unit. Photography application to footwear and tire track evidence will be discussed regardless of previous training or experience.*

GOAL

The trainee will attain sufficient skills to accurately preserve footwear and tire track impression evidence through digital photography, to utilize digital imaging software to improve clarity, contrast, or enhance evidence impressions, to record all necessary documentation in accordance with the Footwear/Tire Tracks Standards and Controls, and to prepare visual aid presentations for courtroom demonstrations.

OBJECTIVES

1. The trainee will successfully demonstrate the ability to digitally preserve impression evidence visualized by all footwear/tire track procedures, as evaluated by the training coordinator on a pass/fail basis.

2. The trainee will demonstrate the ability and skill to use appropriate techniques to enhance digital images for analytical and documentary purposes, as evaluated by the training coordinator on a pass/fail basis.

3. The trainee will successfully demonstrate the ability to prepare demonstrative exhibits for courtroom testimony utilizing digital imaging and presentation software, as evaluated by the training coordinator on a pass/fail basis.

LESSON 1 – Basic Principles of Digital Photography

Estimated Time: 5 Days

Purpose: To understand the basic principles of digital photography, use of equipment, and materials to produce accurate digital images.

Introduction: Preservation of footwear and tire track impressions may well be the most crucial stage of the examination process. An examiner will find it very difficult to compensate for poorly focused photographs, ineffective lighting, or improper framing. The quality of photography could be the essential element in the case results ranging from unsuitable impressions to similar class characteristics to a positive identification.

Photography of evidence impressions may not always be under the control of the footwear/tire track examiner. Usually evidence impressions are photographed at the crime scene by a crime scene investigator or other agency representative. Although the examiner has little or no control over this process; a familiarity with proper equipment, techniques, and procedures will give the examiner the ability to aid those doing the field work.

It is essential that the examiner know how to photograph footwear and tire track evidence in the laboratory since this is the type of photography they will be performing most often. Selection of lighting and digital imaging techniques can result in a wide range of enhancement possibilities. To be able to make full effective use of these tools, the examiner needs to have a good solid photography foundation.

Lectures: Principles of Light
Basics of the Digital Camera: Lens Aperture and Shutter Speed

Exercises:

1. Practical exercises in the use of a digital camera.
2. Practical exercises in various lighting techniques.

Suggested Readings:

1. Bodziak, William J., Footwear Impression Evidence: Detection, Recovery, and Examination, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 27-58, 135-139.

LESSON 2 – Photography of Footwear and Tire Track Evidence

Estimated Time: 5 Days

Purpose: To understand the unique process involved in digitally preserving footwear and tire track evidence in a manner to produce high quality full scale enlargements for comparison.

Introduction: Digital photography of footwear and tire track evidence has certain requirements which are different from those encountered in most crime laboratory photography. Images must be reproduced in full scale prints which require use of large scales in the photograph, precise focusing to avoid blurred enlargements and attention to lighting to provide the greatest enhancement of available detail. The ability to properly use available photographic resources is essential to producing analytical quality full scale prints from which comparison can be made.

Lectures: Lighting of Footwear and Tire Track Impressions
Digital Photography of Footwear and Tire Track Impressions
Use of flatbed scanners to preserve Footwear and Tire Track Impression

Exercises:

1. Practical exercises in various lighting techniques for visualizing and preserving footwear and tire track impressions.
2. Practical exercises in preserving footwear and tire track impressions using digital photography and flatbed scanners.

LESSON 3 – Digital Processing Software

Estimated Time: 5 Days

Purpose: To attain the skill and understanding of the methods of image processing available and permissible using Adobe Photoshop software or an equivalent image editing software.

Introduction: Software programs such as Adobe Photoshop can be used to perform various imaging functions. These functions include color reversal, sharpening and contrast/brightness adjustments. The proper use of these functions is vital as their misuse could cause detrimental effects on image quality and integrity.

Lectures: Importing images into Adobe Photoshop
Using the features in Adobe Photoshop to Process Digital Images Printing Digital Images

Exercises:

1. Import digital images into Adobe Photoshop and perform a size calibration.
2. Become familiar with various appropriate processing functions available in Adobe Photoshop.
3. Print digital images at 1:1 scale at highest available resolution.

LESSON 4 – Courtroom Presentations

Estimated Time: 2 Days

Purpose: To attain the skill and understanding of the methods available to prepare courtroom presentations.

Introduction: Visual courtroom presentations are increasingly becoming part of an effective testimony. Software programs such as Microsoft PowerPoint can be used to illustrate how examinations are conducted, comparisons made and conclusions reached. By incorporating text, images and diagrams, presentations can be created that will enhance courtroom testimony.

Lecture: Creating Courtroom Presentations using Microsoft PowerPoint

Exercise:

1. Create a court room presentation illustrating a footwear or tire track examination and how the examiner's conclusion was reached.

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 27-58, 135-139.

2. Cassidy, Michael J., *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Ottawa, Ontario, 1987, pp. 3-4, 13-18, 50-52.

3. McDonald, Peter, *Tire Imprint Evidence*, CRC Press, Inc., Boca Raton, FL 1993, pp. 37, 45, 50-51, 53-64, 179.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS TRAINING MANUAL

MODULE: IMPRESSION COMPARISON

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

FW-App-I; FW-App-II, FW-App-III; FW-App-IV

UNIT ESTIMATED TIME

10 Days*

* *Unit estimated time is not stated as concurrent or complete days. Impression comparison, practical exercises, and criterion practical examination will be performed in conjunction with other training units.*

GOAL

The trainee will attain the necessary skills to conduct a thorough quantitative-qualitative analysis of footwear and tire track evidence and test impressions, to perform an accurate comparison of class and individualizing characteristics between unknown and known impressions, and to derive a correct conclusion.

OBJECTIVES

1. The trainee will acquire the ability to recognize class and individualizing characteristics and conduct a quantitative-qualitative analysis of the detail by successfully completing a series of practical exercises which will be evaluated by the training coordinator on a pass/fail basis.

2. The trainee will attain the ability to perform a comparison of recognized class and individualizing characteristics between unknown and known impressions by successfully completing a series of practical examinations with a final score of no less than 100%.

LESSON 1 – Quantitative-Qualitative Analysis of Evidence Impressions

Estimated Time:	2 Days
Purpose:	To conduct a quantitative-qualitative analysis of footwear/tire track impressions which determines the suitability of the impression for comparison.
Introduction:	General guidelines to casework are provided in the Footwear/Tire Track Procedures Manual. Each case and item of evidence has its own unique circumstances and evidence and requires its own individual evaluation. Through experience and a willingness to be open to various avenues of approach, an examiner can evaluate each item of evidence on its own merits and give full attention to detail without use of a step-by-step formula. This unit will teach some basics that should be considered while examining footwear and tire track evidence. The potential exists for evidence other than footwear or tire track related evidence to be present. During the initial evaluation of unknowns and standards, the examiner should take note of any possible trace evidence such as hair, fibers, glass, or blood. Comparisons to or collection of these

types of evidence may need to be done prior to the impression comparison. Caution should be exercised before removing items such as rocks, glass, nails, or other debris from the outsole of a shoe or tread of a tire as these items may well be used as individualizing characteristics.

Initial quantitative-qualitative analysis of evidence impressions is focused on determining the pattern design that is present and whether or not sufficient class and individualizing characteristics exist for a comparison to be made. Factors such as the substrate, matrix deposition, condition of the shoe or tire, and the manner by which the impression was made can result in variations or distortions in the size of an impression or appearance of characteristics. Sometimes these variations or distortions may tempt an examiner to erroneously eliminate the known standard. A certain degree of variation should be expected since duplication of the exact circumstances under which an evidence impression is made is virtually impossible.

Lectures: Principles of Comparison
The Philosophy of Suitability

Exercises: To obtain and demonstrate the appropriate skills necessary to determine suitability of footwear and tire track impressions, the trainee will complete the following exercises:

1. Under direct supervision, demonstrate the ability to properly evaluate and record the features and suitability of evidence impressions based upon training coordinator observation and review on a pass/fail basis.
2. Under direct supervision, demonstrate the ability to properly record observations in the form of worksheet documentation in compliance with the standards and controls recorded in the Footwear/Tire Track Procedures Manual Appendix II upon training coordinator observation and review on a pass/fail basis.

Suggested Readings:

1. Abbott, John R., *Footwear Evidence*, A. C. Germann, Ed., Charles C. Thomas, Springfield, IL, 1964, pp. 38-62.

2. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 357-374.

3. Cassidy, Michael J., *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Ottawa, Canada, 1987, pp. 91-108.

LESSON 2 – Overlay Comparison of Class and Individualizing Characteristics

Estimated Time: 4 Days

Purpose: To provide the trainee with the methodology of comparing known standards to unknown impressions through the overlay method.

Introduction: There are several different methods for making test impressions of known standards. One of the most convenient test impression methods is the production of a clear overlay which can be placed directly on top of photographic prints or lifts for comparison of class and individualizing characteristics. The choice of test impression method can depend on the type of unknown impression, but more frequently depends on the individual examiner's personal preference. These test impressions are most commonly used to compare to two-dimensional unknowns, but can also benefit when comparing to a three-dimensional unknown.

In this lesson, the trainee will be exposed o several different common methods of making overlay test impressions. Advantages and disadvantages of these methods will be explored and discussed. Each of the demonstrated techniques will be used by the trainee so they can see for themselves which method is most beneficial to them. Use of a magnifying device and varied lighting will also be learned.

Lectures: Production of Clear Overlay Test Impressions
The Use of Clear Overlay Test Impressions in the Comparison Process

Exercises: To obtain and demonstrate the appropriate skills necessary to produce clear overlay test impressions and use them for comparison to unknown impressions, the trainee will complete the following exercises:

1. Under direct supervision, demonstrate the ability to produce quality clear overlay test impressions using various methods of production upon training coordinator observation and review on a pass/fail basis.
2. Under direct supervision, demonstrate the ability to use clear overlay test impressions to compare to unknown impressions and develop proper conclusions upon training coordinator observation and review on a pass/fail basis.

Suggested Readings:

1. Abbott, John R., *Footwear Evidence*, A. C. Germann, Ed., Charles C. Thomas, Springfield, IL, 1964, pp. 63-71.

2. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 279-306, 329-374.

3. Cassidy, Michael J., *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Ottawa, Ontario, 1987, pp. 91-108.

4. McDonald, Peter, *Tire Imprint Evidence*, CRC Press, Inc., Boca Raton, FL, 1993; pp. 73-80, 111-116.

LESSON 3 – Side-by-Side Comparison of Class and Individualizing Characteristics

Estimated Time: 4 Days

Purpose: To provide the trainee with the methodology of comparing known standards to unknown impressions through the side-by-side method.

Introduction: Side-by-side comparison is most commonly conducted between the known standard (a shoe or tire) and a three-dimensional unknown impression (a dental stone cast). This comparison can be greatly aided by the use of oblique lighting, calipers or some other measuring device, and a magnifying device. Although the need for three-dimensional test impressions is rarely encountered, the trainee needs to be aware of how to produce these test impressions.

Lectures: The Use of the Side-by-Side Comparison Method
Production of Three-Dimensional Test Impressions

Exercises: To obtain and demonstrate the appropriate skills necessary to conduct side-by-side comparison and produce quality three-dimensional test impressions, the trainee will complete the following exercises:

1. Under direct supervision, demonstrate the ability to produce quality three-dimensional test impressions using various methods of production upon training coordinator observation and review on a pass/fail basis.
2. Under direct supervision, demonstrate the ability to use standards or tests of standards to make comparisons to unknowns and develop proper conclusions upon training coordinator observation and review on a pass/fail basis.

Suggested Readings:

1. Abbott, John R., *Footwear Impression Evidence*, A. C. Germann, Ed., Charles C. Thomas, Springfield, IL, 1964, pp. 63-71.

2. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 279-306, 329-374.

3. Cassidy, Michael J., *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Ottawa, Ontario, 1987, pp. 91-108.

4. McDonald, Peter, *Tire Imprint Evidence*, CRC Press, Inc., Boca Raton, FL 1993, pp. 73-80, 111-116.

5. Nause, S/Sgt. Lawren, *Forensic Tire Impression Identification*, Canadian Police Research Centre, NRC Publication, 2001, pp. 217-252.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS
TRAINING MANUAL

MODULE: COMPUTER DATABASES AND PUBLICATIONS OF OUTSOLE AND TIRE TREAD PATTERNS

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

All Procedures

UNIT ESTIMATED TIME

2 Days

GOAL

The trainee will become aware of and familiarized with some of the computer databases and publications available for searching for standards of outsole and tire tread designs. The trainee will also learn to access services offered by the Federal Bureau of Investigation and shoe and tire manufacturers which can aid in identifying possible standards which could have produced unknown impressions.

OBJECTIVES

1. Under direct supervision, the trainee will successfully demonstrate the ability to use available computer databases for searching outsole and tire tread standards based upon training coordinator evaluation on a pass/fail basis.

2. Under direct supervision, the trainee will successfully demonstrate the ability to use printed periodicals for searching outsole and tire tread standards based upon training coordinator evaluation on a pass/fail basis.

3. Under direct supervision, the trainee will successfully demonstrate the ability to use sources outside the ISP Forensic Sciences Command to aid in determining possible footwear or tire standards based upon training coordinator evaluation on a pass/fail basis.

LESSON 1 – Computerized Databases

Estimated Time: 1 Day

Purpose: To familiarize the trainee with some of the available computer databases which can be used to attempt to determine a potential source of an unknown patterned impression.

Introduction: At various times in casework, requests are made of the Footwear/Tire Track examiner to attempt to determine a possible brand name of a shoe or tire that made a patterned impression at a crime scene. There have been a couple of computerized databases made available to the examiner to aid in the determination. These include software available to purchase and use at the examiner’s laboratory and a database search which can be conducted by the Federal Bureau of investigation. Although these searches are often unsuccessful, it is important that an examiner be aware of these available resources and know how to use them.

Lecture: Computer Databases

Exercise: To obtain and demonstrate the appropriate skills required for the proper use of these reference materials, the trainee will complete the following exercise:

1. Demonstrate the correct use of available outsole and tire tread design publications to attempt to determine a possible source of an evidence impression based upon training coordinator observation and review on a pass/fail basis.

Suggested Readings: None.

Additional Resources:

1. Myers, Don A., *Sole Prints A Reference Guide for Law Enforcement Personnel*, Lightning Powder Company, Inc., Salem, Oregon, 1986.

2. *Tread Design Guide*. Tire Guides, Inc., Boca Raton, FL.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS TRAINING MANUAL

MODULE: SUPERVISED CASEWORK

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

All Procedures

UNIT ESTIMATED TIME

17 Days

GOAL

The trainee will utilize all knowledge, skills and abilities acquired from previous instruction to comply with casework demands under varying levels of supervision, including proper evidence handling, documentation, report writing, and quality assurance requirements.

OBJECTIVES

1. The trainee will successfully complete a comprehensive written criterion test on all evidence examination procedures with a score of no less than 80%.

2. Under direct supervision, the trainee will successfully complete a minimum of three simulated cases according to all standards, controls, and quality assurance requirements based upon training coordinator evaluation on a pass/fail basis.

3. Under direct supervision, the trainee will successfully complete a series of lift-only cases according to all standards, controls, and quality assurance requirements based upon training coordinator evaluation on a pass/fail basis.

4. Under direct supervision, the trainee will successfully complete a series of routine evidence examination cases according to all standards, controls, and quality assurance requirements based upon training coordinator evaluation on a pass/fail basis.

5. Under limited supervision, the trainee will successfully complete a more complex series of cases according to all standards, controls, and quality assurance requirements based upon training coordinator evaluation on a pass/fail basis.

6. The following standards must be met to successfully complete this module: no erroneous identifications; no erroneous eliminations; no misinterpreted or overstated results; and all impressions on submitted evidence that the training coordinator deems unquestionably suitable for comparison were called suitable by the trainee. In addition, all standards listed in Command Directive TRN 13 must be met.

LESSON 1 – Casework Requirements

Estimated Time: 2 Days

Purpose: To attain the knowledge and skills of proper evidence handling, casework documentation, and report wording.

Introduction: Prior instruction in footwear/tire track procedures provides the tools needed to conduct accurate and thorough examinations. The ability to visualize evidence impressions successfully and to perform competent analysis, comparison, and evaluation of revealed impressions does not assure all legal requirements will be met. Accurate and thorough examinations depend upon strict adherence to approved practices in evidence handling and casework documentation. Demonstration that all applicable standards and controls were met is essential. Conclusions and findings must be expressed in written reports so that they are understandable and accurately detail the examination results. In addition to satisfying all legal requirements, casework protocols must all comply with ISO criteria and Forensic Sciences Command policies.

Lecture: Evidence Handling, Note Taking, and Report Writing in CALMS
ISO Certification

Exercise:
1. Review of Footwear/Tire Track Section Minimum Standards and Controls.

Suggested Readings:
1. Relevant sections of the Forensic Sciences Command Directives Manual.
2. Relevant sections of the Facility Operations Manual.
3. Footwear/Tire Track Procedures Manual.

LESSON 2 – Simulated Casework

Estimated Time: 5 Days

Purpose: To attain the skills necessary to conduct an accurate and thorough examination utilizing nonprobative simulated conditions.

Introduction: The use of nonprobative simulated evidence enables the trainee to coordinate all acquired knowledge, skills, and abilities into a unified examination. The trainee will outline a course of action based upon the characteristics of the evidence and the case related questions involved. Once the course of action is determined, the trainee will outline the sequence of activities and conduct the examination according to all applicable standards and controls and quality assurance requirements. All examination procedures, including evidence handling, casework documentation, and draft report writing will be reviewed and discussed.

Lecture: Interaction Between Trainee and Training Coordinator During Casework

Exercises:
1. Simulated case 1 and review.
2. Simulated case 2 and review.
3. Simulated case 3 and review.

Suggested Readings:
1. Relevant sections of the Forensic Sciences Command Directives Manual.

2. Relevant sections of the Facility Operations Manual.
3. Footwear/Tire Track Procedures Manual.

LESSON 3 – Probative Casework

Estimated Time: 10 Days

Purpose: To attain the skills necessary to conduct an accurate and thorough examination of casework involving evidence examination, evaluation of evidence impressions, analysis, and comparison of footwear and tire track evidence.

Introduction: Skills required for accurate and thorough examination, evaluation, analysis, and comparison of footwear and tire track evidence are improved by repetition and experience. Casework provides realistic circumstances to develop these skills. The trainee will conduct examinations under direct supervision during which training coordinator review and supervision will continue the instructional process.

