Department of Forensic Science

FIREARM/TOOLMARK FORENSIC SCIENTIST TRAINING MANUAL

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1 INTRODUCTION AND ORIENTATION

1.1 Purpose and Scope

1.1.1 The purpose of this manual is to provide a uniform coordination of the training of forensic Firearms and Toolmarks employed by the Commonwealth of Virginia. This work is intended to be used in a formal training program that will establish a certain minimum standard of professional competency throughout the statewide branches of the Department of Forensic Science.

1.1.2 Certain inherent qualities of firearm and toolmark evidence prohibit the establishment of a rigid set of standard procedures to cover each and every case. Therefore, enough latitude has been given to allow for independent thought and individual freedom in selecting alternative courses of action. Upon completion of this program the trainee will be thoroughly familiar with the options available to handle most pieces of evidence that will be encountered.

1.1.3 The sequence in which the tasks are presented in the outline should not necessarily be considered as a mandatory order of instruction. Exposure to legal aspects and testimony will be continuous throughout the training.

1.2 Coordination of the Program

1.2.1 Unless otherwise designated by the Physical Evidence Program Manager, the Training Coordinator (TC) will be the Section Supervisor in each lab.

1.2.2 The TC will be responsible for the overall training, but may delegate certain duties and blocks of instruction to other qualified examiners.

1.2.3 The TC should arrange training with the other three laboratories.

1.3 Training Period

1.3.1 The length of the training period is approximately 24 months. Certain individuals may require less time than others, depending on experience, education, or learning ability.

1.3.2 Under the direct supervision of a qualified examiner, the trainee will assist with casework throughout the training period. This will familiarize the trainee with different forms of case evidence, packaging, applied analytical techniques and note-taking.

1.4 Location Of Training

Whenever practical, the bulk of an individual's training will occur in the lab to which they will be assigned**.**

1.5 Training Goals

The training shall culminate so that the trainee has the following:

- The knowledge of tool, firearm, and ammunition manufacturing.
- The knowledge of the principles and practices of tool actions and marks imparted by each class of tool.
- The knowledge of the principles and practices of firearm actions and marks imparted by each tool working surface of a firearm.
- The knowledge of the theory and applications of the variety of microscopic techniques used in the analysis and comparison of evidence.
- The knowledge of the theory and practices of serial number restoration.
- The knowledge of the principles and practices of distance determination.
- The ability to perform accurate forensic analysis independently and proficiently.
- The ability to skillfully present and defend analytical findings in courts of record.

1.6 Instructions to the Trainee

1.6.1 The trainee is expected to keep a notebook of information compiled for each Module of this manual. This notebook will be evaluated by the TC throughout the course of the training and by the Program Manager and Quality Assurance Coordinator upon completion of the training.

1.6.2 The written answers to the study questions listed in each section will be used as reference material once the trainee is qualified as an examiner. Therefore, references are to be listed for each answer whenever possible. The completed study questions are to be turned into the TC as scheduled. A list of useful references has been provided in the Reference section of each module.

1.6.3 References listed as "Required Reading" are required for an adequate understanding of the subject matter. Required readings are designated by section numbers listed after the assignment.

1.6.4 The trainee's progress will be evaluated with written examinations, practical exercises, practical examinations, oral sessions, mock trials and competency examinations. Passing for a written examination is at least 85% correct responses. Passing for a practical examination is arriving at the expected result. See sections 1.8 and 1.9 for information on mock trials and competency examinations.

1.6.5 Oral sessions are question and answer sessions that will be conducted throughout the training period. They will be cumulative. There will be two different types of expected responses. First, there will be technical responses. Second, there will also be times were the trainee will need to respond as if speaking to a jury. It will be made clear during the question which type of response is expected. Oral Session Rubric (DFS Form 240-F136) shows the trainee what will be expected of them in these oral sessions. This rubric will be used to evaluate the trainee during the oral sessions.

1.6.6 The trainee should provide a monthly written progress report to the TC.

1.7 Instructions to the Training Coordinator

1.7.1 As previously stated, the intent of the manual is to provide a guide that will ensure each and every trainee of receiving certain basic principles and fundamentals necessary to the complete education of a firearm and toolmark examiner. All of the listed topics must be incorporated into the program. Some of the topics will strongly suggest an order of events and this ranking should be followed. Any significant deviation from the manual must be approved by the Program Manager.

1.7.2 The performance of the trainee will be evaluated during the course of the program. The TC must submit monthly written evaluations to the Program Manager and Laboratory Director (See Appendix P – Quality Manual for a template). The TC is to discuss this evaluation with the trainee prior to forwarding it to the Program Manager. Any relevant comments by either the trainee or TC are to be included with the report. A copy of the report will be placed in the training file.

1.7.3 The TC is responsible for maintaining the Department's training program documentation during the training period. Each module in the Firearms/Toolmark Training Record (DFS Form 240-F138) must be initialed and dated upon completion of the specified task. If any task is not completed, for any reason, this must be explained in the training file and approved by the Program Manager.

1.7.4 The TC will submit a written recommendation to the Program Manager outlining the modules which may be omitted or modified and the justification for doing so. A copy of the approved recommendation will be placed in the training file.

1.7.5 Written and/or oral examination questions for each module will be selected or derived from the study questions and required readings by the TC.

1.7.6 The written and/or oral examination will be given in a "closed book" format.

1.8 Mock Trials

1.8.1 The TC is responsible for ensuring that the trainee is thoroughly prepared for legal questioning. This can be done by a combination of practice mock trials, impromptu question and answer sessions, and observation of courtroom testimony given by experienced examiners.

1.8.2 The scheduling of practice mock trials is to be done by the TC. These are to be conducted throughout the training period.

1.8.3 There will be a midterm mock trial which will be conducted at approximately the one year point. This mock trial will be prepared based on the topics that have been covered in that first year. It will be done in a formal courtroom like setting. This mock trial must be passed prior to continuing in the program. If it is not successfully completed the first time a second opportunity will be given.

1.9 Guidelines for the Competency Examination

1.9.1 Practical Test

The practical test is a mock case, intended to simulate an average case in difficulty and complexity. It should contain, at a minimum, function of a firearm, ammunition component comparison, distance determination and serial number restoration. There should be clear expected outcomes which the ground truth is known and has been validated through comparison and verification by qualified examiners.

The test shall be approved by the Program Manager prior to being presented to the trainee.

1.9.2 Technical Final

The technical final examination will be given by the Laboratory's Firearms Section Supervisor and TC in the presence of the PM and other Department management (as needed) to ascertain the technical knowledge of the individual. This examination will be limited to three (3) hours. After the examination, the TC, PM and relevant management with input from other attendees, will assess the individual's performance. The performance of the individual will be determined to be either satisfactory or unsatisfactory. The trainee must clearly demonstrate sufficient technical knowledge to perform examinations unaided and to draw correct conclusions. If the performance is deemed to be unsatisfactory, the TC, Section Supervisor, Program Manager and Laboratory Director will determine the appropriate action. After satisfactory completion of the technical final examination, the individual will be subjected to a final mock trial.

1.9.3 Mock Trial

A mock trial will follow the successful completion of the technical final examination. The Quality Manual outlines the roles and responsibilities of the participants as well as evaluation and grading guidelines.

1.9.4 Training Documentation

The following shall be maintained and serve as the technical training file:

- written tests
- description of practical exercises, with results as applicable
- copies of the presentations
- competency practical test
- signed and dated Firearms and Toolmark Training Record
- monthly training reports

At the completion of the training the technical training file should be retained by the trainee or supervisor and be accessible for internal and external quality audits.

1.10 Transition from Trainee to Examiner

1.10.1 The job of the TC is to ensure that this transition from training to case work takes place as smoothly as possible.

1.10.2 Casework will be introduced stepwise under the close supervision of a qualified examiner.

1.10.3 For at least six months all reports must be technically reviewed prior to release by the supervisor or designee.

1.10.4 The supervisor, TC, or designee will accompany and monitor the newly qualified examiner to court for at least the first three times they testify.

1.10.5 The new examiner will complete the DFS Training Evaluation Form per the QM.

1.11 Experienced Personnel

A technical assessment interview will be conducted with new employee, Section Supervisor, TC and PM. The interview will contain questions from each module of this training manual.

1.11.1 Individual Training Plan (ITP)

1.11.1.1 The ITP, see Appendix A for template, will address what additional training is needed for each module. The ITP is written by the TC and approved by the PM and Section Supervisor. If no additional training is required for a specific module the plan must contain documentation related what training the new employee received in the subject matter.

1.11.1.2 At a minimum, the new employee should take a written, oral or practical test for each module, provide a presentation on how the discipline meets the prongs of Daubert and provide a presentation on the 2009 NAS report recommendations, specifically how the Department addresses them.

1.11.2 Training Documentation

The following shall be maintained by the employee and serve as the technical training file:

- Individual Training Plan
- Written or oral tests
- Description of practical examinations, with results as applicable
- Copies of the presentations
- Competency practical test
- Signed and dated Firearms and Toolmark Training Record
- Monthly training reports

At the completion of the training the technical training file should be retained by the trainee or supervisor and be accessible for internal and external quality audits.

1.11.3 Guidelines for Competency Examination

An experienced examiner shall complete a Practical Test, Technical Final and Mock trial as outlined in this manual for a new examiner.

1.12 Orientation

1.12.1 Before beginning the training program, an orientation of the new employee will include an introduction to the operating facilities and personnel.

1.12.2 The following documents will be covered:

- Quality Manual
- Firearm/Toolmark Procedures Manual
- Firearm/Toolmark Training Manual

1.12.3 An introduction to the technical capabilities of all regional laboratories, to include the definitions of the regional boundaries and areas of overlap will be discussed.

1.12.4 The outline of the training program and the expectations of both the TC and the trainee will be discussed.

1.12.5 The duties of a forensic examiner, as determined by the classification of the position, will be clarified.

1.12.6 An introduction to the LIMS system will be given.

1.13 Firearms Safety Training

The trainee will be routinely handling a variety of firearms; therefore, it is imperative that the trainee understand how to safely handle a firearm. All firearms must be treated as though they are loaded. This rule cannot be over-emphasized and must be followed at all times.

1.13.1 Safe Firearm Handling

- Always treat firearms as if they are loaded
- The muzzle of the firearm must always be pointed in a safe direction.
- Always wear appropriate eye and ear protection when shooting.
- Keep your finger out of the gun's trigger guard and off of the trigger until you have made the decision to fire.
- Always be certain that your target and the surrounding area are safe before firing.
- Test firing or any examination of the firearm that utilizes ammunition or an ammunition component, will only be performed in designated test firing areas.
- A firearm will not be returned to any agency in a loaded condition.

1.13.2 Training Assignments

1.13.2.1 Attend a Basic Firearm Safety Course at a local police department, online or complete a comprehensive review of firearm handling and safety with the TC. Discuss the course with the TC and document information learned.

1.13.2.2 Study and become familiar with the DFS Safety Manual and the Firearm/Toolmark Technical Procedures Manual as it relates to safely handling and test firing firearms.

1.13.2.3 Become familiar with the laboratory bullet recovery tank and firing range with the TC.

1.13.2.4 Shadow examiners in the laboratory as they prepare case work to become familiar with basic firearm nomenclature and functioning.

1.14 Modes of Evaluation

1.14.1 Oral Session

1.14.2 Written Examination

2 INSTRUMENTATION

2.1 Objective

To make the trainee proficient in the use of the equipment used in the firearm/toolmark laboratory

2.2 Modes of Instruction

2.2.1 Self-directed study questions and practical exercises

2.2.2 Observations

2.3 Assignments

2.3.1 Completion of required reading assignments and PowerPoint presentations (2.7.1 – 2.7.11)

2.3.2 Study questions

2.3.3 Practical exercises

2.4 Study Questions

2.4.1 In simplest terms, what is a comparison microscope?

2.4.2 What are some of the advancements made from the early comparison microscopes to comparison microscopes used today?

2.4.3 What are the major characteristics of a stereo microscope?

2.4.4 What is the difference between a compound microscope, stereo microscope and comparison microscope?

2.4.5 What is field of view and depth of field and how does magnification affect each of these?

2.4.6 What is the dividing line / hairline / line of demarcation? How is this feature helpful in making a comparison?

2.4.7 Explain/define the following:

- Fluorescent lighting
- Fiber optics
- Digital caliper
- Inertial bullet puller
- Perspective Enterprises Device
- Steel rule
- Reticle
- Balance
- Stage micrometer
- Digital (electronic) micrometer
- Trigger pull weights

2.4.8 What would be the advantages/disadvantages of using LED or fiber optic spot lighting vs. fluorescent lighting? Which type of lighting would be best for firearm and toolmark comparisons? Why?

2.4.9 Why do we use both a stereo microscope and a comparison microscope to look at evidence?

2.4.10 Describe the differences in 2D vs. 3D in regards to microscopy.

2.4.11 Describe the laboratory's QA procedures that are in place to ensure that your comparison microscope and other equipment are performing up to specifications.

2.5 Practical Exercises

2.5.1 Familiarize yourself with the various brands of stereo microscopes. Discuss with your TC how to insert a reticle and how to performance check one of the stereo microscopes.

2.5.2 Familiarize yourself with the various brands of comparison microscopes. Discuss with your TC the differences and similarities in each, both mechanically and optically. Discuss with your TC each of the controls and how they function.

2.5.3 Set up a comparison microscope for your vision requirements and focus the "hairline." Prepare the microscope for use, and be familiar with each set of objective lenses on the comparison microscope. Note the differences in depth of field, field of view and individual stria comparison at each objective size. Become familiar with the different types of photographic systems used in the Firearm Section with the comparison microscopes. If applicable, calculate the magnification for each set of objective lenses on the comparison microscope.

2.5.4 **For all of the following practical exercises** - All photomicrographs should be labeled with the following information: Exercise Module #, type of specimen or specimen # (in this instance brand/type of cartridge cases), your initials, date, microscope used, lighting type used, and magnification. Digital images can be labeled electronically with the addition of handwritten initials on the upper right corner of the page. You may make notes throughout the photographs on the lessons learned or provide a summary of what was learned in narrative form (please reference photographs uniquely in the narrative).

2.5.1.1 The trainee will receive four cartridge cases of differing primer materials that have been fired in the same firearm. Mark an index on the head of the cartridge cases. Rotate each cartridge case 90 degrees clockwise so that the index mark is at approximately the 9 o'clock position and observe the marks. Continue rotating the index mark in 90 degree increments until the index mark is back at the 6 o'clock position, observing the marks at each position. Repeat this process for each type of microscope/lighting available in the laboratory. Explore each variable (lighting type, magnification, aperture setting) independently for at least one cartridge case. Document your observations with photomicrographs and be prepared to discuss problems encountered in photographing comparisons through the comparison microscope.

