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 Examiners employed by the Commonwealth of Virginia. This manual 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 table of contents 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 The training program will be coordinated by the Training Coordinator (TC). The TC is designated by the Section Supervisor in consultation with the Program Manager (PM).

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, completing tasks in which competency has been demonstrated, 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

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

1.5 Training Goals

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

1.5.1.1 The knowledge of tool, firearm, and ammunition manufacturing.

1.5.1.2 The knowledge of the principles and practices of tool actions and marks imparted by each class of tool.

1.5.1.3 The knowledge of the principles and practices of firearm actions and marks imparted by each tool working surface of a firearm.

1.5.1.4 The knowledge of the theory and applications of the variety of microscopic techniques used in the analysis and comparison of evidence.

1.5.1.5 The knowledge of the theory and practices of serial number restoration.

1.5.1.6 The knowledge of the principles and practices of distance determination.

1.5.1.7 The ability to properly handle forensic evidence.

1.5.1.8 The ability to perform accurate forensic analysis independently and proficiently.

1.5.1.9 The ability to complete a Certificate of Analysis following section and Department policies.

1.5.1.10 The ability to skillfully present and defend analytical findings in court.

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 PM 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 cumulative question and answer sessions that will be conducted throughout the training period. There will be two different types of expected responses. First, there will be technical responses. Second, there will also be times where 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. The Oral Session Rubric 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 to ensure each trainee receives basic principles and fundamentals necessary to independently function as a firearms and toolmarks 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 PM.

1.7.2 The performance of the trainee will be evaluated during the course of the program. The TC must submit monthly written reports to the PM and Laboratory Director (via Qualtrax). The TC is to discuss this evaluation with the trainee prior to forwarding it to the PM. 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 Firearm/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 PM.

1.7.4 The TC will submit a written recommendation to the PM 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.

1.9 Guidelines for the Competency Examination

1.9.1 Successful demonstration of competence shall be documented in the training record.

1.9.2 The trainee shall demonstrate competence prior to handling evidence during supervised work-alongs. To establish this competency the trainee shall observe the TC handling evidence and successfully complete an oral question and answer session in which the trainee verbally explains the process.

1.9.3 The trainee shall demonstrate competence in performing the below processes prior to conducting these tasks in supervised work-alongs. Competence for this situation is defined as properly conducting the task, not interpreting the result.

- Safe handling of a firearm and ammunition
- Use of the water tank, shooting range and remote firing device
- NIBIN entry

1.9.4 Competency examinations will be given at the completion of both toolmark and firearm training based on the topics that have been covered during the training.

1.9.5 Practical Test

The practical tests are mock cases, intended to simulate an average case in difficulty and complexity. One will be completed after the toolmark portion of the training and another will be completed after the firearm portion of the training. The firearm test should contain, at a minimum, function of a firearm, ammunition component comparison, distance determination and serial number restoration. There should be clear expected outcomes where the ground truth is known and has been validated through comparison and verification by qualified examiners.

The proper chain of custody for all mock case items and containers shall be recorded in the LIMS training database for all tests associated with the mock case.

The tests shall be approved by the PM prior to being presented to the trainee.

1.9.6 Technical Final

The technical final examination will be given by the Laboratory's Firearms & Toolmarks Section Supervisor and TC in the presence of the PM and other Department management (as needed) to ascertain the technical knowledge of the individual. After the examination, the TC, PM and relevant management with input from other attendees, will assess the trainee's performance. The performance of the trainee 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, PM and Laboratory Director will determine the appropriate action. Technical final examinations will be given at the completion of both toolmark and firearm training based on the topics that have been covered during the training. After satisfactory completion of the technical final examination, the trainee will participate in a final mock trial.

1.9.7 Mock Trial

A mock trial will be conducted after the completion of the firearm portion of the training manual and after the completion of the toolmark portion of the training manual. The Quality Manual (QM) outlines the roles and responsibilities of the participants as well as evaluation and grading guidelines. It will be done in a formal courtroom-like setting. The firearm mock trial must be passed prior to performing casework or continuing in the program. If it is not successfully completed the first time, a second opportunity will be given.

1.9.8 Training Documentation

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

- Written and oral tests
- Description of practical exercises, with results as applicable
- Copies of the presentations
- Competency practical test
- Signed and dated Firearm/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 Casework will be introduced stepwise under the close supervision of a qualified examiner.

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

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

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

1.11 Experienced Personnel

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

1.11.2 Individual Training Plan (ITP)

1.11.2.1 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 to what training the new employee received in the subject matter.

1.11.2.2 At a minimum, the new employee shall complete a written, oral or practical test for each module as well as provide presentations listed in sections 7.3.2, 7.3.3 and 7.3.4 of this manual.

1.11.3 Training Documentation

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

- Individual Training Plan
- Written and oral tests
- Description of practical examinations, with results as applicable
- Copies of the presentations
- Competency practical test
- Signed and dated Firearm/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.

1.11.4 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 The required training listed in section 19.4 of the QM shall be completed.

1.12.2 The following documents will be covered:

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

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

1.12.4 The duties of an examiner, as determined by the classification of the position, will be clarified.

1.12.5 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 firearm's trigger guard and off 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.
- If the examiner is not familiar with the function of a firearm or if there is any doubt about the operability of a firearm, they should consult with the Section/Group Supervisor before test firing.
- All observers in test firing areas will stand behind the shooter.

1.13.2 Assignments

1.13.2.1 Attend a Basic Firearm Safety Course at a local firing range or similar external entity. This training shall be completed prior to conducting any test firing at the Department.

1.13.2.1.1 The TC shall coordinate with the Department's Safety Officer for the course selection.

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

1.13.2.3 Review the instruction manual for the laboratory bullet recovery tank and demonstrate competency test firing a pistol, revolver and rifle into the tank.

1.13.2.4 Review the firing range rules and discuss them with the TC.

1.13.2.5 Review the instructions for the operation of the CyberNational Remote Firing Device and demonstrate competency by test firing a pistol, revolver, rifle and shotgun.