Lecture: Interaction Between Trainee and Training Coordinator During Casework

Exercise:

1. Selected casework performed under direct supervision and review.

Suggested Readings:

1. Abbott, John R., *Footwear Evidence*, A. C. Germann, Ed., Charles C. Thomas, Springfield, IL, 1964, pp. 38-71.

2. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 413-458.

3. McDonald, Peter, *Tire Imprint Evidence*, CRC Press, Inc., Boca Raton, FL, 1993, pp. 147-162.

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS TRAINING MANUAL

MODULE: SECTION SPECIFIC COURTROOM TRAINING

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

All Procedures

UNIT ESTIMATED TIME

5 Days*

* *Unit estimated time is not concurrent, but includes mock trials at regular intervals during the training program. Time needed for preparation for mock trials is not included. Estimated time assumes the trainee has received basic courtroom demeanor training.*

GOAL

The trainee will acquire the ability to express proper evidence handling, chain of custody, laboratory procedures, examination methodology, and findings according to established courtroom protocols. This goal will be accomplished by mock trials involving simulated and actual case scenarios addressing specific aspects of footwear/tire track examination.

OBJECTIVES

The trainee will present truthful, technically accurate, understandable, and believable testimony in a mock trial environment following all established protocols for expert witnesses based upon training coordinator or peer review evaluation on a pass/fail basis.

1. The trainee will demonstrate an ability to describe evidence handling, chain of custody, laboratory procedures, and findings based upon training coordinator or peer review evaluation on a pass/fail basis.

2. The trainee will attain the ability to demonstrate convincingly the methodology used to determine individually by use of photographically enlarged visual aids based upon training coordinator or peer review evaluation on a pass/fail basis.

LESSON 1 – Effective Footwear/Tire Track Testimony

Estimated Time: 5 Days

Purpose: To attain specific skills in providing expert Footwear/Tire Track testimony as a supplement to basic courtroom demeanor.

Introduction: The basic courtroom demeanor class provides instruction which is applicable to all forensic scientists regarding fundamentals of testimony and courtroom protocol. It is important that the Footwear/Tire Track examiner learn how to clearly and concisely present the unique details of this forensic science discipline in a courtroom setting. A jury must be able to understand the basis for the expert's conclusions so they can render a decision which does not compromise the integrity of the judicial system and is not prejudiced against the defendant.

Courtroom testimony can be a very demanding aspect of forensic science and can be physically and emotionally draining to the person testifying. The best way to reduce the negative impact on the expert and increase the effectiveness of their testimony is through honing communications skills and familiarization with the field of expertise. The most reliable method of developing these skills is in a simulated courtroom environment using mock trials.

Lecture: Qualifying the Science in the Post-Daubert Era

Exercises:

1. Practical exercises in qualification testimony.
2. Mock Trial 1 and review.
3. Mock Trial 2 and review.
4. Final Mock Trial (Juried).

Suggested Readings:

1. Bodziak, William J., *Footwear Impression Evidence: Detection, Recovery, and Examination*, 2nd Edition, CRC Press LLC, Boca Raton, FL, 2000, pp. 375-379.

2. Abbott, John R., *Footwear Evidence*, A. C. Germann, Ed., Charles C. Thomas, Springfield, IL, 1964, pp. 3-15.

3. Cassidy, Michael J., *Footwear Identification*, Public Relations Branch of the Royal Canadian Mounted Police, Ottawa, Ontario, 1987, pp. 147-157.

4. McDonald, Peter, *Tire Imprint Evidence*, CRC Press, Inc., Boca Raton, FL, 1993, pp. 111-115.

5. Moenssens, Andre A., Fred E. Inbau, and James E. Starrs, *Scientific Evidence in Criminal Cases*, Third Edition, The Foundation Press, Inc., Mineola, New York, 1986, Chapters 1, 11, pp. 784, 795-798.

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FOOTWEAR/TIRE TRACKS TRAINING MANUAL

APPENDIX A-1: TRAINING CHECKLIST

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

William E. Demuth II
Director of Training

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

INITIAL FORENSIC SCIENCE TRAINING CHECKLIST
FOOTWEAR / TIRE TRACKS

Trainee: ______________________________ Coordinator: ______________________________

Training Start Date: ____________________ Training End Date: ______________________

Module	Completion Date	Trainee Initials	Coordinator Initials
General Forensic Science			
Ethics in Forensic Science			
General Information and History			
Manufacturing Processes			
Class and Individualizing Characteristics			
Specialized Processing Techniques – Chemical Processing – Porous			
Specialized Processing Techniques – Physical Processing – Nonporous			
Specialized Processing Techniques – Chemical Processing – Nonporous			
Specialized Processing Techniques – Nondestructive – Porous / Nonporous			
Specialized Processing Techniques – Blood Protein Enhancement – Porous / Nonporous			
Test Impression Methods			
Miscellaneous Procedures			
Photography			
Digital Imaging			
Impression Comparison			
Computer Databases and Publications of Outsole and Tire Tread Patterns			
Section Specific Courtroom Training			
Supervised Casework			

If a module was not completed, mark it as “NC” (“Not completed”).

ILLINOIS STATE POLICE

FOOTWEAR/TIRE TRACKS
TRAINING MANUAL

APPENDIX A-2: AUTHORIZATIONS BASED ON SCOPE

Reviewed by:

Forensic Scientist Vickie Reels, Chairperson
Footwear/Tire Track Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

AUTHORIZATIONS BASED ON SCOPE

Field of Testing: Forensic Testing
Materials Tested

Forensic Scientist: ______________________________
Category: Footwear / Tiretracks

Sub Catergory: Development

Analytical Technique	Authorized
1.2 Screening Tests: Color	
1.3 Screening Tests: Other Chemical Tests	
6.4 General Laboratory Procedures: General Laboratory Techniques	

Sub Category: Comparison

Analytical Technique	Authorized
4.1 Physical Examination: Physical Measurements	
4.2 Physical Examination: Striation/Impression/Mark Comparison	
4.5 Physical Examination: Pattern Recognition	
5.1 Microscopy: Optical	
6.4 General Laboratory Procedures: General Laboratory Techniques	

These are the areas under which I am authorized to conduct casework.

____
Forensic Scientitst / Date

____
Training Coordinator / Date

____
Director of Training / Date

The materials contained in this document are protected under federal law and may not be disseminated or reproduced without the express written permission of the Illinois State Police.

The Microscopy manual is not in use. The Statewide Training Program has no Training Coordinator for this discipline and no trainees have been trained using this manual since April 1, 2010.

A Training Coordinator or “Acting” Training Coordinator will review and revise the manual prior to implementing training for Microscopy. The Director of Training will ensure all approved revisions are made in the manual.

The Questioned Documents manual is not in use. The Statewide Training Program has no Training Coordinator for this discipline and no trainees have been trained using this manual since May 1, 2010.

A Training Coordinator or “Acting” Training Coordinator will review and revise the manual prior to implementing training for Questioned Documents. The Director of Training will ensure all approved revisions are made in the manual.

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TRACE CHEMISTRY
TRAINING MANUAL

MODULE: GAS CHROMATOGRAPHY

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

Procedures in the Trace Chemistry Procedures Manual for Gas Chromatography are (TC-II) for fire debris and (TC-VB-2) for paint analysis.

UNIT ESTIMATED TIME

14 Days

GOAL

To achieve the necessary knowledge, skills and abilities associated with the use of gas chromatography in the identification, classification, and comparison of organic substances submitted to the Trace Chemistry section.

OBJECTIVES

1. The trainee will demonstrate a comprehension of the knowledge required for gas chromatography analysis by passing written criterion test with a score of no less than 80%.

2. The trainee will demonstrate practical knowledge and skills in the operation of the gas chromatograph by successfully performing a variety of practical exercises. These demonstrations will include the following:
   A. A working knowledge of the gas chromatograph hardware with a demonstration of correct installation of column and adjustment of parameters for baseline separation of adjacent peaks.
   B. A working knowledge of the gas chromatograph software by generating a complete and accurate method for the analysis of an organic mixture.
   C. The ability to identify, classify and compare substances using the gas chromatography technique by correctly identifying, classifying or comparing a series of unknowns to be evaluated by the training coordinator on a pass/fail basis.

3. The trainee will explain and perform preventative maintenance, troubleshooting and quality assurance measures related to gas chromatography analysis. This will be evaluated as part of the written criterion test which requires a passing score of no less than 80% and a pass/fail evaluation of the practical measures.

LESSON 1

Estimated Time: 5 Days

Purpose: To familiarize the trainee with the theory of gas chromatography.

Lectures: Theory of Gas Chromatography Separations
Parameters That Effect Separations
Injectors – Types and Function
Columns – Types, Function, and Variables
Detectors – Types and Function
Carrier Gas Glows

Exercises:
1. Complete Part A of the Gas Chromatography Study Guide.
2. Complete Part A assignments in Gas Chromatography.
3, Complete the instrument tutorial on the Theory of Gas Chromatography
4. Pass the theory portion of the criterion test.

Recommended Reading:
1. Trace Chemistry Resource Manual on Gas Chromatography.

2. Willard, Hobard, H., Merritt, Lynne L., Dean, John L., Settle, Frank A., Instrumental Methods of Analysis, 7th Edition, Wadsworth Publishing Co., 1988, pp. 513-574.

3. Buffington, R., and M. Wilson, Detectors for Gas Chromatography – A Practical Primer, Hewlett-Packard Co., 1987, pp. 1-15.

4. Hyver, K. J., and P. Sandra, High Resolution Gas Chromatography, 3rd Edition, Hewlett-Packard Co., 1989, Chapters 1 & 2.

LESSON 2

Estimated Time: 1 Day

Purpose: The trainee will perform the proper set up of the Gas Chromatograph (GC) column and parameters to meet the requirements for Trace Chemistry analysis of ignitable liquids.

Lecture: How To Adjust and Monitor the Variables for GC Operation

Exercises:
1. The trainee will install a column, check flow through column and perform leak checks.
2. The trainee will set each of the temperature zones based on information provided by the training coordinator.
3. The trainee will set the flow rates with values provided by the training coordinator.
4. The trainee will set the column flow rate based upon the unretained peak.
5. The proper completion of Exercises #1-#4 will be the basis of a pass/fail score on the practical quiz.

Recommended Reading:
1. The instrument instruction manuals where applicable.

LESSON 3

Estimated Time: 1 Day

Purpose: The trainee will successfully demonstrate a working knowledge of the software of the current gas chromatograph.

Lectures: How to Establish and Edit a Method
How to Enhance Data File Presentations
Demonstrate the Gas Chromatography Software

Exercises:
1. The trainee will set up the software to run a sample under the conditions stated in the Arson method.
2. The trainee will run a sample of gasoline and obtain baseline separation of the five peak group. An example of this separation is available from the training coordinator.
3. The trainee will run the straight chain Hydrocarbon standard until the peaks have a retention time variation no greater than .08 from values provided by the training coordinator. This will be a pass/fail practical quiz.

Recommended Reading:
1. Instrument instruction and software manuals.

LESSON 4

Estimated Time: 5 Days

Purpose: The trainee will demonstrate his/her knowledge, skills and ability to use the Gas Chromatograph for comparison and classification of organic mixtures.

Lectures: Basic Classification of Petroleum Product Patterns
Sample Injection Techniques

Exercises:
1. The trainee will be provided a set of unknown samples by the training coordinator. The trainee will perform the Gas Chromatography analysis and provide a comparison or classification as requested by the training coordinator. This will be evaluated on a pass/fail basis.
2. Complete Part B of the Gas Chromatography Study Guide.

LESSON 5

Estimated Time: 2 Days

Purpose: The trainee will demonstrate that he/she can explain and perform preventive maintenance, troubleshooting and quality assurance measures related to Gas Chromatography (GC) analysis.

Lectures: Normal Routine Maintenance on the GC
How to Isolate and Correct Problems with the GC
Quality Assurance Measures Required for GC Analysis

Exercises:
1. Complete Part C of the Gas Chromatography Study Guide.
2. Complete Part B assignments in Gas Chromatography.
3. The training coordinator will provide practical examples of problems with the GC. This will be an oral quiz with a pass/fail score.

4. The trainee will pass a written criterion test with a score no less than 80%.

Recommended Reading:

1. Trace Chemistry Resource Manual.
2. Restek Troubleshooting Chart.
3. Instrument Instruction Manuals.
4. Trace Chemistry Procedures Manual, TC-App II, pp. 2-7.

ILLINOIS STATE POLICE

TRACE CHEMISTRY
TRAINING MANUAL

MODULE: MASS SPECTROMETRY

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

Procedures in the Trace Chemistry Procedures Manual for Mass Spectrometry are (TC-II) for fire debris and (TC-III) for explosives analysis.

UNIT ESTIMATED TIME

20 Days

GOAL

To achieve the necessary knowledge, skills and abilities associated with the use of mass spectrometry in the identification of organic substances submitted to the Trace Chemistry section.

OBJECTIVES

1. The trainee will demonstrate a comprehension of the knowledge required for mass spectrometry by passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate practical knowledge and skills in the operation of the mass spectrometer by successfully performing a variety of practical exercises. These demonstrations will include the following:
   A. Generate a complete and accurate method for the analysis of an ignitable liquid to demonstrate general working knowledge of the mass spectrometry software.
   B. Employ the Mass Spectrometer technique to identify a series of unknowns correctly with a practical criterion test score of 100%.
   C. Perform ion extraction to correctly classify peaks with the Total Ion Chromatogram (TIC) according to PM section TC-II-IV.

3. The trainee will demonstrate a basic understanding of the interpretation of a mass spectrum by passing a written criterion test with a score of no less than 80%.

LESSON 1

Estimated Time: 5 Days

Purpose: To familiarize the trainee with the various types of mass spectrometers and how they operate with emphasis on the Agilent Mass Selective Detector.

Lecture: Types of Mass Spectrometers and How They Operate

Exercises:
1. Read the assigned materials and complete the instrument tutorial on the theory of mass spectrometry.
2. Complete Part A of the Mass Spectrometry Study Guide.
3. Complete Part A assignments in Mass Spectrometry.
4. Successfully complete written quizzes on a pass/fail basis.

Recommended Reading:

1. Quadrupole Mass Spectrometry, VG Micromass Publication 02-439May 1977.

2. The Quadrupole Mass Filter: Basic Operating Concepts, Miller, Phillip E., Denton, M. Bonner, Journal of Chem Ed, Vol 63, No 7, July 86, pp. 617-622.

3. Instrumentation for Mass Spectrometry, ACS Video Course, 1992.

LESSON 2

Estimated Time: 3 Days

Purpose: The trainee will successfully demonstrate to the training coordinator a working knowledge of the software of the current mass spectrometers.

Lecture: Use of Current Software

Exercise:

1. The trainee will install a column, check flow through column and perform leak checks.
2. The trainee will set each of the temperature zones based on information provided by the training coordinator.
3. The trainee will set the flow rates with values provided by the training coordinator.
4. The trainee will set the column flow rate based upon the unretained peak.
5. The proper completion of Exercises #1-#4 will be the basis of a pass/fail score on the practical quiz.

Recommended Reading:

1. The instrument instruction manuals where applicable.

LESSON 3

Estimated Time: 2 Days

Purpose: The trainee will successfully demonstrate a working knowledge of the operation of the current mass spectrometer.

Lecture: Mass Spectrometer Hardware

Exercises:

1. Complete Part B of the Mass Spectrometry Study Guide.
2. Complete Part B assignments in Mass Spectrometry.
3. Set up a method to separate a test mixture given by your training coordinator.
4. Run the test mixture and obtain results applying Lesson2 criteria.

Required Reading: 1. The instrument instruction manuals where applicable.

LESSON 4

Estimated Time: 2 Days

Purpose: The trainee will successfully demonstrate a working knowledge of the preventive maintenance, troubleshooting of the current Mass Spectrometer, and Quality Assurance measures.

Lectures:
Evaluation of Autotune Parameters
Routine Preventive Maintenance
Troubleshooting Guidelines
Quality Assurance Requirements

Exercises:
1. Complete Part C of the Mass Spectrometry Study Guide.
2. Complete Part C assignments in Mass Spectrometry.
3. Perform a routine autotune and print out and evaluate the results. Identify and document any discrepancy.
4. Perform the following maintenance procedures:
   - check and repair any air/gas leaks. Verify with MS Spectra.
   - change septa
   - change liner
   - change column

Required Reading: 1. The instrument instruction manuals where applicable.

LESSON 5

Estimated Time: 3 Days

Purpose: To initiate the trainee to basic mass spectrum interpretation and its application to trace chemistry analysis.

Lecture: Basic Mass Spectral Interpretation

Exercises:
1. Using information obtained from the reading, assign structures to spectra obtained from the training coordinator.
2. Compare literature/library spectra to those obtained from the current instrument and explain any differences.
3. Explain a spectra in terms understood by a layman.
4. Complete Part D of the Mass Spectrometry Study Guide.
5. Complete Part D assignments in Mass Spectrometry.
6. Trainee will identify peaks selected by the training coordinator from a stored data file.

Required Reading:

1. Watson, J. Throck, "Introduction to Mass Spectrometry," pp. 156-172, 1985.

2. Yinon, Jehuda, "Forensic Mass Spectrometry," Chapter 1, pp. 1-50, 1987.

3. McLafferty, F. W., "interpretation of Mass Spectra," 4th Edition, 1993.

LESSON 6

Estimated Time: 2 Days

Purpose: The trainee will successfully perform ion extractions to chemically classify peaks within a mixture.

Lecture: The Use and Selection of Mass Ions for Classification

Exercises:

1. Document the mass ions to be used for the following classes of chemical compounds:
   - Alkanes
     Cycloparaffins and alkenes
     Aromatics
     Indanes
     Napthalenes
     Terpenes
2. Use a macro or manually search the data files provided by the training coordinator for the classes of compounds given in Exercise #1. Print the ion extracted profile for each.

Required Reading:

1. Instrument software manuals.

2. Trace Chemistry Procedures Manual TC-II-IV.

LESSON 7

Estimated Time: 3 Days

Purpose: To perform M. S. analysis of Trace Chemistry samples and complete criterion test.

Lecture: None

Exercises:

1. The trainee will perform MS analysis of unknown Trace Chemistry samples provided by the training coordinator.
2. The trainee will correctly identify and classify the compounds from #1. (Practical Criterion Test).
3. The trainee will provide documentation to support compliance to the Quality Assurance requirements.

4. The trainee will pass a criterion test on the theoretical knowledge of Mass Spectrometry and the interpretation of Mass Spectra.

Required Reading:	None

ILLINOIS STATE POLICE

TRACE CHEMISTRY
TRAINING MANUAL

MODULE: FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR)

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

Procedures in the Trace Chemistry Procedures Manual for Fourier Transform Infrared Spectroscopy (FTIR) are (TC-IIIC-3) for explosives and (TC-VB-3) for paint analysis.