2.5.1.2 Trainees will receive a plastic bag containing four bullets, as follows.

- 1 full metal jacketed bullet
- 1 copper coated lead bullet
- 1 Nyclad™ bullet
- 1 plain lead bullet

Using a micrometer/caliper, measure the base diameter of each bullet. Using an appropriate balance, measure the weight of each bullet. Using the air gap method (see Firearm/Toolmark Technical Procedures Manual Section 2.5.3), measure the land and groove impression widths of each bullet. If available, measure land and groove impression widths for one bullet using a stereoscope eyepiece reticle. Record each measurement.

Prepare a written report discussing your observations on the differences encountered with the different objects and materials examined.

2.5.1.3 Demonstrate the use of the equipment and, as applicable, how to performance check the equipment listed below.

- Digital caliper
- Inertial bullet puller
- Perspective Enterprises Device
- Reticle in ocular lens of binocular microscope

- Balances and scales located in the Firearm Section
- Stage micrometer
- Digital (electronic) micrometer
- Trigger Pull Weights
- Comparison Microscope
- Remote Firing Device
- Sonicator

2.6 Modes of Evaluation

2.6.1 Practical Exercises

2.6.2 Oral Session

2.7 References

2.7.1 Biasotti, A.A., "Photomicrography and Illumination: Some Critical Factors," AFTE Journal, 1979; 2(4):60-69.

2.7.2 Chamberlain, D., "Microscope Comparison Bridge," AFTE Newsletter, 1972; 4(18): 9-11.

2.7.3 Chapman, Mark, "Increasing the Depth of Field When Photographing Through the Objectives of a Comparison Microscope," AFTE Journal, 2007; 39(1): 44-46.

2.7.4 Cook, C.W., "Basic Optics," AFTE Journal, 1985; 17(4):14-56.

2.7.5 Dutton, G., "Firearms Identification, Comparison Microscope & the Spencer Lens Co." AFTE Journal, 2002; 34(2):186-198.

2.7.6 Hueske, E.E., "Preliminary Report on the Application of Fiber Optic Video Microscopy to Firearm and Toolmark Examination," AFTE Journal, 1990; 22(3):280-282.

2.7.7 Hueske, E.E., "Application of Fiber Optic Video Microscopy to Firearm and Toolmark Examination: A Further Look," AFTE Journal, 1993; 25(2):132-139.

2.7.8 Thornton, J. I., "Some Historical Notes on the Comparison Microscope," AFTE Journal, 1978; 10(1): 7-10.

2.7.9 Delly, John G., "Photography through the Microscope," pages 3 - 19.

2.7.10 Microscopy PowerPoint Presentation.

2.7.11 Remote Firing Device instructional videos and instructional handout.

3 MACHINING PROCESSES

3.1 Objective

To become knowledgeable and understand different manufacturing processes

3.2 Modes of Instruction

3.2.1 Self-directed study through study questions and practical exercises

3.2.2 Specific lectures, videos or presentations

Smithy (machining) Video (3.7.9)

3.2.3 Observations

3.3 Assignments

3.3.1 Completion of required reading assignments (3.7.1 – 3.7.8)

3.3.2 Study questions

3.3.3 Practical exercises

3.4 Study Questions

3.4.1 Be familiar and be able to explain all of the terms listed in the current AFTE Glossary Section on Machining Terms

3.4.2 Explain/Define the following manufacturing techniques:

- Shaping
- Planning
- Drilling
- Reaming
- Turning
- Boring
- Milling-include both face milling and peripheral (slab) milling
- Broaching
- Abrasive machining-include honing, lapping, grinding, sanding, and ultrasonic methods
- Sawing
- Filing
- Swaging
- Electrochemical machining
- EDM
- Investment casting

3.5 Practical Exercise

The student will first review the DFS machining video and then examine the provided specimens, representing the below listed machining processes. The student should evaluate each specimen type for class characteristics and surface features. Compare the specimens to one another noting the similarities and differences. Photographs will be made of the best correspondence found between specimens, delineating the specific areas of correspondence found. The shavings from each process will also be compared microscopically to observe the similarities and differences. Photographs are to be made of the best correspondence found between shavings produced from the same process / tool surface. This exercise is designed to familiarize the student with various machine processes used in tool and firearm manufacture and the markings that they produce on a tool working surface. It is not designed to test the student's ability to make comparative examinations.

- drilling
- reaming
- turning

- face milling
- peripheral milling (upmilling and downmilling)
- end milling
- deep hole drilling
- boring
- separating
- grinding

NOTE: All photographs should be labeled with the following information: Exercise #, type of specimen or specimen #, your initials, date and magnification. Digital images can be labeled electronically with the addition of handwritten initials on the page.

Thoughts and observations made regarding this study may be delineated in the form that the student feels is most appropriate for future reference.

3.6 Modes of Evaluation

3.6.1 Practical Exercise

3.6.2 Oral session

3.7 References

3.7.1 Cilwa, R.B., and Townshend, D.G., "Identification of Lathe Shavings," AFTE Journal, 1978; 10(1): 23.

3.7.2 McNickle, J., "Sharpening Twist Drills," AFTE Journal, 1988; 20(1): 75-78.

3.7.3 Monturo, Chris, "Characteristics of the Drilling Process," AFTE Journal, 2010; 42(4): 389-390.

3.7.4 Monturo, Chris, "The Effect of the Machining Process as it Relates to Toolmarks on Surfaces," AFTE Journal, 2010; 42(3): 264-266.

3.7.5 Monturo, Chris, "The Mechanics of the Grinding Process," AFTE Journal, 2010; 42(3): 267-270.

3.7.6 Dixon, Bob, and Walker, John R., Machining Fundamentals, 9th Ed., The Goodheart-Willcox Company, Inc., Tinley Park, IL, 2014.

3.7.7 Chenow, Richard and Lemmer, John, "The Use of Investment Castings in the Manufacturer of Firearm Components," AFTE Journal, 1994; 26(1): 64-76.

3.7.8 Machining Operations and Machine Tools

3.7.9 DFS, Smithy® 3-in1 Mill, Lathe, Drill Video

4 INTRODUCTION TO TOOLMARK IDENTIFICATION

4.1 Objectives

4.1.1 An introduction to the forensic examination of toolmarks

4.1.2 The difference between class, subclass and individual characteristics

4.1.3 The AFTE Theory of Identification and the Range of Conclusions

4.2 Modes of Instruction

4.2.1 Self-directed study through study questions

4.2.2 Specific lectures or presentations

Toolmarks compressed presentation

4.3 Assignments

4.3.1 Completion of required reading assignments (4.6.1 – 4.6.8)

4.3.2 Read Section 13 (Toolmark Identification) of the NIJ/NFSTC/AFTE "Firearms Analyst Training". This course of instruction may be found at http://www.ojp.usdoj.gov/nij/training/firearms-training/ and http://projects.nfstc.org/firearms/

4.3.3 Study questions

4.4 Study Questions

4.4.1 Read and summarize reading assignment 4.6.1

4.4.2 Define the terms:

- class characteristics
- subclass characteristics
- individual characteristics
- tool
- toolmark
- toolmark identification
- consecutive matching striae (CMS)
- pattern matching

4.4.3 What are the two (2) basic types of toolmarks and how can they be distinguished?

4.4.4 Explain, in your own words, the AFTE Theory of Identification.

4.4.5 Explain, in your own words, the range of conclusions and the criteria needed to reach each conclusion.

4.4.6 Explain what is subjective and objective in regards to the field of firearms and toolmark identifications.

4.4.7 What is a known non-match and why do you study them?

4.4.8 Is it possible for experts in the forensic science discipline of firearm and toolmark identification to disagree regarding their conclusions? Why or why not?

4.5 Mode of Evaluation

Oral session

4.6 References

4.6.1 Miller, J., "An Introduction to the Forensic Examination of Toolmarks," AFTE Journal, 2001; 33(3): 233-247.

4.6.2 Tomasetti, K.A., "Analysis of the Essential Aspects of Striated Tool Mark Examinations and the Methods for Identification," AFTE Journal, 2002; 34(3): 289-301.

4.6.3 Uchiyama, T., "The Probability of Corresponding Straie in Toolmarks," AFTE Journal, 1992; 24(3): 273-290.

4.6.4 Meyers, C.R., "Objective v. Subjective Boondoggle," AFTE Journal, 1987; 19(1): 24-30.

4.6.5 Miller, J., and McLean, M., "Criteria for Identification of Toolmarks," AFTE Journal, 1998; 30(1): 15-61.

4.6.6 Nichols, R.G., "Firearm and Toolmark Identification Criteria: A Review of the Literature," Journal of Forensic Sciences, 1997; 42(3): 446-474.

4.6.7 Nichols, R.G., "Firearm and Toolmark Identification Criteria: A Review of the Literature, Part II" Journal of Forensic Sciences, 2003; 48(2): 318-327.

4.6.8 "Theory of Identification, Range of Striae Comparison Reports and Modified Glossary Definitions – An AFTE Criteria for Identification Committee* Report," AFTE Journal, 1992, 24(3): 336-340.

5 TOOLMARK EXAMINATIONS AND COMPARISONS

5.1 Objectives

The trainee will be knowledgeable and understand:

- The significance of examining submitted tools for trace evidence.
- Casting techniques
- The various types of tools and the class characteristics produced by each tool.
- The documentation, examination and comparison of tool and toolmarks.

5.2 Modes of Instruction

5.2.1 Self-directed study through study questions and practical exercises

5.2.2 Observations

5.3 Trace Evidence

5.3.1 Completion of required reading assignments (5.9.1 – 5.9.3)

5.3.2 Study Question

Explain the significance of examining the submitted tool first for trace evidence.

5.4 Casting Techniques

5.4.1 Completion of required reading assignments (5.9.4 – 5.9.13)

5.4.2 Study Questions

5.4.2.1 Describe cases where it would be beneficial or necessary to cast a toolmark and/or tool.

5.4.2.2 Describe different types of casting techniques/materials and the potential of casts for making toolmark identifications.

5.4.2.3 Describe the required properties needed for a casting material used in a toolmark case.

5.4.3 Practical Exercise

Practice casting techniques using different casting materials available at the laboratory.

5.5 No Tool Cases

5.5.1 Completion of required reading assignments (5.9.14)

5.5.2 Study Question

In a case involving a toolmark examination wherein no tool is submitted, what are the types of conclusions which can be reached? Consider such things as the type of tool, size of the tool, action employed by tool, value of toolmark for comparison purposes, and unusual tool features.

5.6 Tool and Toolmark Examinations and Comparisons

5.6.1 Completion of required reading assignments.

5.6.1.1 Bolt cutters (5.9.15 – 5.9.20)

5.6.1.2 Screwdrivers (5.9.21 – 5.9.29)

5.6.1.3 Pliers (5.9.30, 5.9.31)

5.6.1.4 Cable and wires (5.9.32 – 5.9.40)

5.6.1.5 Saws (5.9.41 – 5.9.45)

5.6.1.6 Files and abrasives (5.9.46, 5.9.47)

5.6.1.7 Knives and tires (5.9.48 – 5.9.61)

5.6.1.8 Impressions (5.9.62 – 5.9.67)

5.6.1.9 Bone and Cartilage (5.9.68 – 5.9.78)

5.6.2 Study Questions

5.6.2.1 Define the following terms as they relate to toolmark identification and give three examples of tools or methods that could produce each category.

- Shearing
- Pinching
- Scrape mark
- Impression
- Slicing

5.6.2.2 For each tool action listed in 5.6.2.1, describe the class characteristics of the tool and the toolmarks produced.

5.6.2.3 What are differences in class characteristics of shearing, pinching, and slicing actions?

5.6.2.4 What factors can affect the reproduction of a toolmark?

5.6.2.5 Can you eliminate a toolmark without a tool? Why or why not?

5.6.2.6 Does varying the angle and force with which each tool is used change or alter the questioned toolmarks?

5.6.2.7 Is there a difference in the quality of toolmarks produced by a tool in different mediums?

5.6.2.8 Is there a potential for the surface of a tool to change using different mediums?

5.6.2.9 Outline the steps taken when conducted a toolmark identification with an ax blade that contains numerous defects to a piece of cut wood. Include any problems that may be encountered.

5.6.2.10 During a microscopic examination/comparison, what problems can be observed on a multi-stranded cable cut using a slicing action?

5.6.2.11 What problems are generally encountered with respect to the identification of toolmarks produced by a saw?

5.6.2.12 What problems are generally encountered with respect to the identification of toolmarks produced by files and abrasive tools?

5.6.2.13 How might the results of your examinations be altered by sharpening the knife blade, as well as the effect that extended use of a knife might have on the marks produced?

5.6.2.14 What are the differences in class characteristics between knives with single edged blades and knives with double-edged blades?

5.6.2.15 What research has been conducted in the discipline of toolmark identification which demonstrates that the uniqueness theory of the discipline has been tested? Briefly summarize each research study conducted (refer to References 5.9.15 – 5.9.78)

5.6.3 Practical Exercises

5.6.3.1 Examination and comparison of shearing, pinching, scrape mark and impression action toolmarks.

5.6.3.1.1 Select at least two different tool types which represent each of the following: shearing, pinching, scrape mark and impression. Document each tool type on a tool work sheet, using Section 8 of the DFS Firearm/Toolmark Procedures Manual as a guideline. Produce toolmarks in lead with each tool and observe, document and photograph the class characteristics of the toolmark. Discuss in your notes how this might change or alter the questioned toolmarks. Be prepared to demonstrate this orally. The student must thoroughly document how the test marks are made and how the tool working surfaces were identified for examination purposes.

5.6.3.1.2 Using both the "A" and "B" tools provided for each tool type, make two tests in lead with each tool for comparison to one another. Compare the toolmarks known to have been produced with the "A" tool. Do the same with the specimens made with the "B" tool. Make photomicrographs of each comparison, delineating the areas of agreement that you have observed and are demonstrating in the photograph. Be sure to relate the area(s) depicted in the photographs to the tool working surface that is represented. Thoroughly document these photographs for your notebook.

5.6.3.1.3 Compare the toolmarks that you made with the "A" tool to the toolmarks produced with the "B" tool of each type. Make photomicrographs of the best correspondence that you can find and delineate the areas of correspondence on the photograph.

5.6.3.1.4 Make casts of the test marks and repeat the steps listed in 5.6.3.1.2 and 5.6.3.1.3 comparing the casts to one another. Document all comparisons with photography. Delineate the areas of correspondence on each photograph.

5.6.3.1.5 For shearing and pinching action tools: After making initial test cuts in lead wire, use copper wire to make cuts through it. Attempt to identify the cuts in the copper wire as having been made by the same tool as that which cut the test produced in lead. Support your results with photographs and note any lighting considerations necessary by the color difference between copper and lead.

5.6.3.1.6 For flat-bladed tools such as a screwdriver and a pry bar: Make the same type of toolmarks that were produced in lead, in a piece of copper or brass sheeting. Microscopically compare those in the brass or copper sheeting with the test marks in the lead. Attempt to identify the appropriate marks with the appropriate tool. Vary the angle and force with which each tool is used. Repeat making tests in lead and compare them with the original lead tests. Photograph your results and comment on the difference in the quality of marks made by each tool in each medium.