1.13.3 Demonstrate safe loading and then unloading, with dummy cartridges, using the below firearms.

1.13.3.1 Semiautomatic pistol with cartridges in the magazine and one cartridge in the chamber.

1.13.3.2 Slide action shotgun with one shotshell in the tubular magazine and one shotshell in the chamber.

1.13.3.3 Swing-out revolver with one cartridge in the cylinder.

1.13.3.4 Semiautomatic rifle with cartridges in the tubular magazine.

1.13.4 Discuss the safety aspects an examiner should be aware of related to the following topics with the TC:

- Full Auto
- Disconnect
- Dry firing
- Bore obstruction
- Misfeed, chambering issues, jams
- Various shooting "malfunctions"
  - Slam fire
  - Hangfire
  - Misfire
  - Squib
- Bullet puller
- Handling/Checking Loaded firearms
- Tubular magazines
- Unsafe Firearms
  - Remote Firing Device
  - FP Testing Device
  - Primed shotshell/cartridge case
- Loaded firearms
- Rusted firearms
- Accidental vs. Unintentional Discharge
  - Reasons for these
- Active vs. Passive Safeties

1.13.5 Shadow examiners in the laboratory as they prepare casework to become familiar with basic firearm nomenclature and functioning.

1.14 Modes of Evaluation

1.14.1 Oral Sessions

1.14.2 Firearm Safety Written Examination

2 EVIDENCE HANDLING

2.1 Objectives

2.1.1 To ensure the trainee understands the fundamentals of evidence security.

2.1.2 To familiarize the trainee with the chain of custody portion of LIMS.

2.2 Modes of Instruction

2.2.1 Demonstration by the TC of evidence handling.

2.2.2 Self-directed study through assignments and study questions.

2.3 Assignments

2.3.1 Completion of required reading (2.7)

2.4 Study Questions

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

2.4.2 Define a proper seal.

2.4.3 What is the proper way to mark evidence?

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

2.4.5 Who has access to your work area?

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

2.4.7 Explain the lock box procedure.

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

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

2.4.10 Define the following terms:

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

2.4.11 What is a container?

2.4.12 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?

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

2.4.14 Discuss evidence packaging and marking criteria as listed in the QM.

2.4.15 Describe the creation of test fires in Forensic Advantage.

2.5 Practical Exercises

2.5.1 Demonstration of section evidence handling and storage procedures, including evidence transfers to/from Evidence Receiving personnel and other sections within the laboratory.

2.5.2 Demonstration of proper chain of custody practices with the TC, to include taking evidence into personal custody.

2.6 Modes of Evaluation

2.6.1 Practical Exercises

2.6.2 Written Examination

2.7 References

2.7.1 Quality Manual, Department of Forensic Science

2.7.2 Firearm/Toolmark Procedures Manual, Department of Forensic Science

2.7.3 Forensic Advantage® Forensic Laboratory User Guide– Introduction, Workflow, Working with Submission, Working with Evidence, Working with Cases, Working with Case Records, Object Repository, Testimony, Firearm Collection

3 COGNITIVE FACTORS IN COMPARATIVE ANALYSIS

3.1 Objectives

3.1.1 The trainee will be knowledgeable and understand the role the brain plays in the comparative analysis process.

3.1.2 The trainee will be knowledgeable and understand the various factors that can influence the decision making process during the comparison process.

3.2 Modes of Instruction

3.2.1 Self-directed study through assignments and study questions.

3.3 Assignments

3.3.1 Completion of required reading (3.6)

3.4 Study Questions

3.4.1 Describe the different types of bias.

3.4.2 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.

3.4.3 Provide examples where these biases may be encountered when conducting toolmark comparisons.

3.4.4 Explain sources (“the process”) of motivational and conformational biases.

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

3.4.6 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.

3.5 Modes of Evaluation

3.5.1 Oral Sessions

3.6 References

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

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

3.6.3 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

3.6.4 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

3.6.5 Budowle, B., et al. “A Perspective on Errors, Bias, and Interpretation in the Forensic Sciences and Direction for Continuing Advancement,” Journal of Forensic Sciences, 2009. 54(4), 798-809

4 INSTRUMENTATION

4.1 Objectives

4.1.1 The trainee will become proficient in the use of the equipment used in the Firearms and Toolmarks Section.

4.2 Modes of Instruction

4.2.1 Self-directed study through assignments and study questions.

4.2.2 Observations

4.3 Assignments

4.3.1 Completion of required reading (4.7.1 – 4.7.11)

4.3.2 Microscopy PowerPoint Presentation (4.7.12)

4.3.3 Remote Firing Device instructional videos and instructional handout (4.7.13)

4.4 Study Questions

4.4.1 In simplest terms, what is a comparison microscope?

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

4.4.3 What are the major characteristics of a stereo microscope?

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

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

4.4.6 Explain/define the following:

- Fluorescent lighting
- Fiber optics
- Digital caliper
- Inertia bullet puller
- Perspective Enterprises Device
- Steel rule
- Reticle
- Balance
- Stage micrometer
- Digital (electronic) micrometer
- IMADA Digital Force Gauge

4.4.7 What would be the advantages/disadvantages of using LED or fiber optic spot lighting vs. fluorescent lighting?

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

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

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

4.5 Practical Exercises

4.5.1 Familiarize yourself with the various brands of stereo microscopes. Discuss with the TC how to insert a reticle and how to performance check one of the stereo microscopes, if applicable.

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

4.5.3 Review with the TC how to take photographs using a comparison microscope. Discuss the purpose of photography in casework.

4.5.4 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 Firearms and Toolmarks Section with the comparison microscopes. If applicable, calculate the magnification for each set of objective lenses on the comparison microscope.

4.5.5 For all of the following practical exercises, all photographs 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. Record notes on the photographs related to the lessons learned or provide a summary of what was learned in narrative form (please reference photographs uniquely in the narrative).

4.5.5.1 The trainee will receive four cartridge cases of differing primer materials that have been fired in the same firearm.

4.5.5.1.1 Mark an appropriate index on the head of the cartridge cases. Start with the index mark at 6 o'clock and rotate each cartridge case 90 degrees clockwise (so that the index mark is at approximately the 9 o'clock position) and observe the marks in comparison with another. 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. Focus on differences in light and depth of field when changing magnification and aperture settings with at least one comparison. Focusing on the breechface and firing pin marks, note the differences in the appearance of the overall pattern of the marks at the different orientations.

4.5.5.1.2 Document your observations with photographs and be prepared to discuss problems encountered in photographing comparisons.

4.5.5.1.3 Conduct the comparison process for each type of microscope/lighting available in the Firearms and Toolmarks Section to learn the types of microscopes present in the laboratory, their control mechanisms, as well as all of the light options available. Focus on the differences of lighting type and surface material (ease/difficulty, pitfalls, etc.).

4.5.5.2 Trainees will receive a plastic bag containing the below listed bullets. Focus on differences encountered in the examination of different bullet materials and document your measurements on a bullet worksheet.