UNIT ESTIMATED TIME

20 Days

GOAL

To achieve the necessary knowledge, skills and abilities associated with the use of FITR in the identification of organic and inorganic substances submitted to the Trace Chemistry section.

OBJECTIVES

1. The trainee will demonstrate a comprehension of the knowledge required for FTIR by passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate practical knowledge and skills in the operation of the FTIR by successfully performing a variety of practical exercises. These demonstrations will include the following:
   A. Generate a complete and accurate method for standard and micro samples to demonstrate general working knowledge of the FTIR software.
   B. Perform sample preparation techniques for solid, liquid, vapor, and micro samples and verify the correct application of the techniques by producing a set of identifiable IR spectra.
   C. Employ the FITR procedure to identify a series of unknowns correctly with a practical criterion test score of 100%.

3. The trainee will demonstrate a basic understanding of the interpretation of an IR spectrum by passing a written criterion test with a score of no less than 80%.

LESSON 1

Estimated Time: 1 Day

Purpose: To familiarize the trainee with the theory and interactions of infrared radiation.

Lectures: Terminology Related to Electromagnetic Radiation in General and Infrared Radiation in Particular.
Application of Hooke's Law
Factors That Effect IR Absorption

Exercises:
1. Read assigned material.
2. Complete Part A of the FTIR Study Guide.
3. Complete Part A assignments in FTIR.
4. Pass the portion of the written criterion test that deals with subject matter covered in Lesson1.

Recommended Reading:

1. Trace Chemistry Resource Manual for FTIR.
2. Brezinksi, D., An Infrared Spectroscopy Atlas for the Coatings Industry, 4thEd., Vol. 1, Federation of Societies for Coatings Technology, 1991, pp. 1-100.
3. Hill, R. R., Rendell, D., The Interpretation of Infrared Spectra A Programmed Introduction, 1975, Heyden & Son Ltd., pp. 3-35.

LESSON 2

Estimated Time: 1 Day

Purpose: To familiarize the trainee with the theory of infrared spectrometers, the FTIR microscope, and the attenuated total reflectance (ATR) accessory.

Lectures:
The Theory of Fourier Transform Infrared Spectrometer (FTIR)
The Components of the FTIR Spectrometer
The Components and Operation of the FITR Microscope. The Affect of Aperture Size.
The Theory and Use of the Attenuated Total Reflectance (ATR) Accessory

Exercises:

1. Read assigned material.
2. Complete Part B of the FTIR Study Guide.
3. Complete Part B assignments in FTIR.
4. Pass the portion of the written criterion test that deals with the subject matter covered in Lesson 2.

Recommended Reading:

1. Trace Chemistry Resource Manual for FTIR.
2. See Reference Lesson 1, #2.
3. Williams, R., Spectroscopy and the Fourier Transform An Interactive Tutorial, 1996, VCH Publishers, Inc.
4. George, B., McIntyre, P., Infrared Spectroscopy Analytical Chemistry Open Learning, 1987, John Wiley & Sons, pp. 81-114.
5. Willard, H., Merritt, L., Dean, J., Settle, F., Instrumental Methods of Analysis, 7th Ed., Wadsworth Publishing Co., Belmont, CA, 1988, pp. 287-316.
6. Tutorial provided with instrument software.

LESSON 3

Estimated Time: 1 Day

Purpose: To familiarize the trainee with the software used on the FTIR spectrometer.

Lectures: Demonstrate the Software
Settings Required for the Operation of FTIR Microscope. The Use of External Mirror.
Relationships of Scans and Sensitivity, Resolution and Sampling Rate
The Use of the Libraries

Exercises:

1. Set up a method and perform an FTIR analysis of polystyrene in the standard sample chamber. Print out results.
2. Set-up a method and perform an FTIR analysis of polystyrene using the FTIR microscope. Print out results.
3. Complete Part C of the FTIR Study Guide.
4. Pass the portion of the written criterion test that deals with the subject matter covered in Lesson 3.

Required Reading:

1. The instrument software manual and on-line tutorial.
2. Trace Chemistry Resource Manual for FTIR.

LESSON 4

Estimated Time: 5 Days

Purpose: The trainee will successfully demonstrate working knowledge, skills and abilities for proper sample preparation and operation of the FTIR spectrometer.

Lectures: Demonstrate Different Methods of Sample Preparation to Include: Vapors, Liquids, KBr Disks, Thin Films, and Compressed Samples
Explain the Importances of Sample Thickness, Fringing, and Diffraction
Safety Precautions with Liquid Nitrogen.

Exercises:

1. The training coordinator will provide the samples. The trainee will use the appropriate technique to place the sample in the IR beam. This will include, but not limited to: gas cell, liquid cell, KBr powder disks, salt plates, compression with salt plates, compression with diamond windows, 3M cards, and thin films on salt plates. Provide data to support your proper use of the techniques.
2. Solid samples from Exercise #1 will also be run on the FTIR microscope.
3. Complete Part D of the FTIR Study Guide.
4. Pass the portion of the written criterion test that deals with the subject matter covered in Lesson 4.

Required Reading:

1. Trace Chemistry Resource Manual for FTIR.

2. See Reference Lesson 1, #2.

3. George, B., McIntyre, P., Infrared Spectroscopy Analytical Chemistry Open Learning, 1987, John Wiley & Sons, pp. 116-160.

LESSON 5

Estimated Time: 2 Days

Purpose: The trainee will recognize the qualities of a good IR spectrum and explain the theory of the interactions that resulted in the bands. The trainee will demonstrate proper interpretation.

Lectures:
Review IR Radiation and Chemical Bond Interaction
Review Factors That Must Be Considered in Band Interpretation
Relationship of Transmittance and Absorbance
Information That Can Be Derived from the IR Spectrum
The Use of IR Spectrum for Classification

Exercises:

1. Complete Part E of the FTIR Study Guide.
2. Complete Part C assignments in FTIR.
3. The training coordinator will provide IR spectra for interpretation. The trainee will obtain a passing grade on this written quiz. It is based on a pass/fail; system.
4. Pass the portion of the witness criterion test that deals with the subject matter covered in Lesson 5.

Required Reading:

1. Trace Chemistry Resource Manual for FTIR.

2. See Reference Lesson 1, #2.

3. Hill, R. R., Rendell, D., The Interpretation of Infrared Spectra A Programmed Introduction, 1975, Heyden & Son Ltd.

4. George, B., McIntyre, P., Infrared Spectroscopy Analytical Chemistry Open Learning, 1987, John Wiley & Sons, pp. 279-381.

5. Stuart, B., Analytical Chemistry by Open Learning: Modern Infrared Spectroscopy, 1996.

6. Saferstein, A., Forensic Science Handbook, Vol. 1, 2, 3, Regents/Prentice Hall, Englewood Cliffs, New Jersey, 1982, 1988, 1993.

LESSON 6

Estimated Time: 10 Days

Purpose: To perform FTIR analysis of samples and complete written criterion test.

Lectures:
General Quality Assurance Requirements for FTIR Analysis
Qualities to Check When Two Sample Spectra Are Compared
Classification vs. Individualization
Review of Group Frequencies
Review Sampling Techniques

Exercises:

1. Complete Part F of the FTIR Study Guide.
2. The trainee will perform FTIR analysis of unknown samples provided by the training coordinator.
3. The trainee will correctly identify, classify or compare based upon the request in #2. This is a practical criterion test.
4. The trainee will provide documentation to support compliance to the quality assurance requirements.
5. The trainee will pass the written criterion test on the subject matter covered in Lessons 1-6.

Required Reading:

1. Trace Chemistry Procedures Manual, "Fourier Transform Infrared Spectrometer (FTIR)," TC-IIIC-3.

2. Trace Chemistry Procedures Manual, "Fourier Transform Infrared Spectrometer (FTIR)," Analysis, TC-VB-3, pp. 1-8.

ILLINOIS STATE POLICE

TRACE CHEMISTRY
TRAINING MANUAL

MODULE: X-RAY DIFFRACTION

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

Procedures in the Trace Chemistry Procedures Manual for X-ray Diffraction Analysis of Explosives (TC-IIIC-4) and of Sugars (TC-XIC-3). Minimum Standards & Controls (TC-App.II-pages 6 and 7).

UNIT ESTIMATED TIME

15 Days

GOAL

To achieve the necessary knowledge, skills and abilities associated with the use of X-ray Diffraction in the identification of organic and inorganic crystalline substances submitted to the Trace Chemistry section.

OBJECTIVES

1. The trainee will demonstrate a comprehension of the knowledge of X-Ray Diffraction by passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate practical knowledge and skills in the operation of the X-Ray Diffraction by successfully performing a variety of practical exercises. These demonstrations will include the following:
   A. Demonstrate and explain the function of the various components of the X-Ray Diffraction system. This will be evaluated by the trainee's placement of these components in the proper operating mode.
   B. Perform the startup and shutdown procedure and generate a complete and accurate method for analysis.
   C. Verify that the proper sample preparation technique is practiced by producing a set of identifiable x-ray diffraction patterns.
   D. Demonstrate the factors that will affect the quality of the x-ray diffraction pattern.

3. The trainee will demonstrate his/her ability to correctly perform an x-ray diffraction analysis and interpret the results with a 100% practical criterion test score on a set of unknowns.

LESSON 1

Estimated Time: 1 Day

Purpose: To familiarize the trainee with basic crystallography.

Lectures: Crystal Theory to include crystals, space lattice, crystal systems, bravais lattice, unit cell, and Miller indices.

Exercises:
1. Read the assigned materials.
2. Complete Part A of the X-Ray Diffraction Study Guide.
3. Complete Part A assignments in X-Ray Diffraction.

4. Pass the crystallography portion of the X-Ray Diffraction Criterion Test.
5. Solid state modeling kit familiarization.

Recommended Reading:

1. Trace Chemistry Resource Manual for X-Ray Diffraction.
2. Jenkins, R., X-Ray Diffraction, ACS Audio Course, 1998.
3. Bloss, F. D., An Introduction to Crystallography and Crystal Chemistry, Hold, Rinehart & Winston, Inc., 1971.
4. Jenkins, R. & DeVries, J., An Introduction to X-Ray Powder Diffractometry, Philips Instruments.
5. Jenkins, R. & Snyder, R. L., Introduction to X-Ray Powder Diffractometry, John Wiley & Sons, 1996.
6. Klug, H. & Alexander, L., X-Ray Diffraction Procedures, John Wiley & Sons, 1974.
7. Whiston, C., X-Ray Methods, Analytical Chemistry to Open Learning, John Wiley & Sons, 1987.

LESSON 2

Estimated Time: ½ Day

Purpose: To familiarize the trainee with the properties and generation of x-rays.

Lectures:
Electromagnetic Radiation Emphasis on Wavelength and Energy of X-Rays
Generation and Terminology Used for Continuous and Characteristic Radiation
X-rays Scattering and Absorption
X-rays Safety

Exercises:

1. Read assigned material
2. Complete Part B of the X-Ray Diffraction Study Guide.
3. Complete Part B assignments in X-Ray Diffraction.
4. Pass the X-Rays portion of the X-Ray Diffraction Criterion Test.

Recommended Reading:

1. Trace Chemistry Resource Manual for X-Ray Diffraction.
2. Jenkins, R., Methods and Practices in X-Ray Powder Diffraction, International Centre for Diffraction Data, 1993, pp. 14.1.1-14.2.12, 5.1.1-5.5.12.

LESSON 3

Estimated Time: 1 Day

Purpose: To familiarize the trainee with the interaction of crystals and x-rays. To identify the analytical instruments' requirements to generate and record these interactions.

Lectures:
What is X-Ray Diffraction and Why Does It Occur
Bragg Equation
Factors That Affect Position of Diffraction Lines and Extinctions
Factors That Affect Intensity
Components of the Diffractometer

Exercises:
1. Read assigned material.
2. Complete Part C of the X-Ray Diffraction Study Guide. Complete Part C assignments in X-Ray Diffraction.
3. Pass the Diffraction portion of the X-Ray Diffraction Criterion Test.

Required Reading:
1. Trace Chemistry Resource Manual for X-Ray Diffraction.
2. Recommended Reading in Lesson 1.

LESSON 4

Estimated Time: 2 ½ Days

Purpose: The trainee will successfully demonstrate a working knowledge of proper sample preparation and the operation of the X-Ray Diffraction unit.

Lectures:
Qualities of Sample That Affects the Pattern e.g. Size, Moisture, Crystalline, Preferred Orientation, and Sample Placement
Demonstrate Proper Sample Preparation
Demonstrate Method and Instrument Setup
Quality Control Measures

Exercises:
1. Read assigned material.
2. Complete Part D of the X-Ray Diffraction Study Guide.
3. Obtain samples from the training coordinator and perform X-Ray Diffraction analysis.
4. Perform quality control checks.

Required Reading:
1. Trace Chemistry Procedures Manual (TC-IIIC-4), pp. 1-4.
2. Trace Chemistry Resource Manual for X-Ray Diffraction.
3. Recommended Reading in Lesson 2.

LESSON 5

Estimated Time: 5 Days

Purpose: The trainee will recognize the qualities of a good diffraction pattern, factors that affect the diffraction patterns, and criteria for identification.

Lectures: Review Factors That Affect Line Location and Line Intensity
Criteria for Identification

How to Convert 2σ Data into D-spacings
Use of Library

Exercises:

1. Demonstrate correlation between hkl value and d-spacing.
2. Demonstrate inverse relationship between d-spacing value and 2σ value.
3. Perform X-Ray Diffraction analysis on the following types of samples:
   A. Compare NaCl, KCl
   B. Compare Gypsum, Plaster of Paris, Anhydrous $CaSO_4$
   C. Glass
   D. Compare:
      i. Quartz Plate
      ii. Sand Particle > = 25μ
      iii. Ground sand depressed in holder
      iv. Ground sand raised in holder
4. Read assigned material.
5. Complete Part E of the X-Ray Diffraction Study Guide.
6. Pass sample preparation, instrument and interpretation portion of the criterion test.

Recommended Reading.

1. Trace Chemistry Procedures Manual (TC-IIIC-4), pp. 1-4.
2. Trace Chemistry Resource Manual for X-Ray Diffraction.
3. Recommended Reading in Lesson 2.

LESSON 6

Estimated Time: 5 Days

Purpose: To perform X-Ray Diffraction analysis of samples and complete criterion test.

Lectures: None

Exercises:

1. The trainee will perform X-Ray Diffraction analysis of unknown samples provided by the training coordinator.
2. The trainee will correctly identify the compounds from #1 (practical criterion test).
3. The trainee will provide documentation to support compliance to the quality assurance requirements.
4. The trainee will pass a criterion test on the theoretical knowledge of X-Ray Diffraction and the interpretation of diffraction patterns.

Required Reading: None

ILLINOIS STATE POLICE

TRACE CHEMISTRY
TRAINING MANUAL

MODULE: SCANNING ELECTRON MICROSCOPY (SEM)/ ENERGY DISPERSIVE X-RAY (EDX)

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

Procedures in the Trace Chemistry Procedures Manual for Scanning Electron Microscopy (SEM)/ Energy Dispersive X-Ray (EDX) are (TC-VB-4) for Paint and (TC-IIIC-5) for explosives.

UNIT ESTIMATED TIME

14 Days

GOAL

To achieve the necessary knowledge, skills and abilities associated with the use of SEM/EDX for elemental analysis.

OBJECTIVES

1. The trainee will demonstrate a comprehension of the knowledge of Scanning Electron Microscopy (SEM) by passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a comprehension of the knowledge of Energy Dispersive X-Ray analysis (EDX) by passing a written criterion test with a score of no less than 80%.

3. The trainee will demonstrate practical knowledge and skills in the collection of EDX data by using the SEM/EDX to generate and record a spectrum of the elemental composition of known materials.

4. The trainee will demonstrate practical knowledge and skills in the collection of EDX data by using the SEM/EDX to generate and record a spectrum of the elemental composition of known materials.

5. The trainee will demonstrate a basic understanding of the interpretation of EDX patterns by passing an oral quiz based on a pass/fail system.

6. The trainee will demonstrate his/her ability to correctly perform SEM/EDX elemental analysis and interpret the results with a 100% practical criterion test score on a set of unknowns.

LESSON 1

Estimated Time:	1 Day
Purpose:	To familiarize the trainee with the components and operational theory of the SEM.
Lectures:	Components of the SEM Function and Operation of the Components Parameters that are Adjusted To Enhance The Results Detectors Used On The SEM

Exercises:

1. Read assigned material.
2. Complete Part A of the SEM/EDX Study Guide.
3. Complete Part A assignments in SEM/EDX.

Recommended Reading:

1. Trace Chemistry Resource Manual for SEM/EDX.

2. Postek, M., Howard, K., Johnson, A., McMichael, K., Scanning Electron Microscopy – A Student Handbook, 1980, Ladd Research Industries, Inc.

3. Lawes, G., Scanning Electron Microscopy and Microanalysis – Analytical Chemistry by Open Learning, 1987, John Wiley & Sons.

4. Goldstein, J., et. al., Scanning Electron Microscopy and X-Ray Microanalysis, 1981, Plenum Press.

5. *Scanning and Transmission Electron Microscopy An Introduction*, Stanley L. Flegler, John W. Heckman, Jr., Karen L. Klomparens, Oxford University Press, New York, 1993.

LESSON 2

Estimated Time: 1 Day

Purpose: To develop and demonstrate the trainee's skills to mount samples and operate the SEM/EDX to obtain sharp images on micron size particles.

Lectures:
Demonstrate Methods of Mounting Samples
Demonstrate Operation of SEM to Obtain Initial Image
Demonstrate the Image Effect as Parameters Are Adjusted
Charging and Methods to Reduce It
Instrument Maintenance

Exercises:

1. Mount samples provided by the training coordinator and demonstrate an identifiable image on the screen. Isolate two particles which are separated by #1 micron. Provide a monitor display of these particles with sharp borders and a measurable separation.
2. Demonstrate and document the effect on sample image by adjusting the following:
   A. Voltage
   B. Working Distance
   C. Spot Size
   D. Final Aperture
   E. Tilt
3. Demonstrate the changing of filament, cleaning the column and proper alignment of the filament.
4. Pass the SEM portion of the criterion test.

Recommended Reading:

1. References 1, 2, 3, & 4 from Recommended Reading in Lesson 1.

2. Instruction manual supplied with instrument.

LESSON 3

Estimated Time: 1 Day

Purpose: To familiarize the trainee with the properties and generation of x-rays.