5.6.3.1.7 For impression type tools such as a hammer or a pin punch: Make the same type of toolmarks that were produced in lead, in a piece of brass or copper sheeting. Compare the marks in brass or copper to the lead test marks. Make a second set of tests in lead and compare those to the original lead test marks. Attempt to identify these as having been made by the same tool. Support your results by photographs.

5.6.3.1.8 Repeat the comparison process by comparing the "A" and "B" toolmarks that you prepared to those that have been prepared by someone else. Document all comparisons with photography, delineating the areas of correspondence being depicted in the photographs. If possible, compare and document some toolmarks made by a right-handed person to toolmarks made by a left-handed person using the same tool working surface.

NOTE: Label all photographs with the specimen type, A or B test, microscope, magnification, initials and date.

5.6.3.2 Using a doorknob and a serrated-jawed tool, produce impressions and scrape marks like those produced by an attempt at an entry. Devise a method of obtaining test marks in lead like those produced by the serrated-jawed tool on the doorknob. Microscopically examine the marks on the doorknob with those on the test material. Identify the tool with the marks on the doorknob and reproduce the tool-doorknob orientation and relate each mark to its respective serration on the tool.

5.6.3.3 Obtain a section of large-diameter telephone cable and cut it with a pinching type tool and study the effects of a pinching action on a multi-stranded cable. Note the quality and extent of microscopic marks of each strand and comment on the problems involved in identifications of this sort. Photograph the pinched end of the cable.

5.6.3.4 Using the saws and blades provided, properly document each saw/blade type on a tool work sheet. With each type of saw blade, make test cuts in lead and attempt to identify the tests to one another. Make sure that you label your tests properly with respect to the orientation of the blade. Following this examination, produce "questioned" cuts in materials such as wood, plastic and metal. Try to compare these marks with the original lead test marks. Properly document "best match" comparisons with photographs.

5.6.3.5 Repeat exercise 5.6.3.4 with the various files provided, documenting each file type on a tool work sheet.

5.6.3.6 Obtain a used tire and rubber hose. Make cuts and stabs into the sidewall of the tire and rubber hose with a fixed single-edged blade knife. Document the class characteristics of the cut. Attempt to make comparisons of the toolmarks produced by the knife. Support your results with photographs and notes. Sharpen the knife blade. Make a second set of test cuts and compare them to the original test cuts. Repeat this exercise using a knife with a double-edged blade knife.

5.6.3.7 Using the Knife Identification Project AFTE 2002 Kit #41, compare the test cuts made in dip pack of the consecutively manufactured blade specimens 2 through 9 to one another, documenting best "known non-matches" between specimens. You will be given 5 questioned specimens to determine which knife blade, if any, cut the questioned marks. Document all specimens as if they were evidence, using tool and toolmark worksheets. Do not individually mark specimens.

5.7 Subclass Characteristics

5.7.1 Completion of required reading assignment (5.9.79)

5.7.2 Study Questions

5.7.2.1 How do you recognize subclass characteristics?

5.7.2.2 How might the presence of subclass characteristics affect your opinion regarding a comparative examination?

5.7.3 Practical Exercise

Your instructor will provide you with casts that have been produced from the tools referred to in the article "Toolmarks: Examining the Possibility of Subclass Characteristics" by Miller, J. and Beach, G. 2005. Study the marks present on the casts and document your observations.

5.8 Modes of Evaluation

5.8.1 Practical Exercises

5.8.2 Oral Sessions

5.8.3 Practical Examination

Each trainee will successfully complete four practical examinations that are representative of the following tool actions: pinching/shearing, scrape mark, impression and slicing. The appropriate worksheets and supporting documentation will need to be completed on each practical examination.

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6 FIREARM AND TOOLMARK EVIDENCE ADMISSIBILITY CRITERIA AND DEFENSE

6.1 Objectives

6.1.1 To be knowledgeable of the criteria listed in the Daubert decision

6.1.2 To become aware of the legal aspects of the admissibility of toolmark evidence

6.1.3 To describe the development of major agencies/organizations related to the field of firearms identification

6.1.4 To explain the significance of major court decisions that have impacted the field of firearm identification

6.2 Modes of Instruction

6.2.1 Self-directed study through study questions

6.2.2 Observations

6.3 Assignments

6.3.1 Completion of required reading assignments (6.6.1 – 6.6.4)

6.3.2 Prepare a PowerPoint presentation, citing all references, regarding the criteria listed in the Daubert Decision and provide support for each criteria how the firearm and toolmark discipline meets the standard.

6.3.3 Prepare a PowerPoint presentation summarizing the 2009 NAS report Strengthening Forensic Science in the United States: A Path Forward, how DFS meets or doesn't meet the recommendations and AFTE's response to this report.

6.4 Study Questions

6.4.1 What is AFTE and how has AFTE been significant in the development of the field since 1969?

6.4.2 What publications has AFTE produced to enhance the discipline?

6.4.3 What other governing bodies have set standards for the field of firearm and toolmark identification? Explain the evolution of these governing bodies.

6.4.4 What is a validation study?

6.4.4.1 What is the difference between scientific validity and scientific reliability?

6.4.4.2 What research has been conducted in the discipline of firearm and toolmark identification which demonstrates that the uniqueness theory of the discipline has been tested?

6.4.5 Please explain the Daubert decision and how the discipline of firearms and toolmarks meets the standards described in the decision.

6.5 Mode of Evaluation

Presentation of the PowerPoint presentations

6.6 References

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7 HISTORY OF FIREARMS IDENTIFICATION AND CURRENT TRENDS

7.1 Objectives

7.1.1 To describe major historical events significant to the field of firearms identification

7.1.2 To discuss the contributions numerous individuals have made to the field of firearms identification

7.2 Mode of Instruction

Self-directed through reading assignments, training assignments, and study questions

7.3 History of Firearms Identification

7.3.1 Read Section 2 (History) of the NIJ/NFSTC/AFTE "Firearms Analyst Training". This course of instruction may be found at http://www.ojp.usdoj.gov/nij/training/firearms-training/ and http://projects.nfstc.org/firearms/

7.3.2 Training assignment

Prepare a timeline on the significance of the following (not limited to) as they relate to firearms identification:

- Bureau of Forensic Ballistics
- NIBIN (National Integrated Ballistic Information Network)
  - Drugfire
  - IBIS

7.3.3 Study questions

7.3.3.1 Define the following terms:

- firearm identification
- ballistics

7.3.3.2 Who were Jack and Charles Gunther? What are the six (6) basic problems in firearms identification as outlined in their text?

7.3.4 Modes of evaluation

7.3.4.1 Presentation – on the Basic History of Firearms Identification using the timeline prepared above (15-20 minutes then question/answer session)

7.3.4.2 Oral Session

7.4 References

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8 AMMUNITION

8.1 Objective

8.1.1 To become knowledgeable about the historical developments and current manufacture of gunpowder and ammunition components.

8.2 Modes of Instruction

8.2.1 Self-directed through reading assignments, training assignments, study questions and practical exercises

8.2.2 Observations

8.3 Historical Development of Ammunition

8.3.1 Completion of the following required reading assignments (8.7.1-8.7.9)

8.3.2 Read Section 3 (Propellants, Ammunition, and Firearms Development) of the NIJ/NFSTC/AFTE "Firearms Analyst Training". This course of instruction may be found at http://www.ojp.usdoj.gov/nij/training/firearms-training/ and http://projects.nfstc.org/firearms/

8.3.3 Training assignments

8.3.3.1 Prepare a chronological report on the historical development of gunpowder from black powder to smokeless powder. The report should include, but not be limited to:

- components of black powder
- single vs. double base smokeless powder
- ratio of components black powder
- countries of origin
- early researchers/inventors
- sources of raw materials
- manufacturing processes
- glazing process
- grain size
- chemistry of combustion
- role of each component
- mechanical mixture vs. chemical compound
- end products of combustion
- modern improvements

8.3.3.2 Describe the development of ammunition up to the advent of and including metallic cartridges. Include, at a minimum, the following milestones:

- the Minie ball
- rimfire
- centerfire
- Berdan primers and cases
- Boxer primers and cases

8.3.4 Study questions

8.3.4.1 Define the following terms.

- Black powder
- Caseless ammo
- Fulminate of mercury
- Gun cotton

- Patch
- Patched ball
- Percussion cap
- Pyrodex

8.3.4.2 What is contemporary “black powder” made from and why? What do the letter designations indicate?

8.3.4.3 What was considered the earliest form of a cartridge?

8.3.4.4 What was the first commercially successful self-contained metallic cased cartridge made in the US?

8.3.4.5 What were the disadvantages of the pinfire cartridge?

8.4 Ammunition Components

8.4.1 Completion of the following required reading assignments (8.7.10-8.7.26)

8.4.2 Read Section 5 (Small Arms Ammunition) of the NIJ/NFSTC/AFTE "Firearms Analyst Training”. This course of instruction may be found at http://www.ojp.usdoj.gov/nij/training/firearms-training/ and http://projects.nfstc.org/firearms/

8.4.3 Training assignments

8.4.3.1 Prepare a written report detailing trends unfolding in cartridge and bullet development, discussing the usefulness of these developments. This report should include, but not be limited to, the following trends:

- Designs, materials & coatings, to include CCI Stinger, Federal Hydra-Shok, Remington Golden Saber, Winchester PDX, Federal Nyclad, solid copper designs, shot cartridges
- Frangible ammunition
- Lead free or “Clean” ammunition
- Shotshell projectiles

8.4.3.2 Sketch the cross-section of Berdan and Boxer primers, showing their relationship to the head of the cartridge and illustrating how each one functions.

8.4.3.3 Draw a diagram of a bottleneck cartridge and label/define the following:

- Bullet
- Cartridge case
- Cartridge case head
- Cartridge case length
- Cartridge case mouth
- Cartridge case neck
- Cartridge case shoulder
- Extractor groove
- Headstamp
- Primer
- Ogive
- Rim

8.4.3.4 Draw a diagram of a cutaway shotshell and label/define the following:

- Battery cup
- Powder
- Primer
- Shotshell case
- Shot
- Wadding

8.4.3.5 Obtain and be familiar with a chart of current U.S. shot sizes and weights.

8.4.4 Study questions

8.4.4.1 Be familiar with the following terms from the current version of the AFTE Glossary:

- Ammunition
- Antimony
- Anvil
- Base, High
- Base, Low
- Battery cup
- Bearing surface
- Blank
- Brass
- Brass, High
- Brass, Low
- Buckshot
- Buffer
- Bullet (all types)
- Bullet jacket
- Bullet sizing
- Bunter
- Burning rate
- Cannelure
- Cartridge (all types)
- Cartridge case capacity
- Casting seam
- Chamber pressure
- Crimp
- Downloading
- Dram equivalent
- Flash hole
- Gauge
- Grain
- Graphite
- Gunpowder (all types)
- Headspace
- Headstamp
- Lead styphnate
- Load (all types)
- Lubaloy
- Magnum
- Mold marks
- Muzzle energy
- Muzzle velocity
- Nyclad bullet
- Obturation
- Pellet
- Primer (all types)
- Primer leak
- Primer pocket
- Projectile
- Propellant
- Reload
- Reloading
- Rimfire
- Rule of 17
- Sabot
- Seating depth
- Shot (all types)
- Shot cartridge
- Shot collar
- Shot column
- Shot cup
- Shot size
- Shotshell
- Shotshell case
- Slug
- Slug, Brenneke
- Slug, Rifled
- Sprue
- Sprue cutter mark
- Steel penetrator
- Swaging
- Wad (all)
- Yaw

8.4.4.2 What are the different pellet compositions?

8.4.4.3 What are the sizes of buckshot and their equivalent diameters?

8.4.4.4 What are the manufacturing processes used for making shot?

8.4.4.5 What is the purpose of buffer?

8.4.4.6 How are modern 22 rimfire cartridge cases made?

8.4.4.7 What is used to place identifying marks on a cartridge case?

8.4.4.8 What are bullet cores composed of?

8.4.4.9 What are the methods used for the manufacture of lead bullets? Which one is more common today?

8.4.4.10 What are the different shapes of powder? Why are there different shapes?

8.4.4.11 What is SAAMI?

8.4.4.12 What are the uses of cannelures?

8.4.4.13 What classifies a cartridge as being a rimfire?

8.4.4.14 What is the purpose of the priming mixture used in modern cartridges, and what are the essential ingredients? What compounds used to be contained in priming mixtures and what problems did these chemical compounds cause?

8.4.4.15 What is chamber pressure and why is it important? What are the signs of excess chamber pressure? What are the causes of excess chamber pressure?

8.4.4.16 Describe the headspace of a rimless bottleneck cartridge, a rimmed cartridge, and a rimless cartridge.

8.4.4.17 What is “clean ammo”? Name some cartridges that have been designed to be clean.

8.4.4.18 What is meant by / the purpose of +P/+P+ designation on cartridges?

8.4.4.19 What are extrusion/draw marks?

8.4.4.20 Define BB.

8.4.4.21 What are the four components of a cartridge?

8.4.5 Practical exercises

8.4.5.1 If possible, visit at least one ammunition-manufacturing facility such as Remington, Federal or Winchester to observe the manufacture of rimfire and centerfire cartridges and shotshells. Make detailed notes of the manufacturing processes and generate a written report for section files. Also, prepare an oral presentation for section members upon your return. Particular emphasis should be placed on pellet and bullet manufacture, shotshell casing and cartridge case manufacture and the steps involved in the loading of cartridges and shotshells. Coordinate this visit with the Training Coordinator.

8.4.5.2 Using the provided items of ammunition describe the following for each item using terms from the current version of the AFTE Glossary:

- Type of cartridge (e.g., centerfire/rimfire, rimmed, rimless)
- Type of bullet (e.g., lead, jacketed hollow point, round nosed)

8.5 Caliber/Gauge

8.5.1 Completion of the following required reading assignments (8.7.24-8.7.26)

8.5.2 Training assignments

8.5.2.1 Prepare a document that includes the bullet diameter, bullet weight, and cartridge design of the following handgun calibers. Include a short write-up on the history and development of

each cartridge with an (*). Using the laboratory's ammunition reference collection, look at cartridges in each of the calibers and note their design differences.

- 22 Short
- 22 Long
- 22 Long Rifle
- 25 Auto*
- 32 Auto*
- 32 S&W*
- 32 S&W Long
- 32 H&R Magnum
- 32 Short Colt
- 32 Colt New Police
- 380 Auto*
- 9mm Luger*
- 9mm Makarov*
- 38 Special*
- 357 Magnum
- 357 SIG*
- 38 S&W*
- 38 S&W Long
- 38 Colt New Police
- 38 Short Colt
- 38 Long Colt
- 10 mm Auto
- 40 S&W
- 41 Magnum
- 44 Magnum
- 44 Special*
- 45 Auto*
- 45 GAP
- 45 Colt*
- 50 Action Express*

8.5.2.2 Compare the following cartridges and describe their interchangeability:

- 45 Auto and 45 GAP
- 10 mm Auto and 40 S&W
- 44 Magnum and 44 Special
- 9mm Luger and 357 SIG
- 357 Magnum, 38 Special, and 38 S&W
- 9mm Luger, 380 Auto, and 9mm Makarov
- 32 S&W and 32 Auto

8.5.2.3 Prepare a document that includes the bullet diameter, bullet weight, cartridge design, and parent design (if applicable) of the following rifle calibers. Using the laboratory's ammunition reference collection, look at cartridges in each of the calibers and note their design differences.