- 1 full metal jacketed bullet
- 1 copper coated lead bullet
- 1 nylon or polymer coated bullet
- 1 plain lead bullet

4.5.5.2.1 Using a micrometer/caliper, measure the base diameter of each bullet.

4.5.5.2.2 Using an appropriate balance, measure the weight of each bullet.

4.5.5.2.3 Using the air gap method as described in the Firearm/Toolmark Procedures Manual, 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.

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

- Digital caliper
- Inertia 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
- IMADA Digital Force Gauge
- Comparison Microscope
- Remote Firing Device
- Sonicator

4.6 Modes of Evaluation

4.6.1 Practical Exercises

4.6.2 Oral Sessions

4.7 References

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

4.7.2 Chamberlain, D., “Microscope Comparison Bridge,” AFTE Newsletter, 1972; 4(18): 9-11.

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

4.7.4 Cook, C.W., “Basic Optics,” AFTE Journal, 1985; 17(4):14-56.

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

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

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

4.7.8 Miller, J., and McLean, M., “Criteria for Identification of Toolmarks,” AFTE Journal, 1998; 30(1):15-61. and/or Thompson, E., “Editorial: Two Dimensional versus Three Dimensional Characteristics,” AFTE Journal, 2006; 38(1):10-13.

4.7.9 Giverts, P., Hocherman, G., Bokobza, L., and Schecter, B., “Interdetermination of Three Microscopic Methods for Examination of Striae on Polygonal Bullets,” AFTE Journal, 2013; 45(1):48-51.

4.7.10 Weller, T., Brubaker, M., Duez, P., Lilien, R., “Introduction and Initial Evaluation of a Novel Three-Dimensional Imaging and Analysis System for Firearm Forensics,” AFTE Journal, 2015; 47(4):198-208.

4.7.11 Module 7 of https://projects.nfstc.org/firearms/module07/fir_m07.htm

4.7.12 Microscopy PowerPoint Presentation

4.7.13 Remote Firing Device instructional videos and instructional handout

5 MACHINING PROCESSES

5.1 Objectives

5.1.1 The trainee will become knowledgeable of and understand different machining processes.

5.2 Modes of Instruction

5.2.1 Self-directed study through assignments and study questions.

5.2.2 Observations

5.3 Assignments

5.3.1 Completion of required reading (5.7.1-5.7.9)

5.3.2 Video Presentations on Chip Formation & BUE (5.7.10)

5.3.3 Smithy® (machining) Video (5.7.11)

5.3.4 Machining PowerPoint Presentation

5.4 Study Questions

5.4.1 Be familiar and be able to explain the following terms listed in the current AFTE Glossary Section on Machining Terms.

- Abrasive machining
- Age hardening
- Alloy
- Anneal
- Anodizing
- Blanking
- Button
- Brittleness
- Bunting
- Burnishing
- Carburizing
- Case hardening
- Casting
- Chamfer
- Chatter
- Chip
- Chip formation
- Chip types
- Coin
- Cold working
- Compacting
- CNC
- Counterbore
- Countersink
- Crystal
- Cup
- Cutting fluid
- Cyaniding
- Die
- Die casting
- Die stamping
- Draw
- Drawing
- Drop forging
- Ductility
- Elastic limit
- Electrolysis
- Electroplating
- Face
- Flange
- Forge
- Forming
- Grain
- Hardening
- Heat treatment
- Hydrogen Embrittlement
- Induction Hardening
- Knurl

- Lapping
- Lathe
- Mechanical Plating
- MIM
- Mill
- Neck Annealing
- Nitriding
- Normalizing
- Oxidation
- Peen
- Plastic Deformation
- Powder metallurgy
- Punch
- Quenching
- Residual stresses
- Rifling methods
- Sandblast
- Shaper
- Shear
- Sintering
- Strain hardening
- Stress
- Tap
- Temper
- Tensile strength
- Threading
- Tumble
- Work hardening
- Yield Strength

5.4.2 Describe/Explain Built-Up-Edge (BUE) and its potential effects on the work surface.

5.4.3 What are the three types of wear on a tool?

5.4.4 Explain/Define the following manufacturing techniques:

- Shaping
- Planing
- 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
- Upset forging
- Crowning
- Bore slugging

5.5 Practical Exercise

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 trainee feels is most appropriate for future reference.

5.5.1 Review the DFS machining video and/or other comparable videos and then examine the provided specimens, representing the below listed machining processes. This exercise is designed to familiarize the trainee 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 trainee's ability to make comparative examinations.

5.5.1.1 Evaluate each specimen type for class characteristics and surface features. Compare the specimens to one another noting the similarities and differences. Photograph the best correspondence found between specimens, delineating the specific areas of correspondence found.

5.5.1.2 The shavings from each process may also be compared microscopically to observe the similarities and differences.

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

5.6 Modes of Evaluation

5.6.1 Practical Exercises

5.6.2 Oral sessions

5.7 References

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

5.7.2 McNickle, J., “Sharpening Twist Drills,” AFTE Journal, 1988; 20(1): 75-78.

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

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

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

5.7.6 Dixon, Bob, and Walker, John R., Machining Fundamentals, 9th Ed., The Goodheart-Willcox Company, Inc., Tinley Park, IL, 2014. Chapter 10 (know why cutting fluids are necessary), Chapter 12: 12.1.2, 12.3-12.3.1, Cutting Speed v Cutting feed, Chapter 14: p. 212-216, 14.6, 14.11, 14.12, and 14.13, Chapter 15: 15.1-15.5, Chapter 17: all, Chapter 18: p. 298, 18.2, 18.4, Chapter 19: 19.2.5-19.2.7, 19.4.3, 19.4.4, 19.4.9, Chapter 20: p. 360, 20.3 (intro), 20.6, 20.14.1, 20.14.2, Chapter 22: 22.1, 22.2, 22.3 (intro), 22.6 (all), Chapter 29: 29-29.3 (all), Chapter 30: 30.2 (all), Chapter 31: all