Lectures:
X-Rays and Other Electromagnetic Radiation
Generation and Terminology of X-Radiation
Relationship of X-Ray Energy and Wavelength
Effect of Excitation Voltage on the Generation of X-Rays
What Voltage Is Most Appropriate
X-Ray Safety

Exercises:
1. Read assigned material.
2. Complete Part B of the SEM/EDX Study Guide.
3. Complete Part B assignments in SEM/EDX.
4. Pass X-Rays portion of the criterion test.

Recommended Reading:

1. Trace Chemistry Resource Manual for SEM/EDX.

2. Energy-Dispersive X-Ray Microanalysis An Introduction, 1988, Kevex Corp.

3. Dean, J., Analytical Chemistry Handbook, 19985, McGraw-Hill, pp. 10.1-10.12.

4. Reference #2 from Recommended Reading in Lesson 1, pp. 69-74.

5. Reference #3 from Recommended Reading in Lesson 1, pp. 54-64.

6. Bertin, E., Principles and Practices of X-Ray Spectrometric Analysis, 1975, Plenum Press, pp. 6-36.

7. Methods and Practices in X-Ray Powder Diffraction, 1993, International Centre for Diffraction Data, pp. 14.1.1–14.2.12.

LESSON 4

Estimated Time: 1 Day

Purpose: To familiarize the trainee with the theory and operation of the EDX. To demonstrate the trainee’s skills in the operation and collection of EDX data.

Lectures: Components of the EDX Detector
Function and Operation of the Components
Parameters that are Adjusted to Enhance the Results
Maintenance and Method Generation
Demonstrate the Proper Use

Exercises:

1. Set up a method to collect data and perform calibration.
2. Read assigned material.
3. Complete Part C of the SEM/EDX Study Guide.
4. Complete Part C assignments in SEM/EDX.
5. Collect elemental analysis data on known samples provided by training coordinator.

Recommended Reading:

1. References 1 & 2 from Recommended Reading in Lesson 3.
2. Trace Chemistry Procedures Manual (TC-VB-4), pp. 1-6.
3. Trace Chemistry Procedures Manual (TC-IIIC-5), pp. 1-3.
4. Instrument Operation Manual from instrument vendor.
5. Reference #2 from Recommended Reading in Lesson 1, pp. 79-111.

LESSON 5

Estimated Time: 5 Days

Purpose: To have the trainee describe and demonstrate measures that are used to enhance the quality of data and the interpretation.

Lectures: Effects of Voltage, Spot Size, Dead Time, and Collection Time on the Quality of Data
Methods to Differentiate Overlapping Peaks
Statistical Determination of a Peak
Quality Assurance Requirements for SEM/EDX Analysis

Exercises:

1. Read assigned material.
2. Perform analysis of samples supplied by the training coordinator, vary voltage, spot size, and collection time and document the effect.
3. Run samples that contain the following element combinations. Explain and demonstrate how they can be differentiated:
   A. Ba, Ti
   B. S, Mo, Pb
   C. Na, Zn
   D. Cr, V
4. Demonstrate the lower level sensitivity of the instrument for heavy and light elements. Run samples provided by the training coordinator and provide documentation to support the sensitivity limit.
5. Pass the EDX portion of the criterion test.

6. Pass an oral quiz on EDX interpretation. This is based on a pass/fail system.

Recommended Reading:

1. Trace Chemistry Resource Manual for SEM/EDX.
2. Instrument Operation Manual from instrument vendor.
3. Trace Chemistry Procedures Manual (TC-App II), p. 5.

LESSON 6

Estimated Time: 5 Days

Purpose: To perform SEM/EDX analysis of samples and complete criterion test.

Lectures: None

Exercises:

1. The trainee will perform SEM/EDX analysis of unknown samples provided by the training coordinator.
2. The trainee will correctly identify the chemical elements from #1 (practical criterion test).
3. The trainee will provide documentation to support compliance to the quality assurance requirements.
4. The trainee will pass a criterion test on the theoretical knowledge of SEM/EDX analysis and the interpretation of the data.

Required Reading: None

ILLINOIS STATE POLICE

TRACE CHEMISTRY TRAINING MANUAL

MODULE: FIRE DEBRIS/IGNITABLE LIQUIDS

Reviewed by:

Adrienne Bickel
Acting Trace Chemistry Training Coordinator

Approved by:

Sandra N. Brown
Laboratory Director
Training and Applications

PROCEDURAL REFERENCE

Procedures in the Trace Chemistry Procedures Manual for Fire Debris Analysis (TC-II).

UNIT ESTIMATED TIME

160 Days

GOAL

Upon completion of this unit, the trainee will possess the necessary knowledge, skills, and abilities to be proficient in the determination and classification of an ignitable liquid in fire debris or unknown liquid.

OBJECTIVES

1. The trainee will demonstrate a comprehensive knowledge, related to petroleum, chemistry petroleum refining processes, and petroleum product distribution by passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate his/her ability to explain and properly operate the GC/MS, perform the required troubleshooting, Quality Assurance (QA) measures, and interpret MS data. This will be evaluated with oral and practical quizzes on a pass/fail basis.

3. The trainee will demonstrate that he/she is knowledgeable about the ISP and American Society for Testing and Materials (ASTM) classification system for ignitable liquids. This will be accomplished with a score of no less than 80% on a written criterion test and a passing score on a practical quiz based on a pass/fail system.

4. The trainee will demonstrate the ability to classify ignitable liquids based on GC/MS data by providing documentation which support the reported findings.

5. The trainee will demonstrate his/her knowledge of the extraction techniques used in fire debris analysis and apply these methods on fire debris samples. Accomplishment will be based on a score of no less than 80% on a written criterion test and a passing score on a practical quiz based upon a pass/fail system.

6. The trainee will demonstrate his/her ability to classify ignitable liquids in the presence of substrate peaks. This will be accomplished with practical quizzes on a pass/fail basis and a practical criterion test score of 100% on the general unknowns.

7. The trainee will demonstrate his/her knowledge of documentation and QA measures by passing a written criterion test with a score of no less than 80%.

8. The trainee will demonstrate his/her knowledge and ability to recognize, collect, preserve, and submit fire debris evidence. This will be accomplished with practical quizzes on a pass/fail basis and a score of no less than 80% on a written criterion test.

9. The trainee will demonstrate his/her ability to communicate the truth in a manner that is understandable and believable by passing on a pass/fail system a mock court testimony.

10. The trainee will demonstrate that he/she uses proper procedures, evaluations and conclusions in actual casework based on verification with cosignatory of reports by an experienced forensic scientist.

LESSON 1

Estimated Time: 5 Days

Purpose: Provide the trainee with background information related to the chemistry, manufacturing process and distribution of ignitable liquids that may be encountered in fire debris analysis.

Lectures:
Review of Basic Organic Chemistry
Chemistry of Crude Oil
Petroleum Industry Classification System
Petroleum Refining Processes
Chemistry of Petroleum Cuts & Reformation
Marketing & Distribution of Petroleum Products

Exercises:
1. Complete the Chemistry Review and Petroleum and Petroleum Processes Fire Debris Analysis Study Guide.
2. Complete Part A assignments in Fire Debris Analysis.
3. Pass the Organic Chemistry and Petroleum Industry criteria test.

Recommended Reading:
1. Trace Chemistry Resource Manual for Petroleum & Refining Operations.
2. VCR Tape “Shell Refinery Process”.
3. Hoffman, H. L., “Petroleum and Its Products,” Riegel’s Handbook of Industrial Chemistry, 8th ed, pp. 488-518, Van Nostrand Reinhold, 1983.
4. Considine, D. M. & Considine, G. D., “Petroleum,” Encyclopedia of Chemistry, 4th ed., pp. 693-705, Van Nostrand Reinhold, 1984.

LESSON 2

Estimated Time: 5 Days

Purpose: The trainee will demonstrate that he/she can explain the operation of the GC/MS in terms understandable to a jury and can operate the instrument to provide the data required for fire debris analysis.

Lectures: Instrument Parameters for Fire Debris Analysis
QA Measures for the Use of GC/MS in Fire Debris Analysis
Guidelines for Interpretation of Mass Spectra Related to Fire Debris Analysis

Exercises:

1. Must have successfully completed the unit on Mass Spectrometry or demonstrated proficiency in Mass Spectrometry with passing scores on written and practical tests.
2. Complete Part B assignments in Fire Debris Analysis.
3. Successfully complete an oral quiz on the explanation of the GC/MS operation and interpretation of the data. This is a pass/fail basis.
4. Perform a GC/MS analysis of a liquid mixture of gasoline and diesel fuel. Provide ion extracted chromatograms of the alkanes, aromatics, cycolalkanes, naphthalenes and indenes.
5. Provide the same type of data requested in #5, but use a sample provided by the training coordinator. Compare result from split and splitless injections.

Recommended Reading:

1. Instrument software manual where applicable.
2. Trace Chemistry Resource Manual for GC/MS in analysis of fire debris.
3. Trace Chemistry Procedures Manual (TC-II, pp. 1-6).

LESSON 3

Estimated Time: 3 Days

Purpose: The trainee will have to acquire knowledge about the classification systems used for ignitable liquids in fire debris analysis.

Lectures: ISP Classification System
ASTM Classification System
Target Compounds
Commercial Products Within The Classification

Exercises:

1. Complete the Interpretation, Classification, and Report Wording Fire Debris Analysis Study Guide.
2. Complete Part C assignment in Fire Debris Analysis.
3. Pass the Classification criterion test.
4. Pass a practical quiz on classification of unknown patterns. This is based on a pass/fail system.

Required Reading:

1. ASTM Standard 1618, 2014, "Standard Guide for Identification of Ignitable Liquid Residue in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry," ASTM International, West Conshoshocken, PA, 2014, DOI: 10.1520/E1618-14.

2. Trace Chemistry Procedures Manual (TC-II, pp. 7-15).

3. Keto, R. O., "GC/MS Data Interpretation for Petroleum Distillate Identification in Contaminated Arson Debris," Journal of Forensic Sciences, May 1995, 40, 3, 412-423.

4. Wineman, P. L., Keto, R. O., "Target Compound Method for the Analysis of Accelerant Residues in Fire Debris," Analytical Chimica Acta, March 1994, 288, 1-2, 97-110.

LESSON 4

Estimated Time: 17 Days

Purpose: The trainee must demonstrate the ability to classify ignitable liquids from GC/MS data.

Lectures: Sample Prep and Sample Introduction of Neat Ignitable Liquids
Cause & Effect of Petroleum Products Degradation

Exercises:

1. Run hydrocarbon standard and record the retention time for each straight chain hydrocarbon from C_6 to C_{22}. Retain this data file for future reference.
2. Select five (5) ignitable liquids from each major class and perform GC/MS analysis. Provide ion profiles for each samples and store in reference binder.
3. Obtain 90% and 99% evaporated samples of Gasoline, Diesel Fuel, Medium Petroleum Distillate (MPD), Light Petroleum Distillate (LPD), and Kerosene. Provide information requested in Exercise #2.
4. Obtain the following mixtures:
   50/50 Gasoline/Diesel Fuel
   50/50 Gasoline/MPD
   50/50 MPD/Diesel Fuel
   Provide information requested in Exercise #2.
5. Select three different types of turpentine solvents. Provide information requested in Exercise #2.
6. The trainee will explain and illustrate to the training coordinator the distinguishing features that are used to classify the patterns in the reference binder. Also, any pattern that cannot be classified must be shown to lack the required characteristics.

Recommended Reading:

1. Newman, R., Gilbert, M., Lothridge, K., GC-MS Guide to Ignitable Liquids, CRC Press, 1998.

2. Trace Chemistry Resource Manual of GC/MS Data from Ignitable Liquids.

LESSON 5

Estimated Time: 5 Days

Purpose: The trainee will have to acquire knowledge about the various extraction techniques used in fire debris analysis and apply them to fire debris samples.

Lectures: Extraction Techniques of Fire Debris Samples Used in Forensic Labs
Demonstrate Each Technique
Safety Guidelines

Exercises:

1. Complete the Extractions Fire Debris Analysis Study Guide.
2. Complete Part D assignments in Fire Debris Analysis.
3. Pass the Extraction criterion test.
4. Spike 5 paint cans with 2µL of the sensitivity standard. Perform extractions with a different technique for each can.
5. Spike 5 cans with 20µL of the sensitivity standard. Perform extractions with a different technique for each can.
6. Repeat Exercise #4, but use 5 µL of a light petroleum distillate.
7. Repeat Exercise #4, but use 5 µL of gasoline.
8. Repeat Exercise #4, but use 5 µL of medium petroleum distillate.
9. Perform CG/MS analysis on each of the samples from Exercises 4-8. Explain the advantages and disadvantages of each technique.

Required Reading:

1. Trace Chemistry Procedures Manual – Method: Volatiles Recovery (TC-IIA-1-5).

2. ASTM Standard 1388, 2012, "Standard Practice for Sampling of Headspace Vapors from Fire Debris Samples," ASTM International, West Conshohocken, PA, 2012, DOI: 10.1520/E1388-12.

3. Reeve, V., et al., "Developments in Arson Analysis: A Comparison of Charcoal Absorption and Direct Headspace Injection Techniques Using Fused Silica Capillary Gas Chromatography," *Journal of Forensic Sciences*, 1986, 31, 2, 479-488.

4. ASTM Standard 1386, 2010, "Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Solvent Extraction," ASTM International, West Conshohocken, PA, 2010, DOI: 10.1520/E1386-10.

5. ASTM Standard 1413, 2013, "Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Dynamic Headspace Concentration," ASTM International, West Conshohocken, PA, 2013, DOI: 10.1520/E1413-13.

6. Sandercock, P. M. L., "Comparison of Passive Charcoal Adsorption with Dynamic Charcoal Adsorption Technique," *Can. Soc. Forensic Sci, J.*, 1994, 27, 3, 179-201.

7. ASTM Standard 1412, 2012, "Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration," ASTM International, West Conshohocken, PA, 2012, DOI: 10.1520/E1412-12.

8. Demers-Kohls, J. F., "Evaluation of the D FLEX device for Fire Debris Analysis," *Can. Soc. Forensic Science Journal*, 1994, 27, 3, 99-123.

9. Waters, L. V., et al., "Multiple Analysis of Fire Debris Samples using Passive Headspace Concentration," *Journal of Forensic Sciences*, 1993, 38, 1, 165-183.

10. Dietz, W. R., "Improved Charcoal Packaging for Accelerant Recovery by Passive Diffusion," *Journal of Forensic Sciences*, 1991, 36, 1, 111-121.

11. Newman, R. T., et al., "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," *Journal of Forensic Sciences*, 1996, 41, 3, 36-370.

12. Furton, K. G., Bruna, J., "A Simple, Inexpensive, Rapid, Sensitive and Solventless Technique for the Analysis of Accelerants in Fire Debris Based on SPME," *J. High Resol. Chromatogr*, October 1995 18, 625-629.

13. Pehlps, J. L., Chasteen, C. E., Render, M. M., "Extraction and Analysis of Low Molecular Weight Alcohols and Acetone from Fire Debris Using Passive Headspace Concentration," *Journal of Forensic Sciences*, 1983, 194-206.

14. Zhang, Z., Yang, M. J., Pawliszyn, J., "Headspace Solid-Phase Microextraction," *Anal. Chem*, 1993, 65, 17, 1843-1852.

15. Zhang, Z., Yang, M. J., Pawliszyn, J., "Solid-Phase Microextraction," *Anal. Chem*, 1994, 66, 17, 844A-853A.

16. Wong, M., "Headspace Solid Phase Microextraction Technique," Validation, *ISP Trace Memo*, 96-Trace-12.

17. Wong, M., "Detection of Gasoline and Fuel Oil No. 2 Utilizing Headspace Solid-Phase Microextraction," *ISP Trace Memo*, 96-Trace-17.

LESSON 6

Estimated Time: 10 Days

Purpose: The trainee will demonstrate his/her ability to classify ignitable liquids after extraction from an evidence container.

Lectures: Approach to Classification of Unknown Pattern
Ignitable Liquids Degradation and Examples

Exercises:

1. Select two ignitable liquids from each major class and one sample from each subclass. Spike 5µL into a paint can, one can for each liquid. Extract with your technique of choice. Perform GC/MS analysis. Provide documentation to justify your classification of each sample (Set A). Place damp soil in three separate quart paint cans (Set B).
2. Place damp rags that contain mildew in three separate quart paint cans. Spike 100 microliters of gasoline in a can from Set A and a can from Set B. Likewise, spike separate cans with diesel fuel and medium petroleum distillate. Permit the cans to stay in a sealed condition at room temperature for two weeks prior to analysis. Analyze and obtain the information requested in Exercise #1.

Required Reading:

1. Newman, R., Gilbert, M., Lothridge, K., GC-MS Guide to Ignitable Liquids, CRC Press, 1998.

2. Trace Chemistry Resource binder of GC/MS data from ignitable liquids.

LESSON 7

Estimated Time: 15 Days

Purpose: The trainee must be able to distinguish patterns that are associated with pyrolysis products and substrates.

Lecture: Examples of Patterns Associated with Pyrolysis Products

Exercises:

1. The trainee will secure the following substrates. These substrates will be partially charred and placed in an evidence can.
   A. Paper Products (paper, cardboard)
   B. Polymers (plastic)
   C. Clothing
   D. Carpet
   E. Footwear and Leather Products
   F. Soil and Vegetation
   G. Padding and Stuffing Materials
   H. Wood
   I. Floor Covering
   J. Cloth Other Than Clothing
   K. Bedding and Sofa

L. Roofing Materials
M. Candles and Wax
N. Oil (non-fuel e.g. vegetable)
O. Automobile Carpet and Floor Mats

The trainee will obtain 4 different types within each group A-D.
The trainee will obtain 2 different types within each group E-O.

2. The trainee will perform extractions and GC/MS analysis on each of the samples. Document results and retain all charts in a reference binder.
3. The trainee will explain and justify to the trainer the ion profiles that may be influenced by each of these substrates.

Required Reading:

1. Trace Chemistry Resource binder of GC/MS data from substrates.

LESSON 8

Estimated Time: 8 Days

Purpose: The trainee must be able to classify ignitable liquids in the presence of interfering peaks from pyrolysis products and substrates.

Lecture: Review Examples of Patterns with Substrate/Pyrolysis Interference

Exercise:

1. The training coordinator will provide a set of ten (10) samples with different substrates and ignitable liquids. The trainee must demonstrate his/her ability to successfully classify the liquid by not getting more than three (3) incorrect answers on the initial set and 100% on the supplemental set. The supplemental set will include five (5) samples. The supplemental is not required for 100% correct on the initial set.