- 45-70 Government
- 30-40 Krag
- 30-30 Winchester
- 30-06 Springfield
- 35 Remington
- 250 Savage
- 270 Winchester
- 30 Carbine
- 7.62 x 39 Soviet
- 308 Winchester
- 243 Winchester
- 7mm Rem Mag
- 300 Win Mag
- 223 Remington
- 5.45 x 39 Soviet

8.5.2.4 Describe the development/progression of military rifle cartridges using the applicable cartridges listed in 8.5.2.3.

8.5.2.5 What is the bore diameter of the following firearms?

- 10 gauge shotgun
- 12 gauge shotgun
- 16 gauge shotgun
- 20 gauge shotgun
- 28 gauge shotgun
- 410 bore shotgun

8.5.3 Study questions

8.5.3.1 Define caliber.

8.5.3.2 What is the difference between caliber (true), caliber type (nominal caliber), and caliber designation (specific caliber)?

8.5.3.3 What are the members of the 38 class family and why?

8.5.3.4 Give an example of a caliber designation and explain where it originated from.

8.5.3.5 List the metric equivalents of the following cartridges: 223 Remington, 25 Auto, 32 Auto, 380 Auto, 9mm Luger, 9mm Makarov

8.5.3.6 What does the designation "30" in caliber 30-30 Winchester and 30-06 Springfield indicate?

8.5.3.7 What do the numerical designations in 7.62 x 39mm each refer to?

8.5.3.8 What are the differences between 22 Short, 22 Long, and 22 Long Rifle?

8.5.3.9 What is a 9mm Corto? 9mm Kurz?

8.5.3.10 If a bullet has a knurled cannelure does that signify what kind of a firearm it was fired from?

8.5.3.11 What cartridge case designs are represented in the .22 caliber family?

8.5.4 Practical exercises

8.5.4.1 Examine several different cartridges in each of the following caliber families: .22 caliber, .30 caliber and .38 caliber in order to be able to distinguish between the design characteristics of the different caliber types within each caliber family. Identify each one as to the caliber designation and note the different cartridge case sizes and shapes within each caliber family and also the variations in bullets (*weight, jacketing, design, cannelures, etc.*). Check in periodically with your Training Coordinator during this assignment and share your findings.

8.5.4.2 Using the provided wad and pellet samples, determine the gauge and/or shot size of each. Use appropriate laboratory worksheets and document all measurements and sources used to reach conclusions. Use the appropriate report writing section of the Firearms Section Procedures Manual to document your final conclusions.

8.5.4.3 Using the provided bullet samples, appropriate laboratory worksheets, and all available laboratory resources, determine the weight, diameter, type of bullet, manufacturer, and caliber of each bullet. Prepare a written report to include the caliber, brand, style and applicable trademark / manufacturing history of each. Document all sources used to reach conclusions.

8.6 Modes of Evaluation

8.6.1 Practical Examination

8.6.2 Oral Sessions

8.6.3 Written Test

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9 FIREARMS

9.1 Objectives

9.1.1 Trainee will be able to explain the historical development of firearms.

9.1.2 Trainee will be able to describe the manufacturing process of firearms.

9.1.3 Trainee will be able to explain the mechanisms of function and safety features on a variety of firearms.

9.1.4 Trainee will be able to disassemble, reassemble, and test fire a variety of firearms.

9.1.5 Trainee will be able to restore inoperable firearms to mechanical operating condition.

9.1.6 Trainee will be able to discuss a variety of common mechanical malfunctions encountered in the examinations of firearms.

9.2 Modes of Instruction

9.2.1 Self-directed through reading assignments, training assignments, study questions and practical exercises

9.2.2 Observations

9.3 Historical Development of Firearms

9.3.1 Completion of required reading assignments (9.12.1)

9.3.2 Training assignment

Prepare a chronological outline of early firearms development from cannon lock to percussion lock. Describe each type of action, explain how each type of development was an improvement over the previous system, and list the disadvantages of each system.

9.3.3 Study questions

9.3.3.1 In which era were revolvers introduced?

9.3.3.2 What is a muzzleloader?

9.3.3.3 Why was self-contained cartridge important for firearms development?

9.3.3.4 What is the difference between Snaphaunce, Miquelet, and Flint Lock?

9.3.4 Practical exercise

If possible, visit the firearm collection of a museum in the region and observe examples of early firearms. Prepare a summary of what was observed on the visit.

9.4 Firearm Manufacturing

9.4.1 Completion of the following required reading assignments (All in 9.12.2)

9.4.2 Training assignment

Prepare a paper describing the following rifling techniques including the advantages and disadvantages of each as viewed by the industry and the firearms examiner.

- Broach
- Button
- Hammer forging
- Hook
- Scrape
- ECM
- EDM

9.4.3 Study questions

9.4.3.1 Define the following terms as they relate to firearm manufacture using the current version of the AFTE Glossary:

- Shaping
- Planing
- Honing
- Drilling
- Reaming
- Turning
- Boring
- Face Milling
- Peripheral (slab) milling
- Filing
- Crowning
- Bore slugging
- Bore
- Lead lapping
- Burnishing
- Metal Injection molding

9.4.3.2 Describe the basic steps of manufacturing a barrel from a steel blank.

9.4.3.3 Identify the following finishes: blue, chrome, nickel, anodized, painted, and stainless steel.

9.4.3.4 What is rifling?

9.4.3.5 What is meant by the term conventional rifling? How is this different from polygonal rifling?

9.4.3.6 What tooling methods produce conventional rifling versus polygonal rifling?

9.4.3.7 Name some manufacturers who produce firearms with polygonal barrels.

9.4.3.8 Describe abrasive machining and several different methods how this machining technique can be applied.

9.4.3.9 Describe investment casting and give an example of a manufacturer who utilizes it.

9.4.4 Practical exercises

9.4.4.1 Obtain rifled barrels, broaches, and buttons. Determine the difference between barrels which have been broached rifled and those which have been button rifled.

9.4.4.2 Visit several firearm and/or barrel manufacturing facilities. Prepare a PowerPoint presentation emphasizing manufacturing and rifling techniques used by each manufacturer, noting methods and procedures which leave unique manufacturing toolmarks on firearm parts.

9.5 Examination of Firearms

9.5.1 Reading assignments (9.12.3)

9.5.2 Training assignment

Prepare a paper describing the following terms as they related to the manufacture of firearms.

- Proof marks
- Inspector marks
- Factory numbers and markings
- Serial number
- Part numbers
- Company logos

9.5.3 Study questions

9.5.3.1 Define the following terms from the current version of the AFTE Glossary:

- Revolver
- Pistol
- Rifle
- Shotgun
- Semiautomatic
- Automatic
- Derringer
- Bolt-action
- Slide (pump) action
- Single shot
- Submachine gun
- Machine gun
- Assault rifle
- Muzzleloader
- Percussion firearm

9.5.3.2 Define the following terms from the current version of the AFTE Glossary:

- Action
- Barrel
- Bore
- Breech
- Breechface
- Butt
- Chamber
- Crown
- Direction of Twist
- Discharge/Fire
- Double Action
- Dry firing
- Ejection
- Extraction
- Firearm
- Firing pin
- Firing pin aperture
- Frame
- Function testing
- Grip
- Grooves
- Hammer
- Hammerless
- Handgun
- Hybrid Action
- Lands
- Mainspring
- Muzzle
- Rifling
- Safety mechanism
- Sear
- Sights
- Single action
- Test fire
- Trigger
- Trigger bar
- Trigger group
- Trigger guard
- Trigger pull

9.5.3.3 Do all firearms have a serial number? Why or why not?

9.5.4 Practical Exercise

When available, attend armorer training offered by various manufacturers of firearms.

9.6 Revolvers

9.6.1 Reading assignments (9.12.4)

9.6.2 Training assignment

Define the following parts performing the same function in Colt, Smith & Wesson, and Ruger revolvers.

- Colt: Ratchet, Latch, Bolt, Hand, Safety Lever, Strut
- S&W: Extractor, Thumb Piece, Cylinder Stop, Hand, Hammer Block, Sear
- Ruger: Ejector, Cylinder Release Button, Cylinder Latch, Pawl, Transfer Bar, Dog

9.6.3 Study questions

9.6.3.1 Define the following terms from the current version of the AFTE Glossary:

- Crane
- Cylinder
- Cylinder Gap
- Cylinder alignment
- Ejector Rod
- Forcing Cone
- Yoke
- Sear notch
- Sear spring
- Side plate
- Loading gate
- Recoil shield
- Hammer Notch
- Hammer Shroud
- Hammer Spur
- Rebound slide
- Hammer block
- Transfer bar

9.6.3.2 Discuss with the TC how the following safeties function and how to check their function:

- Hammer block
- Safety notch / quarter cock, half cock
- Rebounding hammer
- Transfer bar
- Key lock

9.6.3.3 Explain the cycle of fire as it relates to single/double action revolvers.

9.6.3.4 Describe the procedure for measuring trigger pull.

9.6.3.5 How can trigger pull be lightened in a revolver?

9.6.3.6 Describe the procedure for measuring the barrel and overall length of a revolver.

9.6.3.7 What does the direction of cylinder stop notches on a revolver indicate?

9.6.3.8 What is a top break revolver?

9.6.3.9 Of Colt, Smith & Wesson and Ruger; which manufacturer does not use a side plate?

9.6.3.10 Define cylinder flare / smoke ring / halo. What do cylinder flares indicate and how might they be used during the examination of a revolver?

9.6.3.11 Are there revolvers designed for use with ammunition typically designed for semiautomatic pistols? What adjustments need to be made to accommodate these cartridges?

9.6.3.12 Describe the differences between the following types of cylinders in a revolver: hinged, swing-out, and pin type (fixed).

9.6.3.13 What is the difference between the old model Ruger Blackhawk and the new model Ruger Blackhawk?

9.6.3.14 What are the various locations on Colt, Ruger, Smith & Wesson and top-breaking revolvers that contain the serial number.

9.6.3.15 Describe Smith & Wesson revolver frame sizes.

9.6.3.16 Explain the difference between Colt Single Action Army generations.

9.6.4 Practical exercises

Observe an instructor demonstrate how to safely handle, load, and unload some of the firearms listed. Demonstrate these safety techniques to the instructor.

Document each firearm on a firearm worksheet. Documentation of each safety feature should include specifically how that safety functions.

When applicable, list the manufacturing techniques used to fabricate and finish each of the following parts and note the manufacturing marks. Identify “marks of abuse” which could contribute to the uniqueness of each part and areas that manufacturing marks might “carry over” to another firearm.

- Breechface
- Firing pin
- Rifling
- Barrel

Obtain a copy of an exploded drawing of each of the firearms listed below.

Choose ammunition types with different bullet styles / jacket materials as well as different cartridge case / primer metals unless otherwise specified. Label and maintain the ammunition components produced as a result of the following examinations.

Specify which test fires were fired in single or double action mode.

Follow the instructions listed for each firearm regarding test firing, ammunition used, disassembling/reassembling, trigger pull, and barrel/overall length measurement.

Have an instructor function check all firearms before test firing and returning them to the firearm reference collection.

R.G. Industries model RG23, caliber 22 Long Rifle

- Conduct trigger pull examination
- Test fire two (2) 22 Long Rifle LRN cartridges in single action
- Test fire two (2) 22 Long LRN cartridges in single action
- Test fire two (2) 22 Long Rifle LRN cartridges in double action
- Test fire two (2) 22 Long LRN cartridges in double action
- Test fire two (2) 22 Long Rifle brass coated LRN cartridges
- Test fire two (2) 22 Long Rifle copper coated LRN cartridges
- Measure the barrel and overall length of the firearm and have it verified

Ruger New Model Single-Six, caliber 22 Magnum

- Conduct trigger pull examination
- Test fire in single action two (2) 22 Magnum cartridges

- Test fire in double action two (2) 22 Magnum cartridges
- Test fire two (2) 22 Long Rifle cartridges
- Detail Strip
- Prepare a written report on the early history of Sturm, Ruger & Company and its most notable revolvers

Iver Johnson model Top Break, caliber 32 Smith & Wesson

- Test fire two (2) 32 S&W LRN cartridges
- Test fire two (2) 32 Auto FMJ cartridges

Smith & Wesson model 686, caliber 357 Magnum

- Conduct trigger pull examination
- Test fire in single action two (2) 357 Magnum Winchester JSP
- Test fire in double action two (2) 38 Special Winchester LRN
- Detail Strip
- Prepare a written report on the early history of Smith & Wesson and its most notable revolvers

Colt model Lawman, caliber 357 Magnum

- Test fire two (2) 38 Special Remington SJHP
- Test fire two (2) 38 Special Federal Nyclad
- Detail strip
- Prepare a written report on the early history of Colt and its most notable revolvers

Ruger model Security Six, caliber 357 Magnum

- Test fire two (2) 38 Special PMC FMJ
- Test fire two (2) 38 Special Federal Semi-wadcutter
- Detail strip

9.7 Pistols

9.7.1 Reading assignments (9.12.5)

9.7.2 Training assignment

Prepare a paper on the following types of semi-automatic pistols and list several examples of firearms using these mechanisms.

- Blowback action
- Delayed blowback action
- Gas delayed blowback action
- Gas operated
- Short recoil action

9.7.3 Study Questions

9.7.3.1 Define the following terms using the current version of the AFTE Glossary:

- Backstrap
- Chamber
- Front Strap
- Ejector
- Ejection port
- Extractor

- Feed ramp
- Magazine
- Magazine floorplate
- Receiver
- Take down
- Barrel lug
- Inertia firing pin
- Striker
- Magazine follower
- Magazine spring
- Magazine well
- Recoil spring
- Recoil spring guide
- Slide
- Slide Stop

9.7.3.2 Discuss with the TC how the following safeties function and how to check their function:

- Grip safety
- Magazine safety
- Thumb/manual safety
- Decocker
- Trigger safety
- Disconnect
- Cocking indicator
- Loaded chamber indicator
- Firing pin block
- Key

9.7.3.3 Explain the cycle of fire for a semiautomatic pistol.

9.7.3.4 Describe firing pin ejection and list several manufacturers that use this mechanism.

9.7.3.5 Where are the serial number locations for Glock, Taurus, Ruger, Hi-Point, and Smith & Wesson pistols?

9.7.3.6 Name some pistol manufacturers that use hidden serial numbers.

9.7.3.7 Describe how to perform a function check on a pistol with an exposed hammer versus a striker fired pistol.

9.7.3.8 Describe the differences between Smith & Wesson model Sigma series and Glock pistols.

9.7.3.9 Define cocked and locked. What make and model of firearm made this phrase popular?

9.7.3.10 Describe Glock connectors (include angle degree, angle direction, and trigger pull).

9.7.3.11 Why does the Beretta model 92 have an open top slide design?

9.7.3.12 What are the common GRC for the following:

- 9mm Luger: Hi-Point, Ruger, Glock, Smith & Wesson
- 45 Auto: Glock, Colt, Springfield Armory
- 40 Smith & Wesson: Taurus, Hi-Point
- 380 Auto: Lorcin
- 25 Auto: Raven

9.7.4 Practical exercises

Observe an instructor demonstrate how to safely handle, load, and unload some of the firearms listed. Demonstrate these safety techniques to the instructor.