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

5.7.8 Module 4 of https://projects.nfstc.org/firearms/module04/fir_m04_t04.htm

5.7.9 Monturo, C. Forensic Firearm Examination, 1st Ed., The Academic Press, 2019. Chapters 5 & 6

5.7.10 Chris Monturo’s chip formation and BUE video presentations.

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

6 INTRODUCTION TO FIREARM AND TOOLMARK IDENTIFICATION

6.1 Objectives

6.1.1 To provide the trainee with an introduction to the forensic examination of firearms and toolmarks.

6.1.2 The trainee will understand the difference between class, subclass and individual characteristics.

6.1.3 The trainee will understand the AFTE Theory of Identification and the Range of Conclusions.

6.2 Modes of Instruction

6.2.1 Self-directed study through assignments and study questions.

6.2.2 OSAC Firearms Process Map.

6.3 Introduction to Firearm and Toolmark Identification

6.3.1 Assignments

6.3.1.1 Completion of required reading (6.7.1-6.7.9)

6.3.2 Study questions

6.3.2.1 Define the terms:

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

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

6.3.2.3 What factors affect the production/reproduction of a mark?

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

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

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

6.3.2.7 What is a Known Different Source (KDS) specimen and why do you study them?

6.3.2.8 What is a Known Same Source (KSS) specimen and why do you study them?

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

6.3.3 Practical Exercises

6.3.3.1 Using one of the preloaded sets of scans in the Cadre Virtual Microscopy Viewer, compare KSS specimens and KDS specimens. Using the annotation tool, identify areas of similar and dissimilar features and save the images with annotations. Review the annotated images with the TC and discuss the significance of similarities and differences noted.

6.4 Subclass Characteristics

6.4.1 Assignments

6.4.1.1 Completion of required reading (6.6.10 - 6.6.15)

6.4.2 Study Questions

6.4.2.1 How do you recognize subclass characteristics?

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

6.5 Modes of Evaluation

6.5.1 Practical Exercises

6.5.2 Oral sessions

6.6 References

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

6.6.2 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.

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

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

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

6.6.6 SWGGUN, SWGGUN Guidelines: Criteria for Identification,” AFTE Journal, 2017; 49(2): 69.

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

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

6.6.9 “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.

6.6.10 Monturo, C. Forensic Firearm Examination, 1st Ed., The Academic Press, 2019. Chapter 12

6.6.11 Miller, J., and Beach, G., “Toolmarks: Examining the Possibility of Subclass Characteristics,” 2005; AFTE Journal, 37(4): 296-345.

6.6.12 Nichols, R., “Subclass Characteristics: From Origin to Evaluation,” 2018; AFTE Journal, 50(2): 68-88.

6.6.13 Kramer, S., “Subclass Characteristics on Firing Pins Manufactured by ‘Metal Injection Molding’”, 2013, AFTE Journal, 44(4):21-29.

6.6.14 Hunsinger, M., “Metal Injection Molded Strikers and Extractors in a Smith & Wesson Model M&P Pistol,” 2013, AFTE Journal, 45(1):21-29.

6.6.15 Meyers, C.R., “Firearms and Toolmark Identification: An Introduction,” AFTE Journal, 1993; 25(4):281-285.

7 FIREARM AND TOOLMARK EVIDENCE ADMISSIBILITY CRITERIA AND DEFENSE

7.1 Objectives

7.1.1 The trainee will become knowledgeable of the criteria listed in the Daubert decision.

7.1.2 The trainee will become aware of the legal aspects of the admissibility of toolmark evidence.

7.1.3 The trainee will be able to describe the development of major agencies/organizations related to the field of firearms and toolmarks identification.

7.1.4 The trainee will be able to explain the significance of major court decisions that have impacted the field of firearms and toolmarks identification.

7.2 Modes of Instruction

7.2.1 Self-directed study through assignments and study questions.

7.3 Assignments

7.3.1 Completion of required reading (7.6)

7.3.2 Prepare a PowerPoint presentation, citing all references, regarding the criteria listed in the Daubert decision and provide support for each criteria on how the firearm and toolmark discipline meets the standard (15-20 minutes then question/answer session).

7.3.3 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 (15-20 minutes then question/answer session).

7.3.4 Prepare a PowerPoint presentation summarizing the 2016 President's Council of Advisors on Science and Technology (PCAST) report Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods and explain how the discipline of firearms and toolmarks addresses the criticisms in the report (15-20 minutes then question/answer session).

7.4 Study Questions

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

7.4.2 What publications has AFTE produced to enhance the discipline?

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

7.4.4 What is a validation study?

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

7.4.6 Summarize the research that has been conducted in the discipline of firearm / toolmark identification that has demonstrated the theory of reaching source attribution conclusions.

7.4.7 Discuss with the TC reasonable degree of scientific certainty, practical certainty, absolute certainty and practical impossibility.

7.5 Modes of Evaluation

7.5.1 PowerPoint presentations

7.5.2 Oral sessions

7.6 References

7.6.1 Committee on Identifying the Needs of the Forensic Sciences Community; Committee on Applied And Theoretical Statistics, National Research Council, "Strengthening Forensic Science in the United States: A Path Forward," Washington, DC: National Academies Press, 2009.

7.6.2 AFTE Committee for the Advancement of the Science of Firearm and Toolmark Identification, "The Response of the Association of Firearm and Tool Mark Examiners to the February 2009 National Academy of Science Report 'Strengthening Forensic Science in the United States: A Path Forward'," AFTE Journal, 2009; 41(3): 204-208.

7.6.3 2016 President's Council of Advisors on Science and Technology (PCAST) report Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods

7.6.4 Grzybowski, R., Miller, J., Moran, B., Murdock J., Nichols, R., and Thompson, R., "Firearm/Toolmark Identification: Passing the Reliability Test Under Federal and State Evidentiary Standards," AFTE Journal, 2003; 35(2): 209-241.

7.6.5 SWGGUN Admissibility Resource Kit (ARK) https://afte.org/resources/swggun-ark

8 HISTORY OF FIREARMS IDENTIFICATION AND CURRENT TRENDS

8.1 Objectives

8.1.1 The trainee will be able to describe major historical events significant to the field of firearms identification.

8.1.2 The trainee will be able to discuss the contributions numerous individuals have made to the field of firearms identification.

8.2 Modes of Instruction

8.2.1 Self-directed study through assignments and study questions.

8.3 Assignments

8.3.1 Read Section 2 (History) of the NIJ/NFSTC/AFTE "Firearms Analyst Training" (https://projects.nfstc.org/firearms/)

8.3.2 Completion of required reading (8.6)

8.3.3 PowerPoint presentation on the Basic History of Firearms Identification (15-20 minutes then question/answer session). The presentation should include the following:

- Cases involving firearms identification
- Bureau of Forensic Ballistics
- NIBIN (National Integrated Ballistic Information Network) and other similar virtual software systems
- Virtual Microscopy and 3D imagining technology

8.4 Study questions

8.4.1 Define the following terms:

- firearm identification
- ballistics

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

8.4.3 Explain the progress to make the field more objective and include any limitations.

8.5 Modes of Evaluation

8.5.1 Oral Sessions

8.5.2 PowerPoint presentation

8.6 References

8.6.1 Gunther, J.D., and Gunther, C.O., The Identification of Firearms, John Wiley and Sons, Inc., New York, 1935.

8.6.2 Hatcher, Jury & Weller, Firearms Investigation Identification and Evidence, Ray Riling Arms Books Company, Philadelphia, PA, Chapter 1.