Required Reading:

1. Newman, R., Gilbert, M., Lothridge, K., <u>GC-MS Guide to Ignitable Liquids</u>, CRC Press, 1998.

2. Trace Chemistry Resource binder of GC/MS data from ignitable liquids.

LESSON 9

Estimated Time: 2 Days

Purpose: The trainee must demonstrate that he/she knows the proper documentation and quality assurance measures required for fire debris analysis.

Lectures: Documentation, Report Wording and Quality Assurance
Reasons for Negative or Inconclusive Report

Exercises:

1. The trainee will verbally present the documentation requirements for a fire debris analysis of a case sample.
2. The trainee will verbally present the quality assurance requirements for a fire debris analysis of case sample.
3. Complete Part E of the Fire Debris Analysis Study Guide.
4. Complete Part E assignments in Fire Debris Analysis.
5. Pass the documentation/QA portion of the criterion test.

Required Reading:

1. Trace Chemistry Procedures Manual (TC-App I, pp. 2-6), (TC-APP II, pp. 9-15).

LESSON 10

Estimated Time: 3 Days

Purpose: The trainee will demonstrate that he/she knows and can apply the recognition, collection, preservation and submission of fire debris evidence and applicable state statutes.

Lectures:

Fire Scene Terminology
Fire Debris Evidence Containers & Comparison Samples
Proper Sealing, Marking & Preserving Evidence
Completion of the Evidence Receipt & the Storage of Evidence
State Statutes Related to Arson
The Use of Accelerant Detection Tools at Scene
Incendiary Devices
Factors Effecting Survival of Accelerants

Exercises:

1. Complete the Law, Fire Scene, Collection, and Submission Fire Debris Analysis Study Guide.
2. Complete Part F assignments in Fire Debris Analysis.
3. Demonstrate the procedure for receiving evidence, marking, recording in log book, completion of the evidence receipt, and storage of evidence.
4. Pass the Law, Fire Scene, Collection, and Submission criterion test.

Required Reading:

1. Trace Chemistry Resource Manual for Fire Scene.

2. Trace Chemistry Resource Manual for Collection, Preservation & Submission of Evidence.

3. DeHaan, J. D., Kirk's Fire Investigation, 3rd Ed., Prentice Hall, 1991.

4. NFPA 921, Guide for Fire and Explosion Investigations, 1995 edition, National Fire Protection Association.

LESSON 11

Estimated Time: 35 Days

Purpose: The trainee must provide the correct answers for the analysis of mock fire debris evidence. This represents the general unknowns for this unit of study.

Lecture: None

Exercise:

1. A minimum of fifteen (15) mock samples will be given to the trainee. This may be distributed as ten (10) mock cases. Five (5) of these mock samples will serve as the criterion practical test and the trainee must get a score of 100% in order to pass. To pass, the findings and conclusions of the samples must be correct and all quality assurance measurements must be met.

Recommended Reading:

1. Newman, R., Gilbert, M., Lothridge, K., GC-MS Guide to Ignitable Liquids, CRC Press, 1998.

2. Trace Chemistry Resource binder of GC/MS data from ignitable liquids.

LESSON 12

Estimated Time: 2 Days

Purpose: The trainee must demonstrate the ability to testify in court about the finding and conclusions derived from his/her analysis.

Lecture: Tips on Testimony in Arson Cases

Exercises:

1. Trainee will develop a curriculum vitae.
2. Trainee will generate a list of qualifying questions.
3. The trainee will receive a passing score based on a pass/fail system for his/her testimony on a mock case.

Recommended Reading:

1. Trace Chemistry Resource Manual on Court Testimony.

LESSON 13

Estimated Time: 40 Days

Purpose: The trainee must demonstrate that he/she will provide correct analysis on actual case samples.

Lectures: Review of Ethical Responsibilities in Casework
Service to Law Enforcement Agencies
Case and Individual Activity Reports

Exercise:

1. Trainee will receive and analyze a minimum of ten (10) cases under the direct supervision of an experienced examiner. Reports will be signed by both individuals. Three (3) of these cases will serve as the criterion practical test and the trainee must get a score of 100% in order to pass. To pass, the findings and conclusions of the samples must be correct and all quality assurance measurements must be met.

Recommended Reading:

1. Forensic Sciences Command Quality Manual.
2. Forensic Sciences Command Directives Manual.

ILLINOIS STATE POLICE

TRACE CHEMISTRY TRAINING MANUAL

MODULE: GLASS

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

Procedures in the Trace Chemistry Procedures Manual for Glass Examination and Analysis (TC-IV).

UNIT ESTIMATED TIME

129 Days

GOAL

Upon completion of this unit, the trainee will possess the necessary knowledge, skills, and abilities to be proficient in the identification and comparison of glass.

OBJECTIVES

1. The trainee will demonstrate a comprehensive knowledge of glass terminology, technology, and classification by passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate his/her comprehensive knowledge, skills and abilities in the application of microscopy to forensic glass analysis. This will be accomplished with a score of no less than 80% on a written criterion test and a passing score on a practical quiz based on a pass/fail system.

3. The trainee will demonstrate his/her comprehensive knowledge, skills and abilities to identify glass to the exclusion of all other materials. This will be accomplished with a score of no less than 80% on a written criterion test and a passing score on a practical quiz based on a pass/fail system.

4. The trainee will demonstrate his/her comprehensive knowledge, skills and abilities to determine and perform a comparison of the refractive indices of glass. This will be accomplished with a score of no less than 80% on a written criterion test and a passing score on a practical quiz based on a pass/fail system.

5. The trainee will demonstrate his/her comprehensive knowledge, skills and abilities to determine and perform a comparison of the density of glass. This will be accomplished with a score of no less than 80% on a written criterion test and a passing score on a practical quiz based on a pass/fail system.

6. The trainee will demonstrate his/her comprehensive knowledge related to the analytical approach to tempered glass, safety glass, and fiber glass. This will be accomplished with a score of no less than 80% on a written criterion test.

7. The trainee will demonstrate his/her comprehensive knowledge of the application of elemental analysis in forensic glass comparisons. This will be accomplished with a score of no less than 80% on a written criterion test.

8. The trainee will demonstrate his/her comprehensive knowledge, sills, and abilities to determine and perform a comparison of the thickness of glass. This will be accomplished with a score of no less than 80% on a written criterion test.

9. The trainee will demonstrate his/her comprehensive knowledge of handling a glass fracture examination and determination of the direction of force. This will be accomplished with a score of no less than 80% on a written criterion test.

10. The trainee will demonstrate his/her comprehensive knowledge of statistical applications, documentation, QA measures, and report wording related to forensic glass examination and analysis. This will be accomplished with a score of no less than 80% on a written criterion test.

11. The trainee will demonstrate his/her comprehensive knowledge and ability to recognize, collect, preserve, and submit glass evidence. This will be accomplished with practical quizzes on a pass/fail basis and a score of no less than 80% on a written criterion test.

12. The trainee will demonstrate that he/she can apply the knowledge, skills and abilities required to perform the examination and analysis of glass with 100% accuracy on mock glass cases.

13. The trainee will demonstrate his/her ability to communicate the truth in a manner that is understandable and believable by passing on a pass/fail system a mock court testimony.

14. The trainee will demonstrate that he/she uses proper procedures, evaluations, and conclusions in a actual casework based on verification with cosignatory of reports by an experienced forensic scientist.

LESSON 1

Estimated Time: 3 Days

Purpose: Provide the trainee with background information related to glass. This will include: terminology, technology, chemistry, classifications and historical developments.

Lectures:
Terminology
Chemistry of Glass
Technology in Glass Production
Classifications
History of Glass

Exercises:
1. Complete Part A of the Glass Study Guide.
2. Complete Part A assignments in Glass.
3. Pass the glass introduction portion of the criterion test.

Recommended Reading:

1. Trace Chemistry Procedures Manual TC-IV pp. 2-6.

2. Trace Chemistry Resource Manual for glass.

3. Miller, E. T., “Forensic Glass Comparisons,” in Forensic Science Handbook, ed., Richard Saferstein, Prentice-Hall, Inc., 1982.

4. Snow., R. R., “Chemistry of Glass Manufacturing” presented at the American Chemical Society’s 18th Regional Meeting held in Bowling Green, Ohio.

5. Hutchins, J. R. and Harrington, R. V., “Glass” in Encyclopedia of Chemical Technology, 2nd Ed., Vol. IV, John Wiley and Sons, Inc., 1966, pp. 553-604.

6. Considine, D., “Glass” in Encyclopedia of Chemistry, 4th Ed., Van Nostrand Reinhold Co., 1984, pp. 424-430.

7. Smith, A. K., “Glass Identification Procedures,” Bureau of Identification, Scientific Services, 1975.

8. Brady, G. S. and Clauser, H. R., “Glass” in Materials Handbook, McGraw-Hill Book Co., 1986, pp. 354-361.

9. “Glass Today, and What It Used To Be”, The Family Handyman, Apr. 1990, p. 20.

10. Grayson, M., Encyclopedia of Glass, Ceramics, and Cement, John Wiley and Sons, 1985, pp. 462, 590.

11. Uhlann, D., Glass: Science and Technology, Academic Press, Inc., 1984, Vol. 2, (1), pp. 46, 107.

12. Brill, R., “A Note on the Scientist’s Definition of Glass.” Journal of Glass Studies, 1962. p. 127.

13. Warman, G., “An Introduction to Glass Technology,” MPFSL Report #30, p. 43.

14. Paul, A., Chemistry of Glasses, Chapman & Hall, 1982.

LESSON 2

Estimated Time: 3 Days

Purpose: The trainee will demonstrate knowledge and skills related to the proper use of microscopes in glass examinations.

Lectures: Types and Operation of Microscopes Used in Glass Examinations
Properties of Light

Alignment of Microscopes
Care and Maintenance of the Microscopes

Exercises:
1. Complete Part B of the Glass Study Guide
2. Demonstrate to the training coordinator the microscope components, proper alignment, and preventive maintenance. A passing score on a pass/fail system is required for the practical quiz.
3. Pass microscope portion of the criterion test.

Recommended Reading:
1. Trace Chemistry Procedures Manual "Initial Examination" TC-IVA-1, pp. 1-4.
2. Trace Chemistry Resource Manual in Microscopy.

LESSON 3

Estimated Time: 5 Days

Purpose: The trainee will be able to identify glass to the exclusion of all other materials.

Lecture: Criteria for Glass Identification

Exercises:
1. Complete Part C of the Glass Study Guide.
2. Pass the glass identification portion of the written criterion test.
3. The training coordinator will provide a set of 56 samples. The trainee will document a description of each sample and determine if glass is present. This is a practical quiz with a passing score on a pass/fail system is required.

Required Reading:
1. Trace Chemistry Procedures Manual "Initial Examination" TC-IVA-1, p. 3.

LESSON 4

Estimated Time: 2 Days

Purpose: The trainee will have a comprehensive knowledge related to the analytical approach to tempered glass, safety glass and fiber glass.

Lectures:
Visual Observations Characteristic of These Types of Glasses
Preparation and Optical Analysis of These Glasses
Analysis of Coating Material on Fiber Glass
Types of Safety Glass

Exercises:
1. Visually compare tempered and non-tempered glass. Verbally explain to the training coordinator the differences between these glasses.
2. Observe the shape of the glasses after breakage.

3. Complete Part F of the Glass Study Guide.
4. Pass the portion of the criterion test that deals with the subject matter covered in Lesson 4.

Recommended Reading:

1. Trace Chemistry Procedures Manual, "Glass Annealing" TC-IVB-3, pp. 1-3.

2. Walsh, KAJ, Buckleton, J. S., Triggs, C. M., A practical example of the interpretation of glass evidence, Science & Justice 1996, 36(4):213-218.

3. Edmondstone, G., The Identification of Heat Strengthened Glass in Windshields, Can Soc Forensic Sci J 1997, 30(40:181-184.

LESSON 5

Estimated Time: 1 Day

Purpose: The trainee will demonstrate that he/she has the comprehensive knowledge, skills and abilities to determine and perform a comparison of the thickness of glass

Lectures:
Thickness Range for Different Types of Glass
Accuracy and Variability Related to Glass Thickness Measurements
Guidelines for Performing Glass Thickness Measurements

Exercises:

1. Experimentally determine the thickness of 5 known glass samples
2. Experimentally determine the thickness of 5 unknown glass samples. This is a pass/fail quiz. A passing grade with less than 100% correct will require additional unknown glass samples with 100% correct.
3. Experimentally compare sets of standards and unknowns provided by the training coordinator to determine which sets are a thickness match. This is a pass/fail quiz. A passing grade with less than 100% correct will require additional unknown glass samples with 100% correct.
4. Complete Part H of the Glass Study Guide.
5. Pass glass thickness portion of the written criterion test.

Recommended Reading:

1. Renshaw, G. & Clarke, P., "The Variation in Thickness of Toughened Glass from Car Windows," J. Forens. Sci. Soc. (1974), 14, #4, pp. 311-317.

2. Trace Chemistry Procedures Manual TC-IVA-1, p. 3.

LESSON 6

Estimated Time: 21 Days

Purpose: The trainee will have the comprehensive knowledge, skills and abilities to determine the refractive indices of glass and determine refractive indices variability of glass samples from the same source.

Lectures:
Becke Line
Dispersion
Double Variation Method
How to Obtain Refractive Indices (RI) of Glass
Expected Range of RI Based on Glass Type
GRIM System
Value of the Phase Contrast Microscope

Exercises:
1. Set up the microscope, monochrometer and hot stage.
2. Perform refractive index comparison of the portion of glass under compression versus the portion under tension. Explain your results to the training coordinator.
3. Perform refractive index comparison of glass removed from different sides of the plastic barrier of a piece of safety glass. Explain your results to the training coordinator.
4. Perform a refractive index analysis of fiberglass provided by the training coordinator. Explain your results to the training coordinator.
5. Perform Glass Practical #2.
6. Perform Glass Practical #3.
7. Complete Part D of the Glass Study Guide.
8. Pass refractive index portion of the written criterion test.

Recommended Reading:
1. Trace Chemistry Procedures Manual “Double Variation Procedure” TC-IVB-1, pp. 1-6.
2. Trace Chemistry Resource Manual for Glass.

LESSON 7

Estimated Time: 10 Days

Purpose: The trainee will have the comprehensive knowledge, skills and abilities to determine the density of glass and perform a comparison of the density of glass.

Lectures:
Terminology
Demonstrate Procedure
QA Measures and Safety Requirements
Sample Size and Density Variation
Use of Data Base

Exercises:
1. Set up the density measuring equipment.
2. Complete Part E of the Glass Study Guide.
3. Experimentally determine the density of 5 known glass samples.
4. Experimentally determine the density of 5 unknown glass samples.

This is a pass/fail quiz. A passing grade with less than 100% correct will require additional unknown glass samples with 100% correct.

5. Experimentally compare 5 sets of standards and unknowns to determine which sets are a density match. This is a pass/fail quiz. A passing grade with less than 100% correct will require additional unknown glass samples with 100% correct.
6. Pass density portion of the written criterion test.

Recommended Reading:

1. Trace Chemistry Procedures Manual "Density" TC-IVB-2, pp. 1-6.
2. Trace Chemistry Resource Manual for Glass.

LESSON 8

Estimated Time: 2 Days

Purpose: The trainee will have a comprehensive knowledge of the application of elemental analysis in forensic glass comparison.

Lectures: Instrumental Methods Used for Glass Elemental Analysis
Advantages and Disadvantages of the Various Methods Used for Elemental Analysis
The Importance of Elemental Analysis Compared to Other Methods of Glass Comparison

Exercises:

1. Complete Part G of the Glass Study Guide.
2. Pass elemental analysis portion of the written criterion test.

Recommended Reading:

1. Parouchais, T., Warner, I. M., Palmer, Lt., Kobus, H., The Analysis of Small Glass Fragments Using Inductively Coupled Plasma Mass Spectrometry, J. Forensic Sci 1996: 41(3):351-360.
2. Watling, R. J., Lynch, B. F., Herring, D., Use of Laser Ablation Inductively Coupled Plasma Mass Spectrometry for Fingerprinting Scene of Crime Evidence, J Anal At Spectrom 1997; 12(20;195-203.
3. Sotecklein, W., Fischer, R., Becker, S., Chadzelek, A., The Analysis of Float Glass: Characterization of Glasses from International Sources (abstract), International Workshop on the Forensic Examination of Trace Evidence, 1998 Jan 22-3; Tokyo, Japan.
4. Buscaglia, J., Aitken, CGG, Brown, K., DeForest, P. R., Kubic, T. A., The Discrimination of Window Glass Fragments by Energy Dispersive X-Ray Fluorescence Spectrometry (abstract), International Symposium on the Forensic Examination of Trace Evidence; 1998 Jan 22-23; Tokyo, Japan.

5. Andrasco, J., Forensic Comparison of Glass Fragments Based On Combination of Physical Techniques and Elemental Analysis in a Scanning Microscope (abstract),International Workshop on the Forensic Examination of Trace Evidence, 1998 Jan 22-23; Tokyo, Japan.

6. Goldmann, T., Hicks, T., Margot, P., The Analysis of Glass Fragments Using Energy Dispersive X-Ray µFluorescence (abstract), 14th Meeting of the International Association of Forensic Sciences, 1996 Aug 26-30; Tokyo, Japan.

7. Stocklein, W. Gunaratnam, L., Hicks, T., Kidfeldt G., Rindby, A., Warman J., Widstedt, I., The Analysis of Float Glass Using Elemental Analysis; Comparison of Techniques (abstract). First European Meeting of Forensic Science, 1997 Sept 17-19; Lausanne, Switzerland.

8. Stocklassa, B., Rindby, A., Applications of Micro-beam XRF in Forensic Science (abstract), International Workshop on the Forensic Examination of Trace Evidence, 1998 Jan 22-23; Tokyo, Japan.

9. Almirall, J. R., Cole, M. D., Gettinby, G., Furton, K. G., Discrimination of Glass Sources Using Elemental Composition and Refractive Index: Development of Predictive Models, Science & Justice 1998, 38(2):93-100.

10. Almirall, J., Cole, M., Furton, K., Gettinby, G., Classification and Discrimination of Forensic Glass Samples Using the Statistical Analysis of Their Elemental Composition and Refractive Index Data (abstract), 14th Meeting of the International Association of Forensic Sciences: 1996 Aug 26-30: Tokyo, Japan.

11. Curran, J. M., Triggs, C. M., Almirall, J. R., Buckleton, J. S., Walsh, K. A. J., The Interpretation of Elemental Composition Measurements from Forensic Glass Evidence: I, Science & Justices 1997, 37(4):241-244.

12. Curran, J. M., Triggs, C. M., Almirall, J. R., Buckleton, J. S., Walsh, K. A. J., The Interpretation of Elemental Composition Measurements from Forensic Glass Evidence: II, Science & Justices 1997, 37(4):245-249.