Document each firearm on a firearm worksheet. Documentation of each safety feature should include specifically how that safety functions.

When applicable, list the manufacturing techniques used to fabricate and finish each of the following parts and note the manufacturing marks. Identify “marks of abuse” which could contribute to the uniqueness of each part and areas that manufacturing marks might “carry over” to another firearm.

- Breechface
- Extractor
- Ejector
- Firing pin
- Rifling
- Barrel
- Ramp
- Magazine
- Ejection port

Obtain a copy of an exploded drawing of each of the firearms listed below.

Field strip and reassemble each firearm.

Choose ammunition types with different bullet styles / jacket materials as well as different cartridge case / primer metals unless otherwise specified. Label and maintain the ammunition components produced as a result of the following examinations.

Follow the instructions listed for each firearm regarding test firing, cycling, ammunition used, disassembling/reassembling, trigger pull, and barrel/overall length measurement.

Have an instructor function check all firearms before test firing and returning them to the firearm reference collection.

Ruger model MKII, caliber 22 Long Rifle

- Test fire two (2) 22 Long Rifle LRN cartridges
- Test fire two (2) 22 Long Rifle brass coated LRN cartridges
- Test fire two (2) 22 Long Rifle copper coated LRN cartridges
- Test fire two (2) 22 Long Rifle LHP cartridges
- Detail Strip
- Prepare a brief written paper on the development of the Model MKII

Phoenix Arms model HP 22, caliber 22 Long Rifle

- Test fire two (2) 22 Long Rifle cartridges

Jennings model J-22, caliber 22 Long Rifle

- Test fire two (2) 22 Long Rifle cartridges
- Cycle two (2) 22 Long Rifle cartridges
- Detail strip
- Prepare a brief written report on the “Ring of Fire” firearms

Davis Industries model D22, caliber 22 Long Rifle derringer

- Conduct trigger pull examination
- Test fire two (2) 22 Long Rifle cartridges in each chamber
- Prepare a brief written report on derringer firearms and their development

Beretta model 950BS, caliber 25 Auto

- Test fire in single action two (2) 25 Auto Winchester Expanding Point cartridges
- Test fire in double action two (2) 25 Auto PMC FMJ cartridges
- Detail strip

FIE model Titan, caliber 25 Auto

- Test fire two (2) 25 Auto FMJ cartridges
- Detail strip

Raven model P-25 or MP-25, caliber 25 Auto

- Conduct trigger pull examination
- Cycle two (2) 25 Auto cartridges
- Test fire two (2) 25 Auto cartridges
- Detail strip

Cobra Enterprises model FS32, caliber 32 Auto

- Cycle two (2) 32 Auto cartridges
- Test fire two (2) 32 Auto FMJ and two (2) 32 Auto JHP cartridges

Bersa model Thunder 380, caliber 380 Auto

- Test fire two (2) 380 Auto PMC FMJ cartridges
- Test fire two (2) 380 Auto PPU FMJ cartridges

Ruger model LCP, caliber 380 Auto

- Cycle two (2) 380 Auto FMJ cartridges
- Test fire two (2) 380 Auto FMJ cartridges
- Test fire two (2) 380 Auto Independence/Blazer TMJ cartridges

Walther model PPK, caliber 380 Auto

- Test fire two (2) 380 Auto FMJ cartridges
- Test fire two (2) 380 Auto Sellier & Bellot FMJ cartridges

Baikal model IJ-70, caliber 9mm Makarov

- Test fire three (3) 9mm Makarov FMJ cartridges
- Test fire three (3) 380 Auto FMJ cartridges

Beretta model 92, caliber 9mm Luger

- Test fire in single action two (2) 9mm Luger PMC FMJ cartridges
- Test fire in double action two (2) 9mm Luger Winchester Silver tip JHP cartridges
- Prepare a brief written paper on the history of the Model 92
- Detail strip

Intratec model Tec-9, caliber 9mm Luger

- Test fire two (2) 9mm Luger American Eagle TMJ cartridges

- Test fire two (2) 9mm Luger Federal HST JHP cartridges
- Detail strip

Jimenez Arms model J.A. Nine, caliber 9mm Luger

- Cycle two (2) 9mm Luger cartridges
- Test fire two (2) 9mm Luger Magtech/CBC JHP cartridges
- Test fire two (2) 9mm Luger PMC FMJ cartridges
- Become familiar with limitations of the magazine safety for this firearm

Hi-Point model C9, caliber 9mm Luger

- Test fire two (2) 9mm Luger Hornady Critical Defense JHP cartridges
- Test fire two (2) 9mm Luger Winchester PDX1 JHP cartridges
- Test fire two (2) 380 Auto FMJ cartridges
- Detail strip

Ruger P-series, caliber 9mm Luger

- Conduct trigger pull examination
- Test fire two (2) 9mm Luger Winchester Ranger JHP cartridges
- Test fire two (2) 9mm Luger Winchester SXT JHP cartridges
- Test fire two (2) 9mm Luger Winchester Black Talon JHP cartridges

Glock model 31, caliber 357 SIG

- Conduct trigger pull examination
- Cycle two (2) 357 SIG cartridges
- Test fire two (2) 357 SIG cartridges
- Detail strip
- Prepare a brief written paper on Glock firearms

Ruger model SR40c, caliber 40 S&W

- Cycle two (2) 40 S&W Federal American Eagle TMJ cartridges
- Test fire in remote firing device two (2) 40 S&W Remington Golden Saber cartridges
- Test fire in water tank two (2) 40 S&W Federal American Eagle TMJ cartridges

Smith & Wesson model SD40VE, caliber 40 S&W

- Test fire two (2) 40 S&W Speer Gold Dot JHP cartridges
- Test fire two (2) 40 S&W Federal Hydra-Shok JHP cartridges
- Detail Strip

Springfield Armory model XD-40, caliber 40 S&W

- Test fire two (2) 40 S&W Federal Guard Dog cartridges
- Test fire two (2) 40 S&W Federal American Eagle TMJ cartridges

Smith & Wesson model 1006, caliber 10 mm Auto

- Test fire two (2) 40 S&W FMJ cartridges
- Test fire two (2) 10mm Auto FMJ cartridges

IMI/Magnum Research model Desert Eagle, caliber 357 Magnum

- Test fire two (2) 357 Magnum FMJ cartridges
- Detail strip

Colt model 1911A1, caliber 45 Auto

- Conduct trigger pull examination
- Test fire two (2) 45 Auto PMC FMJ cartridges
- Test fire two (2) 45 Auto Wolf (pre-striated primers) FMJ cartridges
- Prepare a written paper on the development and history of the Colt Model 1911
- Detail strip

Taurus model PT 145 Millennium Pro, caliber 45 Auto

- Test fire two (2) 45 Auto G2 Research 161.5 grain RIP cartridges
- Test fire two (2) 45 Auto PMC 230 grain FMJ cartridges
- Detail strip

45 Auto caliber Heckler & Koch Model USP semiautomatic pistol

- Test fire two (2) 45 Auto PMC 230 grain FMJ cartridges
- Test fire two (2) 45 Auto PMC 230 grain FMJ cartridges
- Test fire two (2) 45 G.A.P. FMJ cartridges

Obtain a copy of an exploded drawing of each of the firearms listed below and identify unique features in their mechanism and cycle of fire.

- 9mm Luger caliber Luger Model P08 semiautomatic pistol
- 9mm Luger caliber Browning Model Hi-Power semiautomatic pistol
- 9mm Luger caliber Walther Model P38 semiautomatic pistol
- 9mm Luger caliber Heckler & Koch Model P7 semiautomatic pistol
- 9mm Luger caliber Steyr Model GB semiautomatic pistol

9.8 Rifles

9.8.1 Reading assignments (9.12.6)

9.8.2 Training assignment

Write a paper describing the following actions and provide an example of a firearm which uses each mechanism:

- Roller delayed blowback
- Gas operated (to include direct impingement and gas piston)
- Bolt action
- Lever action
- Trap door
- Rolling block
- Martini action

9.8.3 Study Questions

9.8.3.1 Define the following terms:

- Long gun
- Carbine
- Rifle
- Mannlicher Type Bolt
- Mauser Type Bolt
- Musket
- Silencer
- Stock
- Stripper Clip
- Rotary magazine
- Drum magazine
- Machine gun
- Receiver bridge (split bridge)
- Receiver ring
- Rotating bolt
- Tilting breechblock
- Muzzle flash
- Muzzle break
- Flash suppressor
- Floating firing pin

9.8.3.2 Describe the function of a cross bolt safety.

9.8.3.3 Name two different types of ejectors on bolt action rifles. Give an example of a rifle that uses each.

9.8.3.4 Explain the difference between push feed and control feed.

9.8.3.5 Name three rifles that use a push feed system.

9.8.3.6 Name three rifles that use a control feed system.

9.8.3.7 Why can't you have a plunger type ejector with control feed?

9.8.3.8 What is meant by the term "microgroove rifling"? Name some manufacturers that use microgroove rifling.

9.8.3.9 What is a fluted chamber and give an example of a firearm that has one.

9.8.3.10 Why can only blunt-nose bullets be used in tubular magazines?

9.8.3.11 What is selective fire?

9.8.3.12 What does it mean to fire from an open bolt?

9.8.3.13 What is an en bloc clip? Give an example of a firearm that uses an en bloc clip.

9.8.3.14 Describe the differences between an AK-47 and SKS. How can these firearms be modified to fire full auto?

9.8.3.15 Describe how to perform a function check on a lever action rifle.

9.8.3.16 List two rifles with free floating firing pins.

9.8.4 Practical exercise

Observe an instructor demonstrate how to safely handle, load, and unload some of the firearms listed. Demonstrate these safety techniques to the instructor.

Document each firearm on a firearm worksheet. Documentation of each safety feature should include specifically how that safety functions.

When applicable, list the manufacturing techniques used to fabricate and finish each of the following parts and note the manufacturing marks. Identify "marks of abuse" which could contribute to the uniqueness of each part and areas that manufacturing marks might "carry over" to another firearm.

- Breechface
- Breech bolt
- Bolt
- Bolt face
- Extractor
- Ejector
- Firing pin
- Rifling
- Barrel
- Feed ramp
- Magazine
- Ejection port

Obtain a copy of an exploded drawing of each of the firearms listed below.

Field strip and reassemble each firearm prior to test firing.

Choose ammunition types with different bullet styles / jacket materials as well as different cartridge case / primer metals unless otherwise specified. Label and maintain the ammunition components produced as a result of the following examinations.

Follow the instructions listed for each firearm regarding test firing, cycling, ammunition used, disassembling/reassembling, trigger pull, and barrel/overall length measurement.

Have an instructor function check all firearms before returning them to the firearm reference collection.

Winchester model 94 caliber 30-30 Winchester

- Test fire two (2) 30-30 Winchester cartridges
- Prepare a written report about the history and development of the Winchester Model 94

Savage model 340 Series E caliber 30-30 Winchester

- Test fire two (2) 30-30 Winchester cartridges using the remote firing device
- Measure the barrel and overall length of the firearm and have it verified

Norinco Type 56S (or other AK-type) caliber 7.62x39mm

- Test fire two (2) 7.62x39mm Wolf FMJ cartridges
- Detail strip

Norinco model SKS rifle (or other SKS-type) caliber 7.62x39mm

- Cycle two (2) 7.62x39mm cartridges
- Test fire two (2) 7.62x39mm cartridges
- Detail strip

Colt model HBAR rifle (or other M16/AR15 type) caliber 223 Remington

- Cycle two (2) 223 Remington cartridges
- Test fire two (2) 223 Remington cartridges
- Test fire two (2) 223 Remington cartridges using the remote firing device
- Detail strip

Ruger model Mini-14 caliber 223 Remington

- Cycle two (2) 223 Remington cartridges
- Test fire two (2) 223 Remington cartridges

In addition, obtain a copy of an exploded drawing of each of the firearms listed below. Be able to identify unique features in their mechanism and cycle of fire.

- 30-06 Springfield caliber U.S. Rifle Model 1903
- 303 British caliber Lee-Enfield rifle
- 30-06 caliber U.S. Rifle M1 Garand
- 30-40 Krag caliber U.S. Rifle Model 1898
- Hi-Point carbines
- U.S. Rifle M14 caliber 308 Winchester

9.9 Shotguns

9.9.1 Completion of the following required reading assignments (9.12.7)

9.9.2 Training assignment

Write a paper describing the following actions and provide an example of a firearm which uses each mechanism:

- Pump action
- Long recoil
- Break open
- Boxlock action
- Sidelock action (back action, bar action)

9.9.3 Study Questions

9.9.3.1 Define the following terms:

- Choke
- Choke tube
- Forcing cone
- Forearm
- Forend
- Shotgun
- Double barrel shotgun
- Over/under shotgun
- Side by side shotgun
- Nonselective single trigger
- Selective single trigger
- Single - Double trigger
- Backboring
- Overbore
- Cartridge stop
- Barrel selector
- Automatic safety
- Barrel guide
- Inertia block
- Ventilated rib
- Barrel porting
- Primary extraction
- Recoil pad
- Combination gun
- Pistol grip

9.9.3.2 Describe magazine cut off and its purpose.

9.9.3.3 Describe magazine plug and its purpose.

9.9.3.4 What is the minimum overall and barrel length for a shotgun to be considered legal?

9.9.3.5 Describe the function of the front trigger and back trigger in a break open shotgun.

9.9.3.6 Describe how a gas operated shotgun can malfunction and how the malfunction can be fixed?

9.9.3.7 Discuss with the TC common safeties on shotguns and how to check their function.

9.9.3.8 What is a drilling?

9.9.3.9 Describe the billiard ball effect.

9.9.3.10 Describe Journee's formula.

9.9.3.11 Describe how a choke functions and list common degrees of chokes from most constriction to least constriction.

9.9.3.12 What is a poly choke and why is it popular?

9.9.3.13 Describe a screw in choke.

9.9.4 Practical exercise

Observe an instructor demonstrate how to safely handle, load, and unload some of the firearms listed. Demonstrate these safety techniques to the instructor.

Document each firearm on a firearm worksheet. Documentation of each safety feature should include specifically how that safety functions.

When applicable, list the manufacturing techniques used to fabricate and finish each of the following parts and note the manufacturing marks. Identify "marks of abuse" which could contribute to the uniqueness of each part and areas that manufacturing marks might "carry over" to another firearm.

- Breechface
- Breech bolt
- Bolt
- Bolt face
- Extractor
- Ejector
- Ejection port
- Magazine
- Firing pin
- Barrel

Obtain a copy of an exploded drawing of each of the firearms listed below.