8.6.3 Hamby and Thorpe, “The History of Firearm and Toolmark Identification,” AFTE Journal, Vol. 31, No. 3, Summer 1999, pp. 266-283.

8.6.4 Garrison, D., “The Guns of Brownsville,” AFTE Journal, Vol. 18, No. 4, Fall 1986, pp. 65-70.

8.6.5 Starrs, J., “Once More Unto the Breech: The Firearms Evidence in the Sacco and Vanzetti Case Revisited: Part I,” AFTE Journal, Vol. 19, No. 1, Winter 1987, pp. 37-56.

8.6.6 Goddard, C., “The Valentine Day Massacre: A Study in Ammunition Tracing,” AFTE Journal, Vol. 12, No. 1, Winter 1980, pp. 44-59.

8.6.7 Denio, D., “Drugfire,” AFTE Journal, Vol. 31, No. 3, Summer 1999, pp. 383-385.

8.6.8 Hamby, J., “History of AFTE,” www.afte.org

8.6.9 Garrison, D., “Gunsmith and the Soldier,” AFTE Journal, Vol. 19, No. 2, Spring 1987, pp. 181-187.

8.6.10 Rowe, W. H., “Firearms Identification,” Forensic Science Handbook, Vol. II, 1988, Saferstein, R. (Ed.), Prentice Hall, Englewood Cliffs, NJ, pp. 411-416.

8.6.11 Murdock, J., et al., “The Development and Application of Random Match Probabilities to Firearm and Toolmark Identification”, Journal of Forensic Science, Vol.62, Issue 3, May 2017, pp. 619-625.

8.6.12 Reno and Kotas, “The Denver Crime Gun Intelligence Center (CGIC): An Example of Successful Implementation of NIBIN as an Investigative Tool,” AFTE Journal, 2015; 47(4): 238-243.

8.6.13 Nichols, R.G., “Consecutive Matching Striations (CMS): Its Definition, Study, and Application in the Discipline of Firearms and Toolmark Identification,” AFTE Journal, Vol. 35, No. 3, Summer 2003, pp. 298-306.

8.6.14 McClarin, D., “Adding an Objective Component to Routine Casework: Use of Confocal Microscopy for the Analysis of 9mm Caliber Bullets,” AFTE Journal, Vol. 47, No. 3, Summer 2015, pp. 161-170.

8.6.15 Weller, T. J., et al, “Introduction and Initial Evaluation of a Novel Three-Dimensional Imaging and Analysis System for Firearm Forensics”, AFTE Journal, Volume 47, Number 4, Fall 2015, pp.198-208.

8.6.16 Song, J., et al., “Estimating error rates for firearm evidence identifications in forensic science”, Forensic Science International, Vol. 284, March 2018, pp. 15-32.

8.6.17 Weller, T. J., et al, "Confocal Microscopy Analysis of Breech Face Marks on Fired Cartridge Cases from 10 Consecutively Manufactured Pistol Slides", Journal of Forensic Sciences, Volume 57, Number 4, July 2012, pp. 912-917.

8.6.18 Riva, F. and C. Champod, “Automatic Comparison and Evaluation of Impressions Left by a Firearm on Fired Cartridge Cases”, Journal of Forensic Science, Vol. 59, Issue 3, May 2014, pp. 637-647.

8.6.19 Duez, Pierre, et al, “Development and Validation of a Virtual Examination Tool for Firearm Forensics”, Journal of Forensic Sciences, Vol. 63(4), July 2018, pp. 1069-1084.

8.6.20 Monturo, C. Forensic Firearm Examination, 1st Ed., The Academic Press, 2019. Chapter 15.

9 HISTORICAL DEVELOPMENT

9.1 Objectives

9.1.1 The trainee will become knowledgeable about the historical developments of gunpowder, ammunition components and firearms.

9.2 Modes of Instruction

9.2.1 Self-directed through assignments and study questions.

9.2.2 Observations

9.3 Ammunition

9.3.1 Assignments

9.3.1.1 Completion of required reading (9.6.1 - 9.6.9)

9.3.1.2 Read Section 3 (Propellants, Ammunition, and Firearms Development) of the NIJ/NFSTC/AFTE "Firearms Examiner Training". (https://projects.nfstc.org/firearms/)

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

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

9.3.1.4 Describe the development of ammunition through modern metallic cartridges. Include, at a minimum, the following milestones:

- rimfire
- centerfire
- Berdan primers and cases
- Boxer primers and cases

9.3.2 Study questions

9.3.2.1 Define the following terms.

- Black powder
- Patch
- Caseless ammo
- Patched ball
- Fulminate of mercury
- Percussion cap
- Gun cotton
- Pyrodex

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

9.3.2.3 What was considered the earliest form of a cartridge?

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

9.4 Firearms

9.4.1 Assignments

9.4.1.1 Completion of required reading (9.6.10 – 9.6.13)

9.4.1.2 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.

9.4.2 Study Questions

9.4.2.1 What is a muzzleloader?

9.4.2.2 Why were self-contained cartridges important for firearms development?

9.4.3 Practical Exercise

9.4.3.1 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.

9.5 Modes of Evaluation

9.5.1 Practical exercise

9.5.2 Oral sessions

9.6 References

9.6.1 Bolton, M., “An Introduction to Propellant Burning,” IAA Journal, Sep/Oct 2015, Issue 505, pp. 30-32

9.6.2 Dillon, J.H., “Black Powder Background,” AFTE Journal, 1991; 23(2); 689-693.

9.6.3 Dillon, J.H., “The Manufacture of Conventional Smokeless Powder,” AFTE Journal, 1991; 23(2): 682-688.

9.6.4 National Rifle Association, The NRA Handloader’s Guide, National Rifle Association of America, Washington D.C., 1969, pp. 15-27 and 88-92.