13. Reeve, B., Mathiesen, J. and Fong, W., Elemental Analysis by Energy Dispersive X-Ray: A Significant Factor in the Forensic Analysis of Glass, Journal of Forensic Sciences, 21: 291-306.

14. Stoecklein, W., Determination of Source and Characterization of Glass of International Origin, presentation to the International Symposium on the Forensic Examination of Trace Evidence, San Antonio, TX, June 1996.

15. Koons, R., Fiedler, C. and Fawalt, R., Classification and Discrimination of Sheet and Container Glasses by Inductively Coupled Plasma-Atomic Emission Spectrometry and Pattern Recognition, Journal of the Forensic Sciences, 1988, 33, 49-67.

16. Koons, R., Peters, C. and Rebbert, P., Comparison of Refractive Index, Energy Dispersive X-Ray Fluorescence and Inductively Couples Plasma Atomic Emission Spectrometry for Forensic Characterization of Sheet Glass Fragments, Journal of Analytical Atomic Spectrometry, 1991, 6, 451-456.

17. Buscaglia, J., Elemental Analysis of Small Glass Fragments in Forensic Science, Analytica Chimica Acta, 288 (1994) 17-24.

LESSON 9

Estimated Time: 1 Day

Purpose: The trainee will demonstrate his/her comprehensive knowledge of handling a glass fracture examination and the demonstration of the direction of force.

Lectures:
Terminology Related to Glass Fractures
Criteria to Determine the Direction of Force
Criteria to Determine Sequence of Breakage When Multiple Forces Were Applied
Problems Associated with the Determination of Direction of Force in Tempered Glass

Exercises:

1. Examine a broken sheet of glass. Explain to the training coordinator the direction of force and the basis for your conclusion.
2. Observe broken tempered glass. Provide visual proof to the training coordinator concerning the problems associated with a direction of force determination.
3. Pass glass fracture portion of the written criterion test.

Recommended Reading:

1. Wunsche, C., Radlein, E., Frischat, G. H., Glass Fracture Surfaces Seen with an Atomic Force Microscope, Fresenius J. Anal Chem 1997, 358:349-351.

2. Garrison, D., “A Template for Reconstructing the Center-of-Impact in Broken Windows,” MAFS Newsletter, Oc. 1990, p. 38.

3. McJunkins, S. P. and Thornton, J. L., “Glass Fracture. A Review,” Forensic Science, Vol. 2, 1973, pp. 1-27.

4. Rhodes, E., Thornton, J., “The Interpretation of Impact Fractures in Glassy Polymers,” JFS, 1975, Vol. 20, #2, pp. 274-282.

5. Saferstein, R., Ed., Forensic Science Handbook, "Glass Fracture Examination," 1982, pp. 146-153.

LESSON 10

Estimated Time: 2 Days

Purpose: The trainee must demonstrate that he/she knows the proper documentation, QA measures, statistical applications, and report wording related to glass examinations and comparisons.

Lectures:
Markings and Proper Completion of the Worksheet
QA Measures
Statistical Applications in Reporting Glass Results
Report Wording

Exercises:
1. The trainee will describe to the training coordinator how he/she would document work performed and how to properly use the computer program and data base related to glass.
2. The trainee will describe the QA measures required for each type of test performed and general QA measures for glass examination and comparison.
3. The trainee will provide the correct report wording for various scenarios presented by the training coordinator.
4. Complete Part I of the Glass Study Guide.
5. Pass the portion of the criterion test that deals with the subject matter covered in Lesson 10.

Recommended Reading:
1. Trace Chemistry Procedures Manual TC-IV, pp. 4-6.
2. Trace Chemistry Procedures Manual TC-App III, pp 2-3, 8-10.

LESSON 11

Estimated Time: 2 Days

Purpose: The trainee will demonstrate that he/she knows and can apply the recognition, collection, preservation and submission of glass evidence.

Lectures:
Removal of Glass from Clothing and Footwear
Package and Shipment of Small glass Fragments
Removal and Handling of Glass Submitted for a Direction of Force Determination
How, What, and Where to Collect the Glass Standards
The Importance of preserving Edges for a Physical Match

Exercises:

1. The trainee will demonstrate the proper collection and preservation techniques for samples and scenarios provided by the training coordinator.
2. Pass the portion of the criterion test that deals with subject matter covered in Lesson 11.

Recommended Reading:

1. Trace Chemistry Procedures Manual, TC-IVA-1, pp. 1-4.
2. Trace Chemistry Procedures Manual, TC-App III, pp. 6-7.
3. Hicks, T., Vanina, R., Margot, P., Transfer and Persistence of Glass Fragments on Garments, Science & Justice 1996, 36(2): 101-107.
4. Underhill, M., The Acquisition of Breaking and Broken Glass, Science & Justice 1997, 37(2): 121-127.
5. Lambert, J. A., Satterthwaite, M. J., Harrison, P. H., A Survey of Glass Fragments Recovered from Clothing of Persons Suspected or Involvement in Crime, Science & Justice 1995, 35(4): 273-281.
6. Lau, L., Beveridge, A. D., Callowhill, B. C., Conners, N, Foster, K., Groves, R. J., et al, The Frequency of Occurrence of Paint and Glass on the Clothing of High School Students, Can Soc Forensic Sci J 1997, 30(4):233-240.
7. Triggs, C. M., Curran, J. M., Buckleton, J. S., Walsh, K. A. J., The Grouping Problem in Forensic Glass Analysis: A Divisive Approach, Forensic Sci Int 1997, 85(10):1-14.
8. Evett, I. W., Lambert, J. A>, Buckleton, J. S., Further Observations on Glass Evidence Interpretation., Science & Justice 1995, 35(4):283-289.
9. McQuillan, J., Edgar, K., A Survey of the Distribution of Glass on Clothing, Journal of the Forensic Science Society, 1992, 32(4):333-348.
10. Curran, J. M., Triggs, C. M., Buckleton, J., Sampling in Forensic Comparison Problems, Science & Justice, 1998, 38(2): 101-107.

LESSON 12

Estimated Time: 35 Days

Purpose: The trainee must provide the correct answers for the examination and comparison of mock glass evidence. This represents the general unknowns for this unit of study. The trainee will pass the written criterion test for this unit of study.

Lecture: None

Exercises:

1. Thirty mock samples will be given to the trainee. This may be distributed as 15 mock cases. This is a criterion practical test and the trainee must get a score of 100%.
2. The trainee will pass the written criterion test for the unit of study with a score of no less than 80%.

Recommended Reading:

1. Trace Chemistry Procedures Manual "Glass" TC-IV, TC-App I, and TC-App II.

LESSON 13

Estimated Time: 2 Days

Purpose: The trainee must demonstrate the ability to testify in court about the findings and conclusions derived from his/her examination and/or comparison.

Lecture: Tips on Testimony About Glass

Exercises:

1. Trainee will develop a curriculum vitae.
2. Trainee will generate a list of qualifying questions.
3. The trainee will receive a passing score based on a pass/fail system for his/her testimony on a mock case.

Recommended Reading:

1. Trace Chemistry Resource Manual on Court Testimony.

LESSON 14

Estimated Time: 40 Days

Purpose: The trainee must demonstrate that he/she will provide correct analysis on actual case samples.

Lecture: Review of Ethical Responsibilities in Casework
Service to Law Enforcement Agencies
Case and Individual Activity Reports
Evidence Security

Exercises:

1. Trainee will receive and analyze a minimum of 20 cases under the direct supervision of an experienced examiner. Reports will be signed by both individuals.

Recommended Reading:

1. Forensic Sciences Command Quality Manual.
2. Forensic Sciences Command Directives Manual.

ILLINOIS STATE POLICE

TRACE CHEMISTRY TRAINING MANUAL

MODULE: GLASS REFRACTIVE INDEX MEASUREMENT (GRIM) INSTRUMENTATION

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Section Advisory Committee

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

Procedures in the Trace Chemistry Procedures Manual for Refractive Index (TC-IVB-1).

PREREQUISITE REFERENCE

Successful completion of the sections of the Trace Chemistry Glass Training Module pertaining to the theoretical and casework applications of glass refractive index measurements and comparisons using the Double Variation Method (Training Module TC-IA-8).

UNIT ESTIMATED TIME

15 Days

GOAL

Upon completion of this module, the trainee will possess the necessary knowledge, skills, and abilities to be proficient in determining glass refractive index values using automated Glass Refractive Index Measurements (GRIM) instruments by the GRIM Standard Method and the GRIM Compatibility Method.

OBJECTIVES

1. The trainee will demonstrate comprehension of the theoretical foundations of automated Glass Refractive Index Measurement (GRIM) instrumentation, the GRIM Standard Method, the GRIM Compatibility Method, and the differences between these methods and the Double Variation Method, by passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate practical skill in the operation of automated Glass Refractive Index Measurement (GRIM) instrumentation using the GRIM Standard Method and the GRIM Compatibility Method by successfully performing a variety of practical exercises. These exercises will include the following:

   A. Perform and document a successful calibration for the GRIM Standard Method.

   B. Perform and document quality assurance checks and assess operation of the system for GRIM Standard Method.

   C. Measure refractive index values for a minimum of three of the Locke B series certified glass standards using the GRIM Standard Method, and assess the measured values against the certified values for the standards.

   D. Measure and compare refractive index values for a minimum of two sets of standards and unknowns using the GRIM Standard Method to determine which sets are similar in refractive index values.

   E. Repeat Exercises 2B, 2C, and 2D using the GRIM Compatibility Method. When repeating Exercise 2C, also compare the measured values to those obtained using the Double Variation Method.

F. Demonstrate the effects of potential sources of error and how to correct them.

3. The trainee will demonstrate his/her ability to correctly perform GRIM Standard Method analysis and interpret the results with a 100% practical criterion test score on a set of standards and unknowns.

4. The trainee will demonstrate his/her ability to correctly perform GRIM Compatibility Method analysis and interpret the results with a 100% practical criterion test score on a set of standards and unknowns.

LESSON 1

Estimated Time: 1 Day

Purpose: To familiarize the trainee with the theoretical foundations of automated Glass Refractive Index Measurements (GRIM) instrumentation and the GRIM Standard Method.

Lectures: Introduction to GRIM Instrumentation

Theoretical Foundations of the GRIM Standard Method

Procedural Overview: GRIM Standard Method

Exercises:

1. Read the assigned materials.
2. Complete related sections of the GRIM Study Guide.

Required Reading:

1. Either (A) or (B):
   (A) "GRIM2 Installation & Instruction Manual," by Foster + Freeman Ltd., UK, 1998, and "GRIM2 Application Notes," by Foster + Freeman Ltd., UK, 2000.
   (B) "GRIM3 User's Manual 08," by Foster + Freeman Ltd., UK, 2006.

2. ASTM Standard E1967, 2011a, "Standard Test Method for the Automated Determination of Refractive Index of Glass Samples Using the Oil Immersion Method and a Phase Contrast Microscope," ASTM International, West Conshohocken, PA, 2011, DOI: 10.1520/E1967-11A.

3. ISP SAC Memo 02-TRACE-02, "Glass Refractive Index Measurement Validation and Procedure (GRIM2)," Don Kristiansen, 2002.

4. "Refractive Index," ISP Trace Chemistry Procedures Manual, Section TC-IVB-1.

5. "Reference Glasses and Silicone Oils for Refractive Index Measurement," by Locke Scientific Services, Ltd., UK, no date specified.

6. SWGMAT Guideline, "Glass Refractive Index Determination," July 2004.

LESSON 2

Estimated Time: 2 Days

Purpose: To familiarize the trainee with the theoretical foundations of the GRIM Compatibility Method.

Lectures: Theoretical Foundations of the GRIM Compatibility Method

Procedural Overview: GRIM Compatibility Method

Exercises:

1. Read the assigned materials.
2. Complete related sections of the GRIM Study Guide.
3. Pass the GRIM Training Module written criterion test.

Required Reading:

1. ISP SAC Memo 12-TRACE-02, "Achieving Compatibility Between GRIM Instruments and the ISP Glass Database," Kimberly Kunkler, 2012.

LESSON 3

Estimated Time: 8 ½ Days

Purpose: To develop the trainee's practical skill in the operation of GRIM instrumentation using the GRIM Standard Method.

Lectures: Overview of GRIM Instrumentation: Parts, Start-Up & Shut-Down Procedures, General Maintenance

Performing Calibration for GRIM Standard Method

Quality Assurance Checks for GRIM Standard Method

Measuring Refractive Index Values Using GRIM Standard Method

Exercises:

1. Perform and document a successful calibration for the GRIM Standard Method.
2. Perform and document quality assurance checks and assess operation of the system for GRIM Standard Method.
3. Measure refractive index values for a minimum of three of the Locke B series certified glass standards using the GRIM Standard Method, and assess the measured values against the certified values for the standards.

4. Measure and compare refractive index values for a minimum of two sets of standards and unknowns using the GRIM Standard Method to determine which sets are similar in refractive index values.

5. Demonstrate the effects of potential sources of error and how to correct them.

6. Pass the GRIM Standard Method practical criterion test.

Required Reading:

1. "Refractive Index." ISP Trace Chemistry Procedures Manual, Section TC-IVB-I.

LESSON 4

Estimated Time: 3 ½ Days

Purpose: To develop the trainee's practical skill in the operation of GRIM instrumentation using the GRIM Compatibility Method.

Lectures: Quality Assurance Checks for GRIM Compatibility Method

Measuring Refractive Index Values Using GRIM Compatibility Method

Exercises:

1. Perform and document quality assurance checks and assess operation of the system for GRIM Compatibility Method.

2. Measure refractive index values for a minimum of three of the Locke B series certified glass standards using the GRIM Compatibility Method, and assess the measured values against the certified values and the Double Variation Method measured values for the standards.

3. Measure and compare refractive index values for a minimum of two sets of standards and unknowns using the GRIM Compatibility Method to determine which sets are similar in refractive index values.

4. Demonstrate the effects of potential sources of error and how to correct them.

5. Pass the GRIM Compatibility Method practical criterion test.

Required Reading:

1. "Refractive Index." ISP Trace Chemistry Procedures Manual, Section TC-IVB-I.

ILLINOIS STATE POLICE

TRACE CHEMISTRY
TRAINING MANUAL

MODULE: PAINT ANALYSIS

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

Procedures in the Trace Chemistry Procedures Manual for Paint Analysis (TC-V).

UNIT ESTIMATED TIME

128 Days

GOAL

Upon completion of this unit, the trainee will possess the necessary knowledge, skills, and abilities to be proficient in the identification and comparison of paint.

OBJECTIVES

1. The trainee will demonstrate a comprehensive knowledge of paint terminology, technology, chemistry and classification by passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a comprehensive knowledge of the analytical schemes used for paint analysis. This will be accomplished with a score of no less than 80% on a written criterion test.

3. The trainee will demonstrate his/her comprehensive knowledge, skills and abilities to perform macroscopic and microscopic examinations of paints. This will be accomplished with a score of no less than 80% on a written criterion test and a passing score on a practical quiz based on a pass/fail system.

4. The trainee will demonstrate knowledge and skills related to chemical reactivity procedures used in paint analysis. Accomplishment will be based on a score of no less than 80% on a written criterion test and a passing score on a practical quiz based on a pass/fail system.

5. The trainee will demonstrate knowledge and skills related to the application of pyrolysis gas chromatography (PGC) in the analysis of paint. Accomplishment will be based on a score of no less than 80% on a written criterion test and a passing score on a practical quiz based on a pass/fail system.

6. The trainee will demonstrate knowledge, skills and abilities related to the application of Fourier Transform Infrared Spectroscopy (FTIR) in the analysis of paint. Accomplishment will be based on a score of no less than 80% on a written criterion test and a passing score on a practical quiz based upon a pass/fail system.

7. The trainee will demonstrate knowledge, skills, and abilities related to the application of the scanning electron microscope/energy dispersive x-ray system in the analysis of paint. Accomplishment will be based on a score of no less than 80% on a written criterion test and a passing score on a practical quiz based upon a pass/fail system.

8. The trainee will demonstrate his/her comprehensive knowledge of documentation, QA measures, safety precautions, classification, and report wording related to paint analysis by passing a written criterion test with a score of no less than 80%.

9. The trainee will demonstrate his/her comprehensive knowledge and ability to recognize, collect, preserve, and submit paint evidence. This will be accomplished with practical quizzes on a pass/fail system and a score of no less than 80% on a written criterion test.

10. The trainee will demonstrate that he/she can apply the knowledge, skills and abilities required to perform the examination and analysis of paint with 100% accuracy on mock paint cases.

11. The trainee will demonstrate his/her ability to communicate the truth in a manner that is understandable and believable by passing on a pass/fail system a mock court testimony.

12. The trainee will demonstrate that he/she uses proper procedures, evaluations, and conclusions in actual casework based upon verification with cosignatory of reports by an experienced forensic scientist.

LESSON 1

Estimated Time: 5 Days

Purpose: Provide the trainee with background information related to paint. This will include: terminology, technology, chemistry, classifications and historical developments.

Lectures:
Terminology
History of Paint
Types/Classification/Uses
Paint Chemistry
Application Techniques
Defects

Exercises:
1. Complete Part A of the Paint Study Guide.
2. Complete Part A assignments in Paint Introduction.
3. Pass the paint introduction portion of the written criterion test.

Recommended Reading:
1. "How a House Works – Making Latex Paint Better," The Family Handyman, 1993, June, pp. 20-24.
2. Peng, W. & Riedl, B., "Thermosetting Resins," Jour. of Chem. Education, 1995, V. 72, #7, pp. 587-592.
3. CD-Rom "SciQuest", Vol. 1, 1995, Federation of Societies for Coatings Technology.

4. CD-Rom, “Paint and Coating Raw Materials Electronic Handbook,” 1996, Gower Publishing Co.

5. Schneberger, G., Understanding Paint and Painting Processes, 3rd Ed., Hitchcock Publ. Co.

6. Morgans, W., Outlines of Paint Technology, 3rd Ed., 1990, Halsted Press.

7. Lambourne, R., paint & Surface Coatings Theory and Practice, 1987, Ellis Harwood Limited.

8. Brandau, A., Introduction to Coatings Technology, 1990, Federation of Societies for Coatings Technology.

9. McBane, B., Automotive Coatings, 1987, Federation of Societies for Coatings Technology.

10. Pierce, P., Coating Film Defects, 1994, Federation of Societies for Coatings Technology.

11. Levinson, S., Application of Paints and Coatings, 1988, Federation of Societies for Coatings Technology.

12. Jilek, J., Powder Coatings, 1991, Federation of Societies for Coatings Technology.

13. Trace Chemistry Procedures Manual TC-V, pp. 3-6.

14. ASTM Standard, 2012, “Terminology Relating to Paint, Coatings, Materials, and Applications,” ASTM International, West Conshohocken, PA, 2012, DOI:”10.1520/D0016-12.