Choose ammunition types with different shotshell loads as well as different shotshell case / primer metals unless otherwise specified. Label and maintain the ammunition components produced as a result of the following examinations.

Follow the instructions listed for each firearm regarding test firing, cycling, ammunition used, disassembling/reassembling, trigger pull, and barrel/overall length measurement.

Have an instructor function check all firearms before test firing and returning them to the firearm reference collection.

Harrington & Richardson Topper Model 158, 12 gauge (shortened barrel)

- Conduct trigger pull examination
- Measure the barrel and overall length and have them verified
- Test fire in remote firing device two (2) 12 gauge shotshells with plastic wadding
- Recover wadding and retain for future examinations

Savage Stevens model 311E, 410 bore, side by side

- Conduct trigger pull examination
- Test fire two (2) 410 shotshells in each barrel

Remington model 1100, 12 gauge

- Test fire two (2) 12 gauge shotshells
- Measure the barrel and overall length and have them verified

Browning model Light Twelve or Auto 5, 12 gauge

- Test fire two (2) 12 gauge shotshells
- Prepare a written paper on the development and history of the Browning Auto 5 shotgun.
- Detail strip

Remington model 870, 12 gauge

- Test fire two (2) 12 gauge shotshells
- Prepare a written paper on the development and history of the Remington model 870 shotgun
- Detail strip

Mossberg model 500A, 12 gauge

- Test fire two (2) 12 gauge shotshells

Ithaca model 37R Featherlight, 16 gauge (shortened barrel)

- Test fire in remote firing device two (2) 16 gauge shotshells
- Choose shotshells with plastic wadding
- Recover wadding and retain for future examinations
- Measure the barrel and overall length and have them verified

9.10 Unique Situations in Firearm Examinations

9.10.1 Completion of the following required reading assignments (9.12.8 through 9.12.14)

9.10.2 Training assignments

9.10.2.1 Prepare a written paper defining and explaining the safety implications of the following terms:

- Excessive headspace
- Bore obstruction
- Barrel bulge
- Broken extractor
- Push off
- Bump off
- Trigger shoe
- Hammer shoe
- False half cock
- Slam fire
- Improper sear engagement
- Defective safety
- High primer
- Rail splitting
- Hairline cracks
- Improper timing
- Excessive pressure
- Dented barrel
- Jar off

9.10.2.2 Discuss with Training Coordinator how to conduct an examination to determine if a firearm has been altered to fire full automatic.

9.10.2.3 Discuss with Training Coordinator the protocol to be used in determining whether a firearm can be made to fire without pulling the trigger.

9.10.2.4 Discuss with Training Coordinator the capabilities and limitations in regard to the following:

- Marking evidence firearms
- Recognition, documentation, recovery, and retention of trace evidence from the bore of a firearm
- Determining whether a firearm has been recently fired
- Determining the manufacturer of a firearm from the examination of a part from a firearm
- Determining the manufacturer of a firearm from a photograph
- Comparing a firearm to a photograph of a firearm

9.10.3 Study Questions

9.10.3.1 Define the following terms:

- Accidental discharge
- Battery (in and out of battery)
- Malfunction
- Misfire
- Misfeed
- Stove pipe

9.10.3.2 What is an air gun?

9.10.3.3 What is a starter gun?

9.10.3.4 How are firearms submitted to the laboratory when they have been recovered from water and why?

9.10.3.5 What are the capabilities, limitations, and reservations, which must be considered when restoring inoperable firearms to operating condition?

9.10.4 Practical exercise

Document each firearm on a firearm worksheet. After documentation is complete, fix the firearm. Document this fix on the firearm worksheet. Have an instructor function check prior to test firing. Test fire each firearm twice.

- Raven pistol with broken firing pin
- Glock pistol with missing recoil spring
- Jimenez pistol with sear inserted backwards
- Hi-Point pistol with magazine safety inserted upside down
- Kel-tec pistol with missing extractor

9.11 Modes of Evaluation

9.11.1 Oral Sessions

9.11.2 Completed firearm worksheets from 9.6, 9.7, 9.8, 9.9 and 9.10

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10 BULLET AND SHOTSHELL COMPONENT EXAMINATIONS AND COMPARISONS

10.1 Objectives

10.1.1 Trainee should be able to evaluate bullets / shotshell components to determine:

- Class Characteristics
- Uniqueness of marks
- Explain subclass/tool carry over and its influence

Explain the source of marks as related to firearms as a tool

10.2 Modes of Instruction

10.2.1 Self-directed study through reading assignments, training assignments, study questions and practical exercises

10.2.2 Observations

10.3 Assignments

10.3.1 Completion of the required reading assignments (10.5.1-10.5.14)

10.3.1.1 Read Sections 2, 5, and 11 of the Firearms/Toolmark Procedures Manual.

10.3.1.2 Read Sections 10 and 11 of the NIJ/NFSTC/AFTE Firearms Analyst Training. This course of instruction may be found at http://www.ojp.usdoj.gov/nij/training/firearms-training/ and http://projects.nfstc.org/firearms/

10.3.2 Study questions

10.3.2.1 Prepare a written answer for each term or phrase below. Include, as appropriate, both definitions and any significance/impact related to the examination of fired bullets.

- ogive
- bearing surface
- general rifling characteristics
- class characteristics
- knurled and smooth cannelure
- boat tail
- open base
- closed base
- recessed base
- hollow point
- weight
- caliber
- caliber type
- manufacturer
- pitch of rifling
- depth of rifling
- jacket construction/composition
- leading edge and trailing edge
- land
- groove
- land impression / groove impression
- indexing

10.3.2.2 What is a general rifling characteristics (GRC) file and what is its purpose?

10.3.2.3 What are the anchor points used for measuring land and groove impressions?

10.3.2.4 What are the manufacturing processes of a barrel that impart unique individual characteristics and how are they transferred onto a bullet?

10.3.2.5 Prepare a written answer defining each term below and relating its significance to the comparison of fired bullets.

- slippage
- shaving
- melting
- blow-by
- striation
- corrosion
- leading
- obturation
- single-action firing
- double-action firing
- individual microscopic marks
- limited individual microscopic marks
- insufficient individual microscopic marks

10.3.2.6 What are some visual differences between a lead bullet and a lead core?

10.3.2.7 What are some factors that need to be considered when selecting ammunition for test firing?

10.3.2.8 When would it be necessary to download ammunition for test firing? What is the procedure for downloading ammunition?

10.3.2.9 What is the significance of identifying manufacturing toolmarks on a fired bullet from a victim to those on unfired bullets loaded into cartridges from the suspect?

10.3.2.10 What are the possibilities for subclass characteristics on fired bullets? How can subclass influence be ruled out?

10.3.2.11 Name some firearm manufacturers that use polygonal rifling.

10.3.2.12 Is identifying a bullet back to a cartridge case a probative exam? Why or why not?

10.3.2.13 Explain the use of the mathematical formula $C=\pi d$, defining "C" and "d".

10.3.2.14 What are the types of comparison conclusions that can be reached in firearm identification comparisons? What is the basis for each of these conclusions?

10.3.2.15 What does "not suitable" for comparison mean? What types of projectile evidence does this effect, why?

10.3.2.16 What are some reasons why bullet identifications cannot be made in some cases and why some barrels and/or bullet types can preclude or tend to preclude identifications?

10.3.2.17 What conclusions can be reached from a fired slug?

10.3.3 Practical exercises

10.3.3.1 Receive a plastic bag containing ten bullets.

- Determine the weight, diameter, number of lands and grooves and direction of twist for each bullet. Measure the land and groove impressions for use with the GRC file. Record this information on a bullet worksheet.
- Search the ammunition reference collection for the possible manufacturer of each bullet.
- Using all available laboratory resources determine the style of bullet, caliber, possible brand, and a listing of the possible brands of firearms from which the bullet could have been fired. Prepare a written report for each exhibit with the findings. Discuss problems encountered when using the ammunition reference collection and GRC file.

10.3.3.2 For each caliber listed below, using each bullet type test fired from the firearms in Module 9, compare the same type of bullet with each other attempting to identify them. After completing the comparison of the same types of bullets, inter-compare the different bullet types with each other attempting to find identifications. Each set of comparison should have appropriate notes and photographs regarding observations and all conclusions. In addition, difficulties encountered within the comparisons should be addressed.

- 9mm Luger pistol
- 357 Magnum revolver
- 25 Auto pistol
- 32 Smith & Wesson revolver
- 30-30 Winchester rifle
- 7.62 x 39mm rifle
- 22 Long Rifle firearm

10.3.3.3 Using the below listed exchanged calibers, inter-compare the bullets and attempt identifications. Take appropriate notes and photographs regarding observations and all conclusions.

- 32 Auto bullets fired from a 32 S&W firearm
- 380 Auto bullets fired from a 9mm Luger firearm
- 380 Auto bullets fired from a 9mm Makarov firearm
- 40 S&W bullets fired from a 10mm Auto firearm
- 45 GAP bullets fired from a 45 Auto firearm
- 22 Long Rifle bullets fired from a 22 Magnum firearm
- 38 Special bullets fired from a 357 Magnum firearm

10.3.3.4 Using provided samples from a study involving bullets fired from consecutively manufactured barrels, conduct microscopic comparisons among all the bullets. Follow the instructions included with the test packet and use the enclosed answer key to record your answers. Compare the known test fires to each other. Observe the differences and similarities in the striations among the bullets and prepare a written report discussing your findings and observations.

10.3.3.5 Prepare a brief written summary of the types of examinations that can be conducted and what conclusions may be reached from each of the following components:

- shot, deformed and non-deformed
- fired card or fiber wads
- fired plastic wads
- fired shotshell cases
- unfired shotshells
- shot buffer material
- shot collar and shot cup

10.3.3.6 Using the fired shotshell components from Module 9 conduct appropriate comparison examinations. Take appropriate notes and photographs of observations and all conclusions.

10.3.3.7 Using a rifle from the firearms reference collection and the procedures for downloading ammunition from the Firearm/Toolmark Procedures Manual, practice downloading a cartridge and test firing the downloaded cartridge with the help of your Training Coordinator.

10.4 Modes of Evaluation

10.4.1 Practical Examination 10.4.1.1

10.4.2 Oral Sessions

10.5 References

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10.5.14 Murdock, J., "The Effect of Crowning on Gun Barrel Individuality," AFTE Newsletter #7, 1970:12-13.

11 CARTRIDGE/SHOTSHELL CASE EXAMINATIONS AND COMPARISONS

11.1 Objective

Trainee should be able to evaluate cartridge/shotshell case components to determine:

- Class Characteristics
- Uniqueness of marks
- Explain subclass/tool carry over and its influence
- Explain the source of marks as related to firearms as a tool

11.2 Modes of Instruction

11.2.1 Self-directed study through reading assignments, training assignments, study questions and practical exercises

11.2.2 Observations

11.3 Assignments

11.3.1 Completion of required reading assignments (11.5.1-11.5.19)

11.3.1.1 Read Sections 3, 5, and 11 of the Firearms/Toolmark Procedures Manual.

11.3.1.2 Read Section 9 of the NIJ/NFSTC/AFTE Firearms Analyst Training. This course of instruction may be found at http://www.ojp.usdoj.gov/nij/training/firearms-training/ and http://projects.nfstc.org/firearms/

11.3.2 Study questions

11.3.2.1 What are class characteristics as they apply to cartridge cases/shotshell cases

11.3.2.2 What types of marks can be left on a cartridge/shotshell during the loading/extracting process?

11.3.2.3 What types of marks can be left on a cartridge case during the firing process?

11.3.2.4 Be familiar with the following terms from the current version of the AFTE Glossary:

- Anvil marks
- Breechface marks
- Cycling marks
- Ejector marks
- Extractor marks
- Firing pin aperture shear
- Firing pin drag mark
- Firing pin impression
- Magazine lip marks
- Primer flow back

11.3.2.5 What are the different types of breechface marks and what manufacturing processes make these marks?

11.3.2.6 What is the significance of manufacturing marks on cartridges/shotshells and cartridge cases/shotshell cases?

11.3.2.7 What is the significance of bunter marks?

11.3.2.8 What marks can be used to differentiate between a cartridge case fired in an AK vs. an SKS type rifle?

11.3.2.9 What are some possibilities for subclass characteristics on fired cartridge cases? How can subclass influence be ruled out?

11.3.2.10 What is the significance of a fluted chamber? Provide an example(s) of firearms manufacturers that produce fluted chambers.

11.3.2.11 What firearms manufacturers use elliptical shaped firing pins?

11.3.2.12 What manufacturer(s) is known for producing ejection port (cyclone/tornado) marks on cartridge cases?

11.3.2.13 What are some known sources of manufacturer produced subclass characteristics in cartridges and which manufacturers produce them?

11.3.2.14 Prepare a written report about comparing and identifying reloading type marks on shotshells/cartridges and/or shotshell/cartridge cases. Identify the various types of marks which may be indicative of reloaded ammunition.

11.3.2.15 What is MIM? What firearm parts are MIM? What manufacturers use MIM parts? What challenges does this present to the firearms discipline?

11.3.3 Training Assignment

Review video of slow motion firing sequence using a semiautomatic firearm making note of what firearm parts come in contact with the cartridge case (located in additional references folder)

11.3.4 Practical Exercises

11.3.4.1 Using previously test fired cartridges cases from the following firearms, visually relate the markings imparted to the fired cartridge case with the part on the firearm which produced these markings. For the firearms through which cartridges were cycled, visually relate the markings imparted to the unfired cartridges with the part on the firearm which produced these markings.

- 22 Long Rifle - Ruger MKII semiautomatic pistol
- 22 Long Rifle - Jennings Model J-22 semiautomatic pistol
- 25 Auto - Raven Model P-25 or MP-25 semiautomatic pistol
- 380 Auto - Bersa Model Thunder 380 semiautomatic pistol
- 380 Auto - Ruger Model LCP semiautomatic pistol
- 9mm Luger - Intratec Model Tec-9 semiautomatic pistol
- 9mm Luger - Beretta Model 92 semiautomatic pistol
- 9mm Luger - Hi-Point Model C9 semiautomatic pistol
- 9mm Luger - Ruger Model P-series semiautomatic pistol
- 9mm Luger - Jimenez Arms Model J.A. Nine semiautomatic pistol
- 357 Magnum - Ruger Model Security Six revolver
- 357 Magnum - Colt Model Lawman revolver
- 357 SIG - Glock Model 31 semiautomatic pistol
- 40 S&W - Smith & Wesson model SD40VE semiautomatic pistol
- 40 S&W - Ruger Model SR40c semiautomatic pistol
- 40 S&W - Springfield Armory model XD-40 semiautomatic pistol
- 10mm Auto - Smith & Wesson Model 1006 semiautomatic pistol

- 45 Auto - Colt Model 1911A1 semiautomatic pistol
- 45 Auto - Taurus Model PT 145 Millennium Pro semiautomatic pistol
- 30-30 Winchester - Winchester Model 94 lever-action rifle
- 7.62x39mm - Norinco Type 56S (or other AK-type) semiautomatic rifle
- 7.62x39mm - Norinco Model SKS (or other SKS-type) semiautomatic rifle
- 223 Remington - caliber Colt Model HBAR (or other AR15 type) semiautomatic rifle
- 12 Gauge - Remington Model 870 slide-action shotgun
- 12 Gauge - Remington Model 1100 semiautomatic shotgun

11.3.4.2 Using the test fired cartridge cases from the firearms listed above, microscopically compare all of the markings with each other. Include the following types of markings in your microscopic comparisons, as applicable: firing pin impression, breechface markings, chamber marks, anvil marks, extractor marks, ejector marks, ramp marks, ejection port marks, and magazine marks. Photograph the results of your comparisons.