9.6.5 Styers, G.R., “History of Black Powder,” AFTE Journal, Vol. 19, No. 4, 1987, pp. 443-446.

9.6.6 Bussard, M.E., Wormley, S.L., NRA Firearms Sourcebook, National Rifle Association of America, Fairfax, VA, 2006, pp. 72-81.

9.6.7 Prieto, M, “Firearms Identification Lessons,” AFTE Journal, 1982; 14(2): 31-43.

9.6.8 Rinker, R.A., Understanding Ballistics, Mulberry House, Corydon, IN, 1997, pp. 18-31.

9.6.9 Smith, W.H.B., and J.E. Smith, Small Arms of the World: Tenth Edition, The Stackpole Company, Harrisburg, PA, 1973, pp. 42-47.

9.6.10 NFSTC "Evolution of Firearms". This course of instruction may be found at http://projects.nfstc.org/firearms/

9.6.11 Peterson, H.L., “The Development of Firearms,” American Rifleman, Parts 1 and 2, Mar. and Apr., 1960.

9.6.12 Smith, W.H.B., and J.E. Smith, Small Arms of the World: Tenth Edition, The Stackpole Company, Harrisburg, PA, 1973, pp. 15-38.

9.6.13 NRA Firearms Fact Book, 3rd edition, National Rifle Association, Fairfax, VA, 1989. (p. 31-46).

10 AMMUNITION

10.1 Objectives

10.1.1 The trainee will become knowledgeable about current manufacture of ammunition components.

10.1.2 The trainee will become knowledgeable about caliber/gauge.

10.2 Modes of Instruction

10.2.1 Self-directed through assignments and study questions.

10.2.2 Observations

10.3 Assignments

10.3.1 Completion of required reading (10.7)

10.3.2 Read Section 5 (Small Arms Ammunition) of the NIJ/NFSTC/AFTE "Firearms Examiner Training". (http://projects.nfstc.org/firearms/)

10.3.3 Prepare a written paper detailing trends unfolding in cartridge and bullet development. The paper should include, at a minimum, the below developments, and their usefulness. The paper should be a minimum of 5-pages, double spaced.

- Frangible ammunition
- Lead free or "Clean" ammunition
- Unique/Proprietary design (e.g., Hydra Shok, FTX, Stinger, Punch)
- Shot cartridges (e.g., Winchester PDX, CCI)

10.3.4 Discuss the following with the TC:

- Lead Round Nose (LRN)
- Wadcutter (WC)
- Semi-wadcutter (SWC)
- Full Metal Jacket (FMJ)
- Total Metal Jacket (TMJ)
- (Semi-) Jacketed Soft Point (SJSP / JSP)
- (Semi-) Jacketed Hollow Point (SJHP / JHP)
- Bullet / Jacket Material
- Copper-Coated / Lubaloy
- Brass-Coated
- Copper-Jacketed
- Nickel-Jacketed
- Aluminum-Jacketed
- Frangible
- Other proprietary coatings or compositions

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

10.3.6 Obtain or draw a diagram of a bottleneck cartridge and label 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

10.3.7 Obtain or draw a diagram of a cutaway shotshell and label the following:

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

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

10.3.9 Prepare a chart that includes the bullet diameter, bullet weight, and cartridge design of the following handgun calibers. Be prepared to discuss the 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.

- 17 HMR
- 22 Short
- 22 Long
- 22 Long Rifle
- 22 Winchester Magnum
- 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 Colt New Police
- 38 Short Colt
- 38 Long Colt
- 10mm Auto*
- 40 S&W*
- 41 Magnum
- 44 Magnum
- 44 Special
- 45 Auto*
- 45 GAP
- 45 Colt*
- 50 Action Express

10.3.10 Compare the following cartridges and describe their interchangeability:

- 45 Auto and 45 GAP
- 10mm Auto and 40 S&W
- 44 Magnum and 44 Special
- 9mm Luger and 357 SIG
- 357 SIG and 40 S&W
- 357 Magnum, 38 Special, and 38 S&W
- 9mm Luger, 380 Auto, and 9mm Makarov
- 32 S&W and 32 Auto
- 22 Short, 22 Long and 22 Long Rifle
- 223 Remington and 5.56x45mm cartridges

10.3.11 Prepare a chart that includes the bullet diameter, bullet weight, cartridge design, and parent design (if applicable) of the following rifle calibers. Be prepared to discuss the 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.

- 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

10.3.12 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

10.4 Study Questions

10.4.1 What are the four components of a cartridge?

10.4.2 Be able to define and understand the relevance of the following:

- 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
- Nylon/polymer coated 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

10.4.3 What are the different pellet compositions? What are the sizes of buckshot and their equivalent diameters?

10.4.4 Explain what markings on the shotshell hull represent.

10.4.5 What are the manufacturing processes used for making shot?

10.4.6 What is the purpose of buffer?

10.4.7 How are modern 22 rimfire cartridge cases made?

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

10.4.9 What are bullet cores composed of?

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

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

10.4.12 What is SAAMI?

10.4.13 What are the uses of cannelures?

10.4.14 What classifies a cartridge as being a rimfire?

10.4.15 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?

10.4.16 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?

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

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

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

10.4.20 What are extrusion/draw marks?

10.4.21 Define BB.

10.4.22 Define caliber.

10.4.23 What is the difference between caliber, caliber family (nominal caliber), and specific caliber (caliber designation)?

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

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

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

10.4.27 What is a 9mm Corto? 9mm Kurz? 9mm Parabellum?

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

10.4.29 What is the significance of the NATO symbol?

10.5 Practical Exercises

10.5.1 If possible, visit or view videos for at least one ammunition manufacturing facility such as Remington, Federal or Winchester to observe the manufacture of rimfire and centerfire cartridges and shotshells.

10.5.1.1 Document the manufacturing processes and provide an oral presentation for section members. 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.

10.5.2 Using the provided items of ammunition describe, on the appropriate worksheet, 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)
- Caliber/Gauge

10.5.3 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 specific calibers within each caliber family.

10.5.3.1 Identify each one as to the specific caliber, note the different cartridge case sizes and shapes within each caliber family and the variations in bullets (weight, jacketing, design, cannelures, etc.).

10.5.3.2 Check in periodically with the TC during this assignment and discuss your findings.

10.5.4 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 Firearm/Toolmark Procedures Manual to document your final conclusions.