LESSON 2

Estimated Time: 2 Days

Purpose: Provide the trainee with the analytical schemes used in paint analysis.

Lectures: Analytical Approach to Paint Analysis
General Analytical Flow Charts
Required and Optional Tests

Exercises:
1. Complete Part B of the Paint Study Guide
2. Complete Part B assignments in Paint.
3. Pass the analytical scheme portion of the criterion test.

Recommended Reading:
1. Trace Chemistry Procedures Manual, TC-V, pp. 9-10.

2. ASTM E1610, 2014, "Standard Guide for Forensic Paint Analysis and Comparison," ASTM International, West Conshohocken, PA, 2014, DOI: 10.1520/E1610-14.

3. Thornton, J. I., "Forensic Paint Examination," Forensic Science Handbook, Vol. 1, Saferstein, R., Ed., Prentice-Hall, NJ, 1982, pp. 529-571.

4. Mary, R. W., Porter, J., "An Evaluation of Common Methods of Paint Analysis," Journal of Forensic Science Society, 1975, 15, 2, 137-146.

LESSON 3

Estimated Time: 10 Days

Purpose: The trainee will demonstrate his/her knowledge, skills, and abilities to perform macroscopic and microscopic examinations of paints.

Lectures:
Macroscopic Checks to Include: Physical Match, Color under Different Illuminations
Microscopic Checks to Include: Color, Thickness, Layer Continuity, Surface Defects, Paint Texture, Number of Layers and Sequence, Contaminants, and Inclusions
Thickness Measurement of Paint Layer and Expected Thickness Range
The Use of Edge Matching or Striae for Physical Match
The Use of the Stereomicroscope and Compound Microscope
Information That Must Be Documented
Review Terms in the Description of Paint Surface Characteristics
Criteria for Paint Identification

Exercises:

1. Trainee will complete Part C of the Paint Study Guide
2. Complete set of practice samples provided by the training coordinator. Document your observations and provide information to support findings that a sample is paint.
3. Complete practical quiz provided by the training coordinator. This is a pass/fail quiz. A passing grade with less than 100% correct will require additional unknown samples with 100% correct.
4. Pass the paint portion of the written criterion test.

Recommended Reading:

1. Laing, D. K., Locke, J., Richard, R. A., and Wilkinson, J. M., "The Examination of Paint Films and Fibers as Thin Sections," The Microscope, Vol. 35, No. 3, 1987, pp. 233-248.

2. Trace Chemistry Procedures Manual, "Minimum Standards & Controls", TC-V, p. 6-8.

3. Trace Chemistry Procedures Manual, "Microscopic Examination," TC-VA-1, pp. 1-3.

4. Ryland S. G., et al, "The Evidential Value of Automobile Paint. Part II: Frequency of Occurrence of Topcoat Colors," Journal of Forensic Sciences, 1981, 26, 1, 64-74.

5. ASTM E1610, 2014, "Standard Guide for Forensic Paint Analysis and Comparison," ASTM International, West Conshohocken, PA, 2014, DOI: 10.1520/E1610-14.

6. Ryland, S. G., Kopec, R. J., "The Evidential Value of Automobile Paint Chips," Journal of Forensic Sciences, 1979, 24, 1, 140-147.

7. Gothard, J. A., "Evaluation of Automobile Paint Flakes as Evidence," Journal of Forensic Sciences, 1976, 21, 3, 636-641.

8. Hamer, P. S., "Pigment Analysis of the Forensic Examination of Paints III. A Guide to Motor Vehicle Paint Examination by Transmitted Light Microscopy," *Journal of Forensic Science Society*, 1982, 22, 22, 187-192.

9. Cartwright, L. J., Cartwright, N. S., Norman, E. W. W., Cameron, R., MacDougall, D. A., Clark, W. H., "The Classification of Automotive Paint Primers Using the Munsell Color Coordinate System – A Collaborative Study," *Canadian Society of Forensic Science Journal*, 1984, 17, 14-18.

10. Thornton, J. I., "Visual Colour Comparisons in Forensic Science," *Forensic Science Review*, 1997, 9:37-57.

LESSON 4

Estimated Time: 5 Days

Purpose: The trainee will demonstrate knowledge and skills related to the proper use of chemical reactivity procedures in paint analysis.

Lectures:
Types and Purpose of the Chemical Reagents Used
Documentation of Results, Immediate Reactions and Set Time Intervals
Characteristics to Be Check Include: Softening, Swelling, Curling or Wrinkling, Layer Desolution, Pigment Filler Effervescence, Flocculation, and Color Changes or Dye Solubility
QA Measures for Use of Chemical Reactivity Tests
Safety Precautions

Exercises:
1. Complete Part D of the Paint Study Guide.
2. Prepare chemical reagents. Complete set of practice samples provided by the training coordinator. Document your observations.
3. Complete practical quiz provided by the training coordinator. This is a pass/fail quiz. A passing grade with less than 100% correct will require additional unknown samples with 100% correct.

4. Pass chemical reactivity portion of the written criterion test.

Recommended Reading:

1. Trace Chemistry Procedures Manual "Minimum Standards & Controls" TC-V, pp. 6-8.

2. Trace Chemistry Procedures Manual "Chemical Reactivity", TC-VB-1, pp. 1-5.

LESSON 5

Estimated Time: 10 Days

Purpose: The trainee will demonstrate that he/she can explain the operation of the pyrolysis gas chromatograph (PGC) in terms understandable to a jury and can operate the instrument to provide the data required for paint analysis.

Lectures: Instrument Conditions for PGC. Factors That Will Effect the Pyrogram: Pyrolytic Temperature and Time, Temperature of Interface, Pyrolytic Temperature Ramp Rate
How to Perform Comparative Analysis of Pyrograms
Sample Prep
QA Measures for the Use of PGC in Paint Analysis

Exercises:

1. Must have successfully completed the unit on gas chromatography or demonstrated proficiency in gas chromatography with passing scores on written and practical tests.
2. Complete Part E of the Paint Study Guide.
3. Successfully complete an oral quiz on the explanation of the GC operation and interpretation of the data. This is a pass/fail quiz.
4. A set of known samples will be provided by the training coordinator. The trainee will set up a method and run the samples. The trainee must obtain data to support his/her opinion concerning a match between the paints.
5. A set of unknown samples will be provided by the training coordinator. The trainee must provide documentation to support answers and must obtain a passing grade on a pass/fail system.
6. Pass the PGC portion of the criterion test.

Recommended Reading:

1. Trace Chemistry Procedures Manual, "Pyrolysis Gas Chromatography Analysis" TC-VB-2, pp. 1-6.

2. Trace Chemistry Procedures Manual, "Minimum Standards & Controls," TC-V, pp. 6-8.

3. Trace Chemistry Training Manual, "Gas Chromatography," TC-IA-1.

4. Stewart, W. D., Jr., "Pyrolysis-Gas Chromatographic Analysis of Automotive Paints," Journal of Forensic Science, Vol. 19, No. 1, 1974, pp. 121-129.

5. Irwin, W. J., "Analytical Pyrolysis-An Overview," Journal of Analytical and Applied Pyrolysis, Vol. 1, No. 1, 1979, pp. 3-25.

6. Windig, W., Kistemaker, P. G., and Haverkamp, J., "The Effects of Sample Preparation, Pyrolysis and Pyrolyzate Transfer Conditions on Pyrolysis Mass Spectra," Journal of Analytical and Applied Pyrolysis, Vol. 1, No. 1, 1979, pp. 39-52.

7. McMinn, D. G., Carlson, T. L., and Munson, T. O., :Pyrolysis Capillary Gas Chromatography/Mass Spectrometry for Analysis of Automotive Paints," Journal of Forensic Sciences, Vol. 30, No. 4, 1985, pp. 1064-1073.

8. Blackledge, R. D., "Application of Pyrolysis Gas Chromatography in Forensic Science," Forensic Science Review, Vol. 4, No. 1, 1992,pp. 2-15.

9. See Reference #5 in Lesson 3.

LESSON 6

Estimated Time: 10 Days

Purpose: The trainee will demonstrate that he/she can explain the operation of the Fourier Transform Infrared Spectrometer (FTIR) in terms understandable to a jury and can operate the instrument to provide the data required for paint analysis.

Lectures:
Operation, Theory and Instrument Parameters Related to the FTIR Microscope
QA Measures for the Use of FTIR in Paint Analysis
Sample Prep and Thin Sections
Guidelines Used for Interpretation and Classification Related to Paint Analysis
Guidelines Used for Comparative Analysis
Sensitivity Limit >5% for Paint Vehicle Component

Exercises:

1. Must have successfully completed the unit on FTIR or demonstrated proficiency in FTIR with passing scores on written and practical tests.
2. Complete Part F of the Paint Study Guide.
3. Successfully complete an oral quiz on the explanation of the FTIR operation and interpretation of the data. This is a pass/fail quiz.
4. Perform analysis on practice samples. Provide complete documentation to support your findings and explain your conclusion to the training coordinator.

5. Analyze a set of unknowns provided by the training coordinator. This is a practical quiz which requires a passing score on a pass/fail scoring system.
6. Pass FTIR portion of the criterion test.

Recommended Reading:

1. Trace Chemistry Procedures Manual, "Minimum Standards & Controls," TC-V, pp.6-8.

2. Trace Chemistry Procedures Manual, "Fourier Transform Infrared Spectrometer (FTIR) Analysis," TC-VB-3, pp. 1-8.

3. Trace Chemistry Training Manual, "Fourier Transform Infrared Spectrometer (FTIR)," TC-IA-3.

4. Laing, D. K., Locke, J., Richard, R. A., and Wilkinson, J. M., "The Examination of Paint Films and Fibers as Thin Sections," The Microscope, Vol. 35, No. 3, 1987, pp. 233-248.

5. Tweed, F. T., et al., "The Forensic Microanalysis of Paints, Plastics and Other Materials by an Infrared Diamond Cell Technique," Forensic Science, Vol. 4, 1974, pp. 211-218.

6. Tilman, V. L., "Automotive Paint Binder Infrared Classification Flowchart," 1991.

7. Audette, R. J., Percy, R. F. E., " A Rapid, Systematic, and Comprehensive Classification System for the Identification and Comparison of Motor Vehicle Paint Samples, I: The Nature and Scope of the Classification System," J. Forensic Sci, 1979, 24:790-807.

8. Cartwright, L. J., Cartwright, N. S., Rodgers, P. G., :A Mocrotome Technique for Sectioning Multilayer Paint Samples for Microanalysis," Can. Soc. Forensic Sci. J., 1977, 10:7-12.

9. Cassita, A. C., Sandercock, P. M. L., "Comparison and Identification of Automotive Topcoats; Microchemical Spot Tests, Microspectrophotometry, Pyrolysis-Gas Chromatography, and Diamond Anvil Cell FITR," Can. Soc. Forensic Sci. J., 1994, 27:209-223.

10. See Reference #5 in Lesson 3.

LESSON 7

Estimated Time: 5 Days

Purpose: The trainee will demonstrate his/her ability to explain and properly operate the scanning electron microscope (SEM)/energy dispersive x-ray system (EDX), perform the required troubleshooting and quality assurance measures, and interpret EDX data related to paint analysis.

Lectures: Instrument Parameters for Paint Analysis
QA Measures for the Use of SEM/EDX in Paint Analysis
Sample Prep and Mounting Samples
Guidelines for Interpretation
Stress A 10x10 µm Scan Area of SEM Will Generate X-Rays from a Depth of 10 µm and a Surface Area of 20 µm x20 µm.
Sensitivity Limit for Paint. Elements must be > 0.8%.

Exercises:
1. Must have successfully completed the unit on SEM/EDX or demonstrated proficiency in SEM/EDX with passing scores on written and practical tests.
2. Complete Part G of the Paint Study Guide.
3. Successfully complete an oral quiz on the explanation of the SEM/EDX operation and interpretation of the data. This is a pass/fail quiz.
4. Perform analysis on practice samples. Provide complete documentation to support your findings and explain your conclusion to the training coordinator.
5. Analyze a set of unknowns provided by the training coordinator. This is a practical quiz which requires a passing score on a pass/fail scoring system.
6. Pass the SEM/EDX portion of the criterion test.

Recommended Reading:
1. Trace Chemistry Procedures Manual, "Minimum Standards & Controls," TC-V, pp. 6-8.
2. Trace Chemistry Procedures Manual, "Scanning Electron Microscope/Energy Dispersive X-Ray," TC-VB-4, pp. 1-6.
3. Trace Chemistry Training Manual, "Scanning Electron Microscopy/Energy Dispersive X-Ray," TC-IA-5.

LESSON 8

Estimated Time: 2 Days

Purpose: The trainee must demonstrate that he/she knows the proper documentation, QA measures, safety precautions, classification, and report wording related to paint analysis.

Lectures: Markings and Proper Completion of the Worksheet
QA Measures
Safely Working with Paint Chemicals
Report Wording

Exercises:
1. The trainee will describe to the training coordinator how he/she would document work performed and what safety measures would be practiced.
2. The trainee will describe the QA measures required for each type of test performed and general QA measures for paint analysis.

3. The trainee will provide the correct report wording for various scenarios presented by the training coordinator.
4. Complete Part H of the Paint Study Guide.
5. Pass portion of the criterion test that deals with subject matter covered in Lesson 8.

Recommended Reading:

1. Trace Chemistry Procedures Manual, "Introduction," TC-V.

2. Trace Chemistry Procedures Manual, "Report Wording."

3. Trace Chemistry Procedures Manual, "Minimum Standards & Controls," TC-V, pp 6-8.

4. Trace Chemistry Procedures Manual, TC-VB-3, pp. 5-6.

LESSON 9

Estimated Time: 2 Days

Purpose: The trainee will demonstrate that he/she knows and can apply the proper action related to the recognition, collection, preservation and submission of paint evidence.

Lectures:
Proper Collection Technique Includes Collection of Paint Chips from Areas Immediately Adjacent to Damaged Area or Points of Transfer. The Sample Collected Should Include All Layers Methods to Remove Paint Chips
Preservation Means to Properly Secure Chips in Evidence Container and Avoid Attaching Sample on Tape
Proper Documentation Before Removal of Transferred Chips
Review Importance of Physical Match
Screening Clothing for Paint Chips

Exercises:

1. Materials will be provided by the training coordinator. The trainee will demonstrate to the training coordinator the proper approach for checking and removal of any paint chips. This includes paint standards.
2. The trainee will demonstrate the proper method to package the paint evidence and proper documentation.
3. Pass the portion of the criterion test that deals with the subject matter covered in Lesson 9.

Recommended Reading:

1. Trace Chemistry Procedures Manual, "Collection and Preservation of Evidence," TC-App III, pp 8-9.

2. McDermott, S. D., Willis, S. M., "A Survey of the Evidential Value of Paint Transfer Evidence," J. Forensic Sci., 1997, 42(6): 1012-1018.

LESSON 10

Estimated Time: 35 Days

Purpose: The trainee must provide the correct answers for the analysis of mock paint evidence. This represents the general unknowns for this unit of study. The trainee will pass the written criterion test.

Lectures: None

Exercises:
1. Thirty mock samples will be given to the trainee. This may be distributed as 15 mock cases. This is a criterion practical test and the trainee must get a score of 100%.
2. The trainee will pass the written criterion test for the unit with a score of no less than 80%.

Recommended Reading:
1. Trace Chemistry Procedures Manual, "Paint Analysis," TC-V.

LESSON 11

Estimated Time: 40 Days

Purpose: The trainee must demonstrate the ability to testify in court about the findings and conclusions derived from his/her analysis.

Lecture: Tips on Testimony in Paint

Exercises:
1. Trainee will develop a curriculum vitae.
2. Trainee will generate a list of qualifying questions.
3. The trainee will receive a passing score based on a pass/fail system for his/her testimony on a mock case.

Recommended Reading:
1. Trace Chemistry Resource Manual on Court Testimony.

LESSON 12

Estimated Time: 40 Days

Purpose: The trainee must demonstrate that he/she will provide correct analysis on actual case samples.

Lectures: Review of Ethical Responsibilities in Casework
Service to Law Enforcement Agencies
Case and Individual Activity Reports

Exercises: 1. Trainee will receive and analyze a minimum of 20 cases under the direct supervision of an experienced examiner. Reports will be signed by both individuals.

Recommended Reading:

1. Forensic Sciences Command Quality Manual.
2. Forensic Sciences Command Directives Manual.

ILLINOIS STATE POLICE

TRACE CHEMISTRY
TRAINING MANUAL

MODULE: PAINT DATA QUERY (PDQ)

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

Procedures in the Trace Chemistry Procedures Manual for Make, Model, Year Determination (TC-VC-2).

PREREQUISITE REFERENCE

Trace Chemistry Procedure Manual for Paint TC-V.

UNIT ESTIMATED TIME

15 Days

GOAL

Upon completion of this module, the trainee will possess the necessary knowledge, skills, and abilities to be proficient in determining the possible make, model, and year range of unknown automotive paint chips.

OBJECTIVES

1. The trainee will demonstrate knowledge, skills, and abilities in sampling and analyzing the individual layers of an automotive paint chip using either the bench or microscope accessory on the FTIR as observed and evaluated by the training coordinator on a pass/fail basis.

2. The trainee will demonstrate a comprehensive knowledge in determining if a paint chip is Original Equipment Manufacturer (OEM) or a refinish as observed and evaluated by the training coordinator on a pass/fail basis.

3. The trainee will demonstrate a comprehensive knowledge on how to determine the chemical components of a paint chip based on the FTIR spectra and be able to code the components using RCMP's coding system as observed and evaluated by the training coordinator on a pass/fail basis.

4. The trainee will demonstrate knowledge in using the Munsell Color Coordinate System as observed and evaluated by the training coordinator on a pass/fail basis.

5. The trainee will demonstrate a comprehensive knowledge on how to search the PDQ automotive paint database as observed and evaluated by the training coordinator on a pass/fail basis.

6. The trainee will demonstrate a comprehensive knowledge on how to effectively use the spectral search library software to narrow down a hit list of possible manufacturers, plants, and years as observed and evaluated by the training coordinator on a pass/fail basis.

7. The trainee will demonstrate knowledge on how to use the refinish color collection books to narrow down the possible make, model, and year list as observed and evaluated by the training coordinator on a pass/fail basis.

8. The trainee will demonstrate a knowledge in determining the possible vehicle models by using Automotive News magazine and other printed resources as observed and evaluated by the training coordinator on a pass/fail basis.