11.3.4.3 Test fire a cartridge in each chamber of a Harrington & Richardson Model 622 caliber 22 Long Rifle revolver and microscopically compare the fired cartridge cases to each other. Include the following types of markings in your microscopic comparison: firing pin impression, breechface marks, chamber marks, and anvil marks. Photograph the results of your comparisons.

11.3.4.4 Using the cycled cartridges from the firearms listed below, microscopically compare any markings with each other and then to the test fired cartridge cases from the same firearm. Photograph the results of your comparisons.

- 25 Auto - Raven Model P-25 or MP-25 semiautomatic pistol
- 32 Auto - Cobra Enterprises Model FS32 semiautomatic pistol
- 380 Auto - Ruger Model LCP semiautomatic pistol
- 9mm Luger - Jimenez Arms Model J.A. Nine semiautomatic pistol
- 357 SIG - Glock Model 31 semiautomatic pistol
- 40 S&W - Ruger Model SR40c semiautomatic pistol
- 223 Remington - Colt Model HBAR rifle (or other M16/AR15 type rifle)
- 7.62x39mm - AK type rifle

11.3.4.5 Using the below listed exchanged calibers, inter-compare the cartridge cases and attempt identifications. Take appropriate notes and photographs regarding observations and all conclusions.

- 380 Auto cartridge cases fired in a 9mm Luger firearm
- 380 Auto cartridge cases fired in a 9mm Makarov firearm
- 40 S&W cartridge cases fired in a 10mm Auto firearm
- 45 GAP cartridge cases fired in a 45 Auto firearm

11.3.4.6 Using the test fired cartridge cases provided from the following firearms, examine the cartridge cases microscopically. First compare the sets of knowns to each other and then inter-compare the test fires from different firearms. Fill out a worksheet for each set of test fired cartridge cases and take appropriate notes and photographs regarding observations about the similarities and differences between each set. Note similarities and/or differences in the firing pin, firing pin aperture, shape of ejector mark, and ejector mark placement.

- 9mm Luger Smith & Wesson (Sigma Series with elliptical FP)
- 9mm Luger Glock (Elliptical FP)
- 9mm Luger Springfield (XDS with elliptical FP)

11.3.4.7 Using the test fired cartridge cases provided from the following firearms, examine the cartridge cases microscopically. First compare the sets of knowns to each other and then inter-

compare the test fires from different firearms. Fill out a worksheet for each set of test fired cartridge cases and take appropriate notes and photographs regarding observations about the similarities and differences between each set. Note similarities and/or differences in the firing pin, firing pin aperture, shape of ejector mark, and ejector mark placement.

- 9mm Luger Smith & Wesson (Sigma series with D/Oval shaped FP)
- 9mm Luger Smith & Wesson (M&P series with Hemispherical FP and teardrop shaped aperture)
- 9mm Luger Glock (D shaped FP and teardrop shaped aperture)

11.3.4.8 Using the provided test fires from the following firearms, microscopically examine the sets of test fires and note the class characteristics of each firearm. Take appropriate notes and photographs.

- Bersa
- Cobra
- Cobray
- Glock
- Hi-Point
- Jimenez Arms/Bryco Jennings Nine
- Phoenix Arms
- Ruger
- Smith & Wesson Sigma series
- Smith & Wesson M&P series
- Springfield Armory XDS
- Taurus

11.4 Modes of Evaluation

11.4.1 Practical Examination 11.4.1.1

11.4.2 Oral Sessions

11.5 References

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12 GUNSHOT RESIDUE AND DISTANCE DETERMINATION

12.1 Objective

To make the trainee proficient in the examination of objects for gunshot residue and conduct appropriate firearm / muzzle-to-object distance determination.

12.2 Modes of Instruction

12.2.1 Self-directed through study questions and practical exercises

12.2.2 Mentored casework / Observations

12.3 Assignments

12.3.1 Completion of required reading assignments (12.7.1 – 12.7.21)

12.3.2 Read Sections 7 and 11 of the Firearms/Toolmark Procedures Manual

12.3.3 Study questions

12.3.4 Practical exercises

12.4 Study Questions

12.4.1 Write a report describing the chemical reactions for the following chemical tests:

- Diphenylamine
- Modified Griess
- Sodium Rhodizonate
- DTO (dithiooxamide)

12.4.2 In general, explain the steps involved in evaluating an article of clothing for the presence of a gunshot residue pattern.

12.4.3 Describe why and how you would conduct a Modified Griess test.

12.4.4 Describe why and how you would conduct a Sodium Rhodizonate test.

12.4.5 How would you conduct a Sodium Rhodizonate test when the substrate is dark and the reaction cannot be observed?

12.4.6 What are the characteristics of a contact shot?

12.4.7 Why is a range reported / what is the purpose of a bracket?

12.4.8 How does choke affect spread?

12.4.9 Discuss with your TC the basic laboratory steps for conducting distance determinations, examination conclusion limitations, and the potential effects of the following:

- Barrel length
- Powder morphology
- Ammunition type
- Intermediate objects
- Handling of clothing

- Type of clothing
- Distance
- Interference from body fluids

12.5 Practical Exercises

12.5.1 Working with your TC, as available, prepare the necessary materials (e.g., chemicals, controls, papers) for conducting distance determination evaluations/examinations.

12.5.2 Complete the microscopic evaluation and direct chemical processing of white fabric sample(s). Document using appropriate notes, worksheets and photographs. Explore one of the factors listed in Study Question 12.4.9.

12.5.3 Complete the microscopic evaluation and chemical processing using transfer techniques of dark fabric sample(s). Document using appropriate notes, worksheets and photographs.

12.5.4 Complete the microscopic evaluation and appropriate chemical processing of provided "complex" gunshot residue samples. (To include possible folds; angle influence; cylinder flash)

12.5.5 Evaluate the pellet patterns provided to you from your TC. Discuss results with your TC.

12.5.6 Receive a firearm, ammunition, and an unknown pattern from your TC to complete a distance determination. Conduct all appropriate visual, microscopic and chemical examinations on the unknown and generated known patterns. Complete appropriate notes/photographs, and document your final distance determination.

12.5.7 Complete the microscopic evaluation and appropriate chemical processing of provided "complex" gunshot residue samples. (To include possible folds; angle influence; cylinder flash)

12.5.7.1 Using appropriate laboratory reference firearms, produce/reproduce gunshot residue patterns similar to those in the "complex" samples (e.g., cylinder flash / top strap; folds; angles)

12.5.7.2 After the completion of the complex exercise, receive a firearm and ammunition from your TC and complete known patterns for comparison determining an appropriate distance with the selected gunshot residue pattern.

12.5.8 Complete the evaluation of a provided pellet pattern. Using the approximate 1" per 1 yard criteria, determine an approximate distance. Complete appropriate notes/worksheets.

12.5.9 Using provided non-porous materials, chemically process each using appropriate Modified Griess and Sodium Rhodizonate transfer techniques.

12.6 Modes of Evaluation

12.6.1 Practical Exercises 12.5.6, 12.5.7.1 and 12.5.8

12.6.2 Successful completion Practical Exam

12.6.3 Oral Session

12.7 References

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12.7.2 Bonfanti, M. and Gallusser, A., "Problems Encountered in the Detection of Gunshot Residues," AFTE Journal, 1995; 28(2): 105-122.

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13 FRACTURE MATCH EXAMINATIONS

13.1 Objectives

13.1.1 To become knowledgeable and understand the methodologies used to identify two objects as having been at one time joined and a part of the same object (fracture or physical matching)

13.1.2 Learn the technique of reverse lighting

13.2 Modes of Instruction

13.2.1 Self-directed study through study questions and practical exercises

13.2.2 Specific lectures or presentations

13.2.2 Observations

13.3 Assignments

13.3.1 Completion of required reading assignments (13.6.1 – 13.6.13)

13.3.2 Study questions

13.3.3 Practical exercises

13.4 Study Questions

13.4.1 Explain the random processes that produce uniqueness in surface fractures.

13.4.2 Define fracture match.

13.4.3 Describe a “physical fit” examination.

13.4.4 Explain plastic deformation in non-brittle fractures.

13.5 Modes of Evaluation

13.5.1 Practical exercises

13.5.1.1 You will receive 3 sets of broken objects. 1) Broken screwdriver tips 2) broken key blanks 3) a broken grip plate(s). Complete the appropriate worksheets, documenting observations with photos and/or sketches. At least a minimum, one of the 3 practical sets shall be additionally examined using opposite/reverse lighting and casting methods. Be prepared to discuss all conclusions and observations of method limitations.

13.5.1.2 Tear and cut various samples of tape; document observations of cut versus torn edges, and any limitations of source conclusions.

13.5.2 Practical examination

13.5.3 Oral session

13.6 References

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14 NUMBER RESTORATION

14.1 Objectives

14.1.1 To become knowledgeable in the scientific theory behind the restoration of obliterated characters

14.1.2 To become proficient in the different methods used to restore obliterated characters

14.2 Modes of Instruction

14.2.1 Self-directed study through study questions and practical exercises

14.2.2 Observations

14.3 Assignments

14.3.1 Completion of required reading assignments (14.7.1-14.7.8)

14.3.2 Study questions

14.3.3 Practical exercises

14.4 Study Questions

14.4.1 Define the following as they pertain to number restoration:

- Plastic deformation
- Elastic deformation
- Grinding
- Over stamping (re-stamping)
- Gouging
- Heating
- Welding
- Removal

14.4.2 Explain the scientific theory for the restoration of characters.

14.4.3 Explain the examination procedure used for the restoration of characters.

14.4.4 Briefly explain the chemical reactions that occur during the restoration of characters.

14.4.5 List and explain obliteration methods and how to recognize each. List potential effects on the subsurface and the selection of the appropriate polishing technique.

14.4.6 Prepare a list of chemical etchants, their contents, and the most common metals they would be used for.

14.4.7 Briefly explain the principle of magnetic particle inspection.

14.4.8 How do manufacturers impart serial numbers and what effect do these processes have on the potential restoration?

14.5 Practical Exercises

14.5.1 Using laboratory specimens, conduct several number restorations. At a minimum, document with appropriate notes/photographs the following: obliteration method (several methods may be evaluated), material evaluated (the student should include both ferrous and non-ferrous materials), polishing

techniques, and various etchants used/combined and any resulting effectiveness (e.g., restoration character contrast, speed of oxidation).

14.5.2 Using laboratory specimens, as available, conduct magnetic particle inspection restorations.

14.5.3 Using the appropriate bar code appendix from the firearms section procedures manual, select a firearm from the reference collection and decode the associated serial number. Take appropriate notes/photographs.

14.5.4 Discuss with your TC the use of the firearms reference collection and other available references in determining alphanumeric serial number combinations, font styles, and potential "secondary"/hidden serial numbers.

14.5.5 Discuss with your TC the safe handling and storage of all chemicals potentially used in Number Restoration.

14.5.6 Discuss with your TC the heat procedure that is used for restorations in plastic.

14.5.7 Obtain from the TC, laboratory specimens with areas of obliteration and attempt to restore them. As instructed, prepare notes and photographs to substantiate all conclusions and results.

14.5.8 Complete an assigned unknown bar code for serial number decryption. Take appropriate notes/photographs.

14.5.9 Using appropriate method(s), complete an assigned unknown serial number restoration. Take appropriate notes/photographs.

14.6 Modes of Evaluation

14.6.1 Practical Exercises (14.5.8 and 14.5.9)

14.6.2 Oral Session

14.7 References

14.7.1 Klees, Gregory, "The Restoration of Obliterated Laser-Etched Firearm Identifiers by Conventional and Alternative Decryption Methods", AFTE Journal, 2002; 34(3): 264-267.

14.7.2 O'Reilly, W. E., "Magnetic Restoration of Serial Number", AFTE Newsletter 7, No. 2, April 1970, pp. 26-27.

14.7.3 Polk, Donald E. and Giessen, Bill C., "Metallurgical Aspects of Serial Number Recovery", AFTE Journal, 1975; 7(2): 38-52.

14.7.4 Massiah, Ernest E., "A Compilation of Techniques and Chemical Formula Used in the Restoration of Obliterated Markings", AFTE Journal, 1976; 8(2): 26-62.

14.7.5 Treptow, Richard, Handbook of Methods for the Restoration of Obliterated Serial Numbers, National Aeronautics and Space Administration, January 1978, Chapters 1, 2, 3, 5, 8.

14.7.6 Collins, John, "Modern Marking and Serial Number Methods", AFTE Journal, 1999; 31(3): 309-317.

14.7.7 Wagoner, Andy, "Griffin's Reagent for Serial Number Restoration in Stainless Steel", AFTE Journal, 1999; 31(4): 497.

14.7.8 Kuppuswamy, R., “Metallographic Etching of Aluminium and Its Alloys for Restoration of Obliterated Marks in Forensic Science Practice and Investigations, Aluminium Alloys, Theory and Applications”, 2011. Available on-line: http://www.intechopen.com/books

15 REPORT WRITING, EXPERT TESTIMONY, AND PROFESSIONALISM

15.1 Objectives

15.1.1 To become familiar with the Department of Forensic Science Quality Manual in regards to note taking, chain of custody and report writing.

15.1.2 To become familiar with the Department of Forensic Science Firearm/Toolmark Procedures Manual in regards to note taking, chain of custody and report writing.

15.1.3 To become familiar with the Department of Forensic Science LIMS.

15.1.4 To become familiar with technical and administrative review of case files.

15.1.5 To become proficient presenting findings in court.

15.2 Modes of Instruction

15.2.1 Self-directed study through study questions and practical exercises

15.2.2 Observations

15.3 Assignments

15.3.1 Completion of required reading assignments (15.7.1-15.7.26)

15.3.2 Study questions

15.3.3 Practical exercises

15.4 Study Questions

15.4.1 Define the following:

- Expert witness
- Opinion
- Voir dire
- Ethics
- Bias
- Forensic science

15.4.2 Discuss with your TC reasonable degree of scientific certainty, practical certainty and practical impossibility.

15.4.3 Discuss potential juror bias of forensic scientists and their potential effect on testimony.

15.4.4 What is the CSI Effect and how has it impacted forensic expert testimony?

15.4.5 Discuss non-verbal cues and delivery influences on expert credibility.

15.4.6 Discuss evidence packaging and marking criteria as listed in the Quality Manual.

15.4.7 Discuss the general examination documentation requirements in the Quality Manual and the Firearm/Toolmark Procedures Manual.