10.5.5 Using the provided bullet samples, and all available laboratory resources, document the weight, diameter, type of bullet, manufacturer, and caliber of each bullet, on the appropriate laboratory worksheet. Document all sources used to reach conclusions. Use the appropriate report writing section of the Firearm/Toolmark Procedures Manual to document your final conclusions

10.6 Modes of Evaluation

10.6.1 Practical Exercises

10.6.2 Oral Sessions

10.6.3 Written Examination

10.7 References

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10.7.3 Klatt, P., “American Rimfire Cartridges Part I,” American Rifleman, May 1981, pp. 48-51.

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10.7.9 Ramage, C.K., Lyman Shotshell Handbook 3rd Edition, Lyman Publications, Middlefield, CT, 1984, pp. 64-87.

10.7.10 Rayer, R. J., “Molybdenum Disulfide (MoS2) Influence on Fired Bullets,” AFTE Journal, 2007; 39(3): 200-205.

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10.7.12 Scarlatta, P., “Next Wave Indoor Ammo,” American Rifleman, April 1998, pp. 30-33.

10.7.13 Taylor, J., Shotshells & Ballistics, Safari Press, Inc., Long Beach, CA, 2003, pp. 25-38.

10.7.14 Wallace, J.S., “Chemical Aspects of Firearms Ammunition,” AFTE Journal, 1990; 22(4): 364-375.

10.7.15 Boddington, C., “America’s Beloved .30’s,” Guns & Ammo, Nov. 2010, pp.56-63.

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10.7.17 Johnson, D., “Demystifying +P,” Guns & Ammo Handguns, Oct./Nov. 2006, pp. 16-17.

10.7.18 Monturo, C. Forensic Firearm Identification, 1st Ed., The Academic Press, 2019. Chapter 3.

11 FIREARM MANUFACTURING & EXAMINATIONS

11.1 Objectives

11.1.1 The trainee will be able to describe the manufacturing process of firearms.

11.1.2 The trainee will be able to recognize and explain a variety of firearms types, components, and markings

11.2 Modes of Instruction

11.2.1 Self-directed through assignments and study questions.

11.2.2 Observations

11.3 Manufacturing

11.3.1 Assignments

11.3.1.1 Completion of required reading (11.6.1)

11.3.1.2 Provide a written summary describing the following rifling techniques and include, at a minimum, the advantages and disadvantages of each as viewed by the industry and firearm examiners.

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

11.3.2 Study questions

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

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

11.3.2.3 What is rifling?

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

11.3.2.5 What tooling methods produce conventional rifling versus polygonal rifling?

11.3.2.6 Name some manufacturers who produce firearms with polygonal barrels.

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

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

11.3.3 Practical exercises

11.3.3.1 Obtain rifled barrels, broaches, mandrels, and buttons. Determine the difference between barrels which have been broach rifled, hammer forged, and button rifled.

11.3.3.2 If possible, visit or view videos of 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.

11.4 Examinations

11.4.1 Assignments

11.4.1.1 Completion of the required reading (11.6.2)

11.4.1.2 Prepare a written summary of the following terms as they relate to the manufacture of firearms.

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

11.4.2 Study Questions

11.4.2.1 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

11.4.2.2 Define and understand the relevance of 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
- Receiver
- Rifling
- Safety mechanism
- Sear
- Sights
- Single action
- Test fire
- Trigger
- Trigger bar
- Trigger group
- Trigger guard
- Trigger pull

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

11.4.2.4 Explain the significance of examining a submitted firearm first for trace evidence.

11.4.3 Practical Exercise

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

11.5 Modes of Evaluation

11.5.1 Practical exercises

11.5.2 Oral sessions

11.6 References

11.6.1 Manufacturing

11.6.1.1 Hatcher, J.S., Jury, F.J., and Weller, J., Firearms Investigation, Identification and Evidence, 2nd edition, Stackpole Books, Harrisburg, PA, 1957, Pages 110-127.

11.6.1.2 Papke, R., “Electrochemical Machining: A New Barrel Making Process,” AFTE Journal, 1988, 20(1): 48-52.

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11.6.2 Examinations

11.6.2.1 Virginia Department of Forensic Science Firearm/Toolmark Procedures Manual – Physical Examination and Classification of Firearms.

11.6.2.2 Dutton, G., “Firearms Safety in the Laboratory,” AFTE Journal, Vol. 29, No. 1, Winter 1997, pp. 37-41.

11.6.2.3 Murdock, J.E., “Associative Evidence,” AFTE Journal, 1984; 16(2): 5.

12 REVOLVERS

12.1 Objectives

12.1.1 The trainee will be able to explain the mechanisms of function and safety features of revolvers.

12.1.2 The trainee will be able to disassemble, reassemble, and test fire a variety of revolvers.

12.1.3 The trainee will be able to restore inoperable revolvers to mechanical operating condition.

12.1.4 The trainee will be able to evaluate ammunition components to determine:

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

12.2 Modes of Instruction

12.2.1 Self-directed through assignments and study questions.

12.2.2 Observations

12.3 Assignments

12.3.1 Completion of required reading (12.7)

12.3.2 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

12.4 Study Questions

12.4.1 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

12.4.2 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

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

12.4.4 Describe the procedure for measuring trigger pull.

12.4.5 How can trigger pull be lightened in a revolver?

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

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

12.4.8 What is a top break revolver?

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

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

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

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

12.4.13 What are the various locations on Colt, Ruger, Smith & Wesson and top-break revolvers that contain the serial number?

12.5 Practical Exercises

12.5.1 Observe the TC demonstrate how to safely handle, load, and unload some of the firearms listed. Demonstrate these safety techniques to the TC. The TC shall function check all firearms before test firing and returning them to the firearm reference collection.

12.5.2 Obtain a copy of an exploded diagram of each firearm and document each on a firearm worksheet. Describe, in detail, the internal working mechanism of each firearm and specifically how each safety functions.

12.5.3 Follow the instructions listed for each firearm regarding test firing, ammunition used, disassembling/reassembling, trigger pull, and barrel/overall length measurement. Specify which test fires were fired in single or double action. Consult with the TC if the listed ammunition for test firing is not available. Note: If suitable marks are not obtained, test fire additional specimens.

12.5.4 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
- Barrel
- Rifling

12.5.5 Using the test fired cartridge cases and bullets from each firearm perform the following:

12.5.5.1 Record the class characteristics of the fired cartridge cases and bullets.

12.5.5.2 Visually relate the markings imparted to the fired cartridge cases with the part on the firearm that produced the markings.

12.5.5.3 Microscopically compare the test fired cartridge cases from each firearm. Include the following types of markings in your microscopic comparisons, as applicable: firing pin impression, breechface markings, chamber marks, and anvil marks. Photograph the results of your conclusions.

12.5.5.4 Microscopically compare the test fired bullets of the same type from each firearm. As applicable, inter-compare the different types of bullets fired from the same firearm. Each set of comparisons should have appropriate notes and photographs regarding observations and all conclusions. In addition, difficulties encountered within the comparisons should be addressed.

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

- 32 Auto bullets/cartridge cases fired from/in a 32 S&W firearm
- 38 Special bullets/cartridge cases fired from/in a 357 Magnum firearm

12.5.7 Harrington and Richardson Model 622, caliber 22 Long Rifle

- Conduct a 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
- Ensure that at least one cartridge is fired in each chamber. Note the chambers on each test fire.
- Measure the barrel and overall length of the firearm in accordance with the Firearm/Toolmark Procedures Manual

12.5.8 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

12.5.9 Smith & Wesson model 686, caliber 357 Magnum

- Conduct a trigger pull examination
- Test fire two (2) 357 Magnum Winchester JSP in double action

- Test fire two (2) 38 Special Winchester LRN and two (2) 357 Magnum Winchester JSP in single action
- Compare the SA JSP bullets to the DA JSP bullets and the SA LRN bullets to the SA JSP bullets
- Detail strip

12.5.10 Colt model Lawman, caliber 357 Magnum

- Test fire two (2) 38 Special Remington SJHP
- Test fire two (2) 38 Special Federal Nyclad
- Detail strip

12.5.11 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

12.6 Modes of Evaluation

12.6.1 Practical Exercises

12.6.2 Oral sessions

12.7 References

12.7.1 NFSTC “Examination of Firearms – Handguns – Single Action Revolvers and Double Action Revolvers". This course of instruction may be found at https://projects.nfstc.org/firearms/module08/fir_m08_t07.htm

12.7.2 Venturino, M., “The Ruger Blackhawk...Today’s Single Action,” Guns & Ammo, December 1988; 54-57, 91-93.

12.7.3 McElrath, D., “Smith & Wesson, The First 150 Years,” American Rifleman, December 2002: 48-55, 80-81.

12.7.4 Berg, S.O., “History of Revolver Safeties,” AFTE Journal, 1982; 14(4): 29.

13 PISTOLS

13.1 Objectives

13.1.1 The trainee will be able to explain the mechanisms of function and safety features of pistols.

13.1.2 The trainee will be able to disassemble, reassemble, and test fire a variety of pistols.

13.1.3 The trainee will be able to restore inoperable pistols to mechanical operating condition.

13.1.4 The trainee will be able to evaluate ammunition components to determine:

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

13.2 Modes of Instruction

13.2.1 Self-directed through assignments and study questions.

13.2.2 Observations

13.3 Assignments

13.3.1 Completion of required reading (13.7)

13.3.2 Provide a written summary of the following types of semi-automatic pistols action types, to include a minimum of two examples of firearms which use each mechanism.

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

13.3.3 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

13.4 Study Questions

13.4.1 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

13.4.2 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

13.4.3 Explain the cycle of fire for a semiautomatic pistol.

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

13.4.5 Describe derringer firearms and their development.

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

13.4.7 Name some pistol manufacturers that use hidden serial numbers.

13.4.8 Describe how to perform a function check on a pistol.

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

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

13.4.11 Explain the Kel-Tec Dynamic Safety System. List other firearms that may have a similarly operating safety feature.

13.4.12 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

13.5 Practical Exercises

13.5.1 Observe the TC demonstrate how to safely handle, load, and unload some of the firearms listed. Demonstrate these safety techniques to the TC. The TC shall function check all firearms before test firing and returning them to the firearm reference collection.

13.5.2 Obtain a copy of an exploded drawing of each firearm listed below and document each firearm on a firearm worksheet. In detail, describe the internal working mechanism and how each safety functions.

13.5.3 Field strip and reassemble each firearm. Follow the instructions listed for each firearm regarding test firing, cycling, ammunition used, disassembling/reassembling, trigger pull, and barrel/overall length measurement. Consult with the TC if the listed ammunition for test firing is not available. Note: If suitable marks are not obtained, test fire additional specimens.

13.5.4 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
- Barrel/Rifling
- Ramp
- Magazine
- Ejection port

13.5.5 Using the test fired cartridge cases and bullets from each firearm perform the following:

13.5.5.1 Record the class characteristics of the fired cartridge cases and bullets.

13.5.5.2 Visually relate the markings imparted to the fired cartridge cases with the part on the firearm that produced the markings.

13.5.5.3 Microscopically compare the test fired cartridge cases from each firearm. Include the following types of markings, 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 conclusions.

13.5.5.4 As applicable, microscopically compare the cycled cartridges with each other and then to the test fired cartridge cases from the same firearm. Photograph the results of your conclusions.

13.5.5.5 Microscopically compare the test fired bullets of the same type from each firearm. As applicable, inter-compare the different types of bullets fired from the same firearm. Each set of comparisons should have appropriate notes and photographs regarding observations and all conclusions. In addition, difficulties encountered within the comparisons should be addressed.

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

- 380 Auto bullets/cartridge cases fired from/in a 9mm Luger firearm
- 380 Auto bullets/cartridge cases fired from/in a 9mm Makarov firearm

- 40 S&W bullets/cartridge cases fired from/in a 10mm Auto firearm
- 45 GAP bullets/cartridge cases fired from/in a 45 Auto firearm
- 357 SIG bullets/cartridge cases fired from/in a 40 S&W firearm

13.5.7 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

13.5.8 Jennings model J-22, caliber 22 Long Rifle

- Test fire two (2) 22 Long Rifle cartridges
- Cycle two (2) 22 Long Rifle cartridges

13.5.9 Beretta model 950BS, caliber 25 Auto

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

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

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

13.5.11 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

13.5.12 Bersa model Thunder 380, caliber 380 Auto

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

13.5.13 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

13.5.14 Walther model PPK, caliber 380 Auto

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

13.5.15 Baikal model IJ-70, caliber 9mm Makarov

- Test fire two (2) 9mm Makarov FMJ cartridges
- Test fire two (2) 380 Auto FMJ cartridges

13.5.16 Beretta model 92, caliber 9mm Luger

- Test fire in single action one (1) 9mm Luger PMC FMJ cartridge and one(1) 9mm Luger Winchester Silver tip JHP cartridge
- Test fire in double action one (1) 9mm Luger PMC FMJ cartridge and one (1) 9mm Luger Winchester Silver tip JHP cartridge
- Detail