9. The trainee will discuss options for report wording as observed and evaluated by the training coordinator on a pass/fail basis.

LESSON 1

Estimated Time: 1 Day

Purpose: Introduction to PDQ, background behind the PDQ database, and characteristics of automotive paint (how it is applied and the type of layers seen in a typical automotive paint system).

Lectures: What is PDQ
A database maintained by the Royal Canadian Mounted Police (RCMP) that contains over 18,000 samples (over 70,000 individual paint layers) representing the paint systems used on most domestic and foreign vehicles marketed in North America. Each year over 500 samples are added to the international automotive paint database.

Significance of PDQ
The paint systems on an automobile typically have three or four layers. Automotive manufacturers and their suppliers tend to use unique combinations of pigments and binders in each of these layers. It is this unique combination that allows forensic scientist to determine the possible make, model, and year range for the vehicle that a paint chip may have originated from.

History of PDQ
Studies conducted over 30 years ago by the RCMP forensic laboratory system showed that vehicles could be differentiated by comparing the color, layer sequence, and chemical composition of each individual layers in a paint system.

The Different Layers Of An Automotive Paint System, Their Purposes And How They Are Applied To The Vehicle

Required Reading:

1. PDQ Workshop notebook: Section 1, 2 and 3.

2. Buckle, J.L., MacDougall, D.A., and Grant, R.R., "PDQ – paint data queries: The history and technology behind the development of the Royal Canadian Mounted Police Forensic Laboratory Services automotive paint database," Can. So. For. Sci. J., Vol. 30, No. 4, 1997, pp. 199-212.

3. Bishea, G., Buckle, J., and Ryland, S., "International forensic automotive paint database." Proceedings of SPIE Conference, Investigation and Forensic Science Technologies, International Society for Optical Engineering, Vol. 3576, February, 1999, pp. 73-76.

LESSON 2

Estimated Time: 1 Day

Purpose: The trainee will be able to take an automotive paint chip and slice the layers individually, mount the layers onto a sampling device, and analyze each layer separately on the FTIR.

Lectures: The Importance Of Getting Clean Slices Of Each Layer

Slicing A Sample Using Different Types Of Scalpels, Techniques, And Microtome

The Different Possible Sampling Devices That Can Be Used On The FTIR (Scope, Compression Cells, Etc.)

Exercises:

1. The trainee will demonstrate to the training coordinator a proper technique in getting clean slices of each layer of paint in an automotive paint system and be able to mount them onto an acceptable sampling device for FTIR analysis (KBr crystal, diamond compression cell, etc.).

2. The trainee will analyze each layer by FTIR and obtain acceptable and usable spectra.

Required Reading:

1. ISP R&D Laboratory "Preparations of Thin Sections of Paint for Fourier Transform Infrared (FTIR) Microscopic Analysis", ISP Trace Memo, 02-TRACE-7.

2. Ryland, S.G., "Infrared Microspectroscopy of Forensic Paint Evidence," Chapter 6, Practical Guide to Infrared Microspectroscopy, Humecki, H.J., ed., Marcel Dekker, Inc., 1995, pp. 177-185.

LESSON 3

Estimated Time: 1½ Days

Purpose: The trainee will look at FTIR spectra of a paint sample and be able to determine the chemical components of the paint sample and label the samples using PDQ's coding system.

Lectures: Determination Of Chemical Components In A Paint Layer By FTIR Analysis (Binder Types, Fillers), What To Look For

The Codes Used In PDQ

The Differences Seen In Each Layer And How It Can Sometimes Be Determined What Layer A Paint Is From, By Its Components

Exercises:

1. The trainee will take the FTIR spectra produced from the previous lesson, figure out the chemical components, and code them using RCMP's coding system.
2. The trainee will take an additional 5 sets of FTIR spectra from different paint systems and code each layer.

Required Reading:

1. PDQ Workshop notebook: Section 5.
2. Ryland, S.G., "Infrared Microspectroscopy of Forensic Paint Evidence," Chapter 6, <u>Practical Guide to Infrared Microspectroscopy</u>, Humecki, H.J., ed., Marcel Dekker, Inc., 1995, pp. 185-209.
3. Rodgers, P.G., et al, "The Classification of Automobile Paint by Diamond Cell Window Infrared Spectrophotometry – Part I: Binders and Pigments", Canadian Society of Forensic Science Journal, 9 (1), pp. 1-14, 1976.
4. Rodgers, P.G., et al, "The Classification of Automotive Paint by Diamond Window Infrared Spectrophotometry – Part II: Automotive Topcoats and Undercoats," Canadian Society of Forensic Science Journal, 9 (2), pp. 49-68, 1976.

LESSON 4

Estimated Time: ½ Day

Purpose: The trainee will look at a paint chip and be able to determine if the paint chip is OEM paint or refinish paint based upon the stereoscopic properties of the paint and/or the FTIR spectra of the layers.

Lectures: Determining If The System Is OEM Or Repaint By Physical Appearance

Determining If The System Is OEM Or Repaint By Chemistry

Exercises:

1. The trainee will look at various paint chips and try to determine if they are OEM or a repaint based upon stereoscopic examination.

2. The trainee will take the spectra from Lesson 3 and try to determine if the spectra are from an OEM paint system or a repaint.

Required Reading: None

LESSON 5

Estimated Time: 1 Day

Purpose: The trainee will learn about the PDQ software, the different possible searches that can be performed on the PDQ database, how to get a hit list, and how to narrow down a hit list. The trainee will also become familiar with Munsell Color System, how it works, and how it applies to PDQ.

Lectures: Layer System Query (LSQ) And How To Enter Data

Editing LSQ Searches (What Components To Look To Exclude If The Hit List Is Too Large)

Fill In The Blank Query (FITB)

The Different Ways To Display The Hit List Results And What Documentation Is Required For Casework

What Is The Munsell Color System And How Is It Used In PDQ

Exercise: The trainee will take the codes of the suspected OEM spectra from Lesson 3 and enter them into the PDQ database to generate a hit list for each paint system.

Required Reading:

1. PDQ Workshop Notebook: Sections 4 and 6.

2. The Munsell Book of Color Collection.

LESSON 6

Estimated Time: 2 Days

Purpose: The trainee will be able to take a hit list from PDQ and do a spectral library search to narrow the hit list down into possible makes, plants, and years. The trainee will know the different types of searches available and be able to determine what constitutes a significant difference when comparing spectra.

Lectures: The Use Of The Know It All Software (Or Other Spectral Library Search Software)

Loading Unknown Spectra Into The Spectral Library Search Software

How PDQ Labels The Standards In The Spectral Search Software

Extracting A Specific Layer Or Layer System From The PDQ Libraries

Spectral Searching Vs. Name Searching Vs. Combination Searching

What To Enter When Doing A Name Search

How To Narrow Down The Year Range

How To Generate A Report And What Documentation Is Required For Casework

Exercise: The trainee will take 1-2 hit lists (and associated spectra) generated in Lesson 5 and the hit list and spectra of the paint generated in Lesson 2 and do a search to determine the possible makes, plants, and years of those paint systems.

Required Reading:

1. PDQ Workshop notebook: Section 7.

LESSON 7

Estimated Time: ½ Day

Purpose: The trainee will be able to narrow the year range down by using the Refinish Color Collection books. The trainee will also be able to determine the possible vehicle models of a paint system by using the Automotive News magazine and other resources.

Lectures: How To Use The Refinish Color Collection Books To Narrow Down Year Range

How To Determine The Possible Vehicle Models By Using The Automotive News Magazine

Exercises:

1. The trainee will take the year ranges of the paint systems from Lesson 6 and see if the year ranges can be narrowed down by using the Refinish Color Collection.

2. The trainee will determine the possible vehicle models by using the Automotive News magazine and other information in Section 3 of the Content Manual supplied by RCMP.

Required Reading:

1. PDQ Workshop notebook: Section 8.

LESSON 8

Estimated Time: ½ Day

Purpose: Introduction to report wording and court testimony.

Lectures: Possible Results From PDQ Analysis

A. A possible list of makes, models, and years, was produced
B. The paint does not appear to be OEM
C. The hit list is too large for meaningful results
D. No hits were observed

Report Wording

The Necessary Information And Documentation Needed In A Casefile

Testimony And Pre-Trial Qualifying Questions

A. Limitations of PDQ – not every single paint layer in PDQ
B. Significance of PDQ – over 18,000 paint layer systems in database (over 70,000 layers overall) and growing every year

Exercise: The trainee will write a mock report of the results from the exercise in Lesson 7.

Required Reading: None

LESSON 9

Estimated Time: 4 Days

Purpose: The trainee will be able to determine the possible make, model, and years of practical paint layer sets.

Lectures: None

Exercises:

1. The trainee will receive 1-2 paint chips from the training coordinator, analyze the layers by FTIR and utilize PDQ to identify possible make, model, and year range information.

2. The trainee will write a sample report for one of the paint sample sets.

Required Reading: None

LESSON 10

Estimated Time: 3 Days

Purpose: The trainee must provide the correct answers for the analysis of mock PDQ evidence. This represents the general unknowns for this unit of study.

Lectures: None

Exercise: One mock paint sample will be given to the trainee. The trainee will section the layers of the paint, do a complete PDQ analysis, write a mock report and include all necessary paperwork in a casefile. This is a criterion practical test and the trainee must get a score of 100%.

Required Reading: None

ILLINOIS STATE POLICE

TRACE CHEMISTRY
TRAINING MANUAL

MODULE: COLLECTION AND PRESERVATION OF PRIMER GUNSHOT RESIDUE

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

None

UNIT ESTIMATED TIME

½ Day

GOAL

To achieve the necessary knowledge, skills and abilities to properly accept, collect, and preserve primer gunshot residue evidence.

OBJECTIVES

1. The trainee will become familiar with gunshot residue: its definition, its deposition, its composition, its transfer properties, and its examination. Successful completion of this assignment will be determined by the training coordinator on a pass/fail basis.

2. The trainee will learn to determine what types of evidence to accept and the appropriate information needed by Trace examiners. Successful completion of this assignment will be determined by the training coordinator on a pass/fail basis.

3. The trainee will learn how to collect, preserve, and document primer gunshot residue evidence. Successful completion of this assignment will be determined by the training coordinator on a pass/fail basis.

4. The trainee will demonstrate his/her ability to explain sample documentation and the proper collection of samples. This will be evaluated through an oral quiz on a pass/fail basis.

LESSON 1

Estimated Time: ½ Day

Purpose: To teach the trainee about gunshot residue and how to collect and preserve primer gunshot residue.

Lecture: Gunshot Residue Definition, Collection, and Documentation

Exercises:

1. Definition of gunshot residue, primer gunshot residue, interpretation of case acceptance policy, and discussion on how to determine what type of analysis required.
2. Discussion of various evidence types and collection areas.
3. Demonstration on the collection, preservation, and documentation process.

ILLINOIS STATE POLICE

TRACE CHEMISTRY
TRAINING MANUAL

MODULE: AUTOMATED PRIMER GUNSHOT RESIDUE ANALYSIS USING SEM/EDX AND BIBLIOGRAPHY

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

PROCEDURAL REFERENCE

This training is for the automated scanning electron microscope/energy dispersive x-ray (SEM/EDX) analysis of primer gunshot residue (PGSR). It can employ the training module for SEM/EDX (TC-IA-5).

UNIT ESTIMATED TIME

4 Months

GOAL

To achieve the necessary knowledge, skills and abilities associated with the SEM/EDX for performing automated PGSR analysis and identifying primer gunshot residue.

OBJECTIVES

1. The trainee will demonstrate a comprehension of the knowledge of primer gunshot residue by passing a written criterion test with a score of no less than 80%.

2. The trainee will demonstrate a practical knowledge of the interpretation of primer gunshot residue particles by passing a written criterion test with a score of no less than 80%.

3. The trainee will demonstrate his/her ability to explain and properly operate the SEM/EDX, perform the required troubleshooting, routine maintenance, and Quality Assurance measures, and interpret the data. This will be evaluated with oral and practical quizzes on a pass/fail basis.

4. The trainee will develop a reference collection of primer gunshot residue particles that will serve as a basis for identifying such particles.

5. The trainee will demonstrate his/her knowledge and ability to recognize, collect, preserve, and prepare PGSR evidence. This will be accomplished by oral and practical quizzes on a pass/fail basis.

6. The trainee will demonstrate that he/she can apply the knowledge, skills, and abilities required to perform the examination and analysis of PGSR with a 100% on mock PGSR cases.

7. The trainee will demonstrate that he/she uses proper procedures, evaluations, and conclusions in actual casework based upon verification with cosignatory of reports by an experienced forensic scientist.

8. The trainee will demonstrate his/her ability to communicate the truth in a manner that is understandable and believability by passing on a pass/fail system a mock court testimony.

LESSON 1

Estimated Time: 2 Weeks

Purpose: To familiarize the trainee with the operational control of the automated SEM and utilization of the EDX system.

Lecture: Components of SEM/EDX
Function and Operation of the Components
Functional Capabilities of the Software for Manual and Automated Operations
Primer Gunshot Residue Software Package
Maintenance of the SEM

Exercises:

1. Read assigned material.
2. Demonstrate the ability to operate the instrument and produce an image with spectra and the associated printout.
3. Demonstrate the ability to perform routine maintenance.
4. Develop a reference collection of pure reference powders and mixture of pure powders.
5. Demonstrate the ability to identify sample elemental components.
6. Demonstrate the ability to perform automated analysis.

Recommended Reading:

1. SEM User and Operations Manual.

2. Bibliography of journal articles on primer gunshot residue analysis.

LESSON 2

Estimated Time: 4 Weeks

Purpose: To provide trainee with the definition of a primer gunshot residue particle and the ability to identify them using SEM/EDX.

Lectures: Aerospace Report
Primer Manufacture and Composition
Discussion of Journal Articles
Particle Types

Exercises:

1. Read assigned materials.
2. Complete the associated study guides.
3. Develop a reference collection of PGSR particle types.

Recommended Reading:

1. Bibliography of journal articles on primer gunshot residue analysis.

LESSON 3

Estimated Time: 10 Weeks

Purpose: To familiarize the trainee with the automated operation of the SEM/EDX system for PGSR analysis.

Lectures:
Automated System Operation
Sample Preparation
Data Interpretation
ISP Protocol and Validation Study
Study Guide Discussions

Exercises:
1. Automated analysis of previously analyzed discharge samples.
2. Complete study guides.
3. Pass written criterion test with score of 80% or better.
4. Pass particle identification criterion test with score of 80% or better.
5. Complete mock cases/mock trial.

Recommended Readings:
1. ISP PGSR Procedure.
2. ISP PGSR Validation Study.

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TRACE CHEMISTRY TRAINING MANUAL

APPENDIX A-1: TRAINING CHECKLIST

Reviewed by:

Forensic Scientist Robert A. Dubbert, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

William E. Demuth II
Director of Training

INITIAL FORENSIC SCIENCE TRAINING CHECKLIST
TRACE CHEMISTRY

Trainee: ______________________ Coordinator: ______________________

Training Start Date: ______________ Training End Date: ______________

Module	Completion Date	Trainee Initials	Coordinator Initials
General Forensic Science			
Ethics in Forensic Science			
Courtroom Training for Trace Chemistry			
Gas Chromatography			
Mass Spectrometry			
Fourier Transform Infrared Spectroscopy			
X-Ray Diffraction			
Scanning Electron Microscopy/Energy Dispersive X-Ray			
Fire Debris – Ignitable Liquids			
Explosives			
Glass			
Glass Refractive Index Measurement Instrumentation			
Paint Analysis			
Paint Data Query			
Collection and Preservation of Primer Gunshot Residue			
Automated Primer Gunshot Residue Analysis Using SEM/EDX and Bibliography			
Lamp Filament Analysis			
Supervised Casework			

If a module was not completed, mark it as “NC” (“Not completed”).

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TRACE CHEMISTRY TRAINING MANUAL

APPENDIX A-2: AUTHORIZATIONS BASED ON SCOPE

Reviewed by:

Forensic Scientist Alan Osoba, Chairperson
Trace Chemistry Command Advisory Board

Approved by:

Sandra N. Brown
Acting Director of Training

AUTHORIZATIONS BASED ON SCOPE

Field of Testing: Forensic Testing Forensic Scientist: ______________________

Category: Trace Chemistry

Sub Catergory: Flammables

Analytical Technique	Authorized
1.4 Screening Techniques: Solubility	
2.1 Chromatography: Gas Chromatography	
3.1 Spectroscopy: Infrared	
3.2.1 Spectroscopy: Gas Chromatography/Mass Spectrometry	
4.3 Physical Examination: Performance Evaluation	
4.5 Physical Examination: Pattern Recognition	
6.4 General Laboratory Procedures: General Laboratory Techniques	

Sub Category: Paint / Paint Data Query (PDQ)

Analytical Technique	Authorized
1.2 Screening Tests: Color	
1.4 Screening Tests: Solubility	
2.1 Chromatography: Gas Chromatography	
3.1 Spectroscopy: Infrared	
3.2.1 Spectroscopy: Gas Chromatography/Mass Spectrometry	
3.7 Spectroscopy: Energy Dispersive X-ray (EDX)	
4.1 Physical Examination: Physical Measurements	
4.3 Physical Examination: Performance Evaluation	
4.4 Physical Examination: Database Comparison	
5.1 Microscopy: Optical	
5.2 Microscopy: Scanning Electron Microscope (SEM)	
6.4 General Laboratory Procedures: General Laboratory Techniques	

Sub Category: Glass Refractive Index Measurement (GRIM) Instrumentation

Analytical Technique	Authorized
1.2 Screening Tests: Color	
1.4 Screening Tests: Solubility	
4.1 Physical Examination: Physical Measurements	
4.2 Physical Examination: Striation/Impression/Mark Comparison	
4.4 Physical Examination: Population Database Comparison	
4.5 Physical Examination: Pattern Recognition	
5.1 Microscopy: Optical	
6.4 General Laboratory Procedures: General Laboratory Techniques	

Sub Category: Automated Gunshot Residue (PGSR) Analysis Using SEM/EDX

Analytical Technique	Authorized
3.7 Spectroscopy: EDX	
5.1 Microscopy: Optical	
5.2 Microscopy: SEM	
6.4 General Laboratory Procedures: General Laboratory Techniques	

ILLINOIS STATE POLICE
DIVISION OF FORENSIC SERVICES
FORENSIC SCIENCES COMMAND

AUTHORIZATIONS BASED ON SCOPE

These are the areas under which I am authorized to conduct casework.

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Forensic Scientist / Date

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Training Coordinator / Date

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Director of Training / Date