15.4.8 What is the standard for admissibility of expert testimony in Virginia and how would that differ from Federal Court?

15.5 Practical Exercises

15.5.1 Discuss with your TC the standards regarding note taking, chain of custody and report writing as they relate to the Department of Forensic Science Quality Manual and the Firearm/Toolmark Procedures Manual.

15.5.2 Discuss with your TC the standards regarding file maintenance and location and courtroom testimony monitoring as they relate to the Department of Forensic Science Quality Manual.

15.5.3 Read through copies of reports generated by examiners to familiarize yourself with report formats and phraseology.

15.5.4 Discuss with your TC the operation of local, state and federal law enforcement agencies and court systems.

15.5.5 When possible, observe examiners testifying; discuss with your TC their demeanor and professionalism.

15.5.6 Confer with other examiners regarding personal hints and recommendations in regards to courtroom testimony.

15.5.7 Using current ASCLD/LAB criteria and the Department's Quality Manual and Section Procedures manual, discuss with your TC how the laboratory meets the accreditation standards.

15.5.8 Prepare a list of "qualification questions" which can be used by the prosecutor to qualify you as an expert witness. Discuss with your TC.

15.5.9 Discuss with the TC the laboratory policy regarding the reexamination of evidence.

15.5.10 Discuss with the TC the laboratory policies regarding the following:

- Providing verbal results prior to issuance of a final laboratory report
- Inquiries from the press and other media
- Providing a laboratory report to other agencies and Medical Examiner
- The Department's subpoena policy (to include, civil, federal, and state courts)
- The Department's policies on case file check out; SDT for notes; FOIA requests; taking cases to court; providing copies of notes to attorneys; deposition requests

15.5.11 Discuss with the TC the Department of Forensic Science's proficiency testing program as it relates to the firearm and toolmark section and be able to discuss this topic.

15.5.12 Demonstrate a working ability to describe the uncertainty of measurement in a courtroom testimony situation.

15.5.13 The trainee should document the review of at least five case files using the appropriate Technical Review Form. Case files should be generated by multiple examiners, if possible. The potential findings of the reviews shall be discussed with the TC. Technical Review forms generated in this capacity shall be marked as Training and retained in their Training File. The case files shall be technically reviewed by an authorized examiner pursuant to QM 17 prior to release.

15.5.14 Complete an ASCLD/LAB-*International* Audit Trail Worksheet on at least one case.

15.5.15 Complete at least one mock case in the stage database of LIMS.

15.6 Modes of Evaluation

15.6.1 Practical Exercises

15.6.2 Oral Session

15.7 References

15.7.1 Dutton, Gerard, “Ethics in Forensic Firearm Investigation”, AFTE Journal, 2005; 37(2): 79-85.

15.7.2 Giannelli, Paul C., LL.M., "Evidentiary and Procedural Rules Governing Expert Testimony," Journal of Forensic Sciences, 1989; 34(3): 730-748.

15.7.3 Hatcher, J.S., Jury, F.J., and Weller, J., Firearms Investigation, Identification and Evidence, 2nd edition, Stackpole Books, Harrisburg, 1957, pp. 445-460.

15.7.4 Hodge, Evan E. and Blackburn, Bobby D., "The Firearms-Toolmark Examiner in Court", AFTE Journal, 1979; 11(4): 70-96.

15.7.5 “Effective Expert Testimony,” AFTE Journal, 1972; 4(4): 8.

15.7.6 Joling, R.J., and Stern, W.W., “An Overview of Firearms Identification Evidence for Attorneys, II: Applicable Law of Recent Origin,” AFTE Journal, 1981; 13(4):134-139.

15.7.7 Joling, R.J., and Stern W.W., “An Overview of Firearms Identification Evidence for Attorneys, III: Qualifying and Using the Firearms Examiner as a Witness,” AFTE Journal, 1981; 13(4): 140-144.

15.7.8 Joling, R.J., and Stern W.W., “An Overview of Firearms Identification Evidence for Attorneys, IV: Practice and Procedures When Using the Firearms Examiner and Demonstrative Evidence,” AFTE Journal, 1981; 13(4): 145-148.

15.7.9 Kates, James H. and Henry K. Guttenplan, Ph.D., "Ethical Considerations in Forensic Science Services," Journal of Forensic Sciences, 1983; 28(4): 972-976.

15.7.10 Lucas, Douglas M., M.Sc., "The Ethical Responsibilities of the Forensic Scientist: Exploring the Limits," Journal of Forensic Sciences, 1989; 34(3): 719-729.

15.7.11 Saks, Michael J., Ph.D., M.S.L., "Prevalence and Impact of Ethical Problems in Forensic Science," Journal of Forensic Sciences, 1989; 34(3): 772-793.

15.7.12 Schroeder, Oliver C., J.D., "Ethical and Moral Dilemmas Confronting Forensic Scientists," Journal of Forensic Sciences, 1984; 29(4): 966-986.

15.7.13 Moran, Bruce, "Firearms Examiner Expert Witness Testimony: The Forensic Firearms Identification Process Including Criteria for Identification and Distance Determination," AFTE Journal, 2000; 32(3): 231-251.

15.7.14 Murdock, J.E., “Some Suggested Court Questions to Test Criteria for Identification Qualifications,” AFTE Journal, 1992; 24(1): 69-75.

15.7.15 Peterson, Joseph L., D. Crim. and John E. Murdock, M. Crim., "Forensic Science Ethics: Developing an Integrated System of Support and Enforcement," Journal of Forensic Sciences, 1989; 34(3): 749-762.

15.7.16 Sereno, Kenneth K., Ph.D., "Source Credibility," Journal of Forensic Sciences, 1983; 28(2): 532-536.

15.7.17 Tanton, R.L., “Jury Preconceptions and Their Effect on Expert Scientific Testimony,” AFTE Journal, 1980; 12(2): 67-77.

15.7.18 Townshend, D.G., “Observation of the Witness,” AFTE Newsletter, 1973; 5(4): 26-28.

15.7.19 Mogil, Hon. B. Marc, J.D., "Maximizing Your Courtroom Testimony," FBI Law Enforcement Bulletin, May 1989, p. 7-9.

15.7.20 Shelton, Donald E. et al., “Studying Juror Expectations for Scientific Evidence,” Court Review, 2011; 47(1): 8-18.

15.7.21 Scanlon, Timothy, “Influences of the CSI Effect, Daubert Ruling and NAS Report on Forensic Practices”, Walden University Scholar Works, 2015; pp. 1-160.

15.7.22 Tuthill, Harold, Individualization: Principles and Procedures in Criminalistics, 1994; pp. 2-119.

15.7.23 Quality Manual – Section 17 Monitoring Results

15.7.24 Firearms and Toolmarks Procedure Manual Sections, referring to Examination Documentation

15.7.25 DFS Document 100-F111 Technical Review Form

15.7.26 ASCLD/LAB-*International* Supplemental Requirements for Accreditation of Forensic Science Testing Laboratories (2011)

15.7.27 ISO/IEC 17025:2005 – accessible through DFS Intranet

16 UNCERTAINTY OF MEASUREMENT

16.1 Objectives

16.1.1 To familiarize the trainee with concepts of uncertainty of measurement.

16.1.2 To familiarize the trainee with traceability and its associated concepts.

16.2 Modes of Instruction

16.2.1 Self-directed study questions and practical exercises

16.2.2 Observation

16.3 Assignments

16.3.1 Completion of required reading and presentations (16.7.1)

16.3.2 Study questions

16.3.3 Practical exercises

16.4 Study Questions

16.4.1 Define the following terms:

- Mean
- Range
- Accuracy
- Precision
- Gaussian distribution
- Confidence Interval
- Measurement
- Measurand
- Type A evaluation
- Type B evaluation

16.4.2 Draw and explain what a Gaussian distribution is and how it relates to measurement uncertainty. Demonstrate two Gaussian distributions where one has high variability and one has low variability.

16.5 Practical Exercises

16.5.1 Summarize how the value for each Uncertainty Component was determined.

16.5.2 Write a brief description of the traceability of the ruler used for the measurement.

16.6 Mode of Evaluation

16.6.1 Practical exercises

16.7 Reading and Presentations

16.7.1 Required

16.7.1.1 Presentations and Record of Procedure in the Quality System, Uncertainty of Measurement folder on the intranet

16.7.1.2 ASCLD/LAB Policy on Measurement Uncertainty (AL-PD-3060).

16.7.1.3 ASCLD/LAB Policy on Measurement Traceability (AL-PD-3057).

16.7.1.4 ASCLD/LAB Guidance on Measurement Traceability (AL-PD-3058).

16.7.1.5 ASCLD/LAB Guidance on Estimation of Measurement Uncertainty – Overview (AL-PD-3061).

16.7.1.6 ASCLD/LAB Guidance on Estimation of Measurement Uncertainty – ANNEX A: Details on the NIST 8 Step Process (AL-PD-3062).

16.7.1.7 ASCLD/LAB Guidance on Measurement Traceability – Measurement Assurance (AL-PD-3059).

16.7.1.8 Section Specific Guidance Documents.

16.7.1.8.1 ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty – ANNEX C Firearms/Toolmarks Discipline: Firearms Category of Testing Example – Overall Length of a Firearm (AL-PD-3064).

16.7.2 Additional References

16.7.2.1 Introducing the Concept of Uncertainty of Measurement in Testing in Association with the Application of the Standard ISO/IEC 17025 (ILAC-G7:2002).

16.7.2.2 Bell, S. A Beginner's Guide to Uncertainty of Measurement, Measurement Good Practice Guide No. 11 (Issue 2), ISSN 1368-6550.

17 EVIDENCE HANDLING

17.1 Objectives

17.1.1 For the trainee to understand the fundamentals of evidence security

17.1.2 To familiarize the trainee with the chain of custody portion of LIMS

17.2 Modes of Instruction

17.2.1 Demonstration by the TC of evidence handling

17.2.2 Self-directed study through reading assignments and study questions

17.3 Assignments

17.3.1 Completion of required reading assignments (17.7)

17.3.2 Study questions

17.3.3 Practical exercises

17.4 Study Questions

17.4.1 Explain the parallel chain of custody documentation methods used by the Department.

17.4.2 Define a proper seal.

17.4.3 What is the proper way to mark evidence?

17.4.4 Who has access to the main evidence storage room in the section? Your personal locker?

17.4.5 Who has access to your work area?

17.4.6 Describe the procedures for access to your locker in your absence.

17.4.7 Explain the lock box procedure.

17.4.8 Explain how to handle evidence which also needs a latent print analysis.

17.4.9 Explain how to handle evidence which also needs a DNA analysis.

17.4.10 Define the following terms:

- chain of custody
- lock box
- evidence seal
- convenience packaging
- RFLE
- FS Lab #
- LIMS

17.4.11 What is a container?

17.4.12 What is the pathway that an item of evidence goes through from the time it enters DFS to the time it is returned to the agency?

17.4.13 Describe the duties of the “primary examiner”. How is the “primary examiner” determined?

17.5 Practical Exercises

17.5.1 Discuss with your TC the standards regarding chain of custody as they relate to the Department of Forensic Science Quality Manual and the Firearm/Toolmark Procedures Manual.

17.5.2 Demonstration of proper chain of custody practices with the TC.

17.6 Mode of Evaluation

Written Examination

17.7 References

17.7.1 Quality Manual, Department of Forensic Science

17.7.2 Firearm/Toolmark Procedures Manual, Department of Forensic Science

17.7.3 17.7.3 LIMS system manual

18 COGNITIVE FACTORS IN COMPARATIVE ANALYSIS

18.1 Purpose

Toolmark comparisons are conducted using comparative analysis. Comparative analysis is a cognitive process in which the primary "tool" is the examiner's brain. It is important therefore to have an understanding of how the brain "sees" images and how one's view can be influenced by outside factors or extraneous information. The trainee will develop an awareness of how the brain affects what is seen and the implications this can have on the decision making process when conducting toolmark comparisons.

18.2 Objective

The trainee will be knowledgeable and understand:

- The role the brain plays in the comparative analysis process.
- The various factors that can influence the decision making process during the comparison process.

18.3 Mode of Instruction

Self-directed study through study questions

18.4 Assignments

18.4.1 Completion of required reading assignments (18.6.1 – 18.6.5)

18.4.2 Study Questions

18.4.2.1 Describe the different types of bias

18.4.2.2 Explain how a person "sees" things; to include the role of the brain in the comparative analysis process and factors that can influence the comparison process.

18.4.2.3 Provide examples where these biases may be encountered when conducting toolmark comparisons. Explain sources ("the process") of motivational and conformational biases

18.4.2.4 Summarize the findings from cognitive research in the pattern comparison discipline.

18.4.2.5 Summarize the suggestions to reduce biases within the laboratory; include potential ramifications of different types of errors and specific steps you can implement into daily work habits to help prevent negative influences.

18.5 Mode of Evaluation

18.5.1 Study Questions

18.5.2 Oral Session

18.6 References

18.6.1 Dror, Itiel and Charlton, David, "Why Experts Make Errors," Journal of Forensic Identification, 2006, 56 (4) 600 – 616

18.6.2 Dror, Itiel E., "Practical Solutions to Cognitive and Human Factor Challenges in Forensic Science," *Forensic Science Policy & Management* 2013, 4 (3-4), 1 - 9

18.6.3 Kassin, Saul M., Dror, Itiel E., and Kukucka, Jeff, "The Forensic Confirmation Bias: Problems, Perspectives, and Proposed Solutions,: *Journal of Applied Research in Memory and Cognition*, 3 (2013) 42 - 52

18.6.4 Kerstholt, Jose, Eikelboom, Aletta, Dijkman, Tjisse, Stoel, Reinoud, Hermsen, Rob, and van Leuven, Bert, "Does Suggestive Information Cause a Confirmation Bias in Bullet Comparison?" *Forensic Science International* 198 (2010) 138 – 142

18.6.5 Nickerson, Raymond S., "Confirmation Bias: A Ubiquitous Phenomenon in Many Guises," Review of General Psychology, 1998, 2 (2) 175 - 220

Appendix A - Individual Training Plan (ITP) Template

For each section listed below include the following information:

- List previous documented training received
- Provide detailed plan, including assignments, exercises, exams and presentations to be completed with dates, for each section.

The objectives listed in the Firearm/Toolmark Training Manual should be used as a guide for questions during the assessment to determine the individual's knowledge level.

Quality Manual / Firearms Safety
Instrumentation
Machining Processes
Introduction to Toolmark Identification
Toolmark Examinations and Comparisons
Firearm and Toolmark Evidence Admissibility Criteria and Defense
History of Firearms Identification
Ammunition
Firearms
Bullet and Shotshell Component Examinations and Comparisons
Cartridge and Shotshell Case Examinations and Comparisons
Gunshot Residue and Distance Determination
Fracture Match Examinations
Number Restoration
Report Writing, Expert Testimony and Professionalism
Uncertainty of Measurement
Evidence Handling
Cognitive Factors in Comparative Analysis

The expected completion date of this training plan is _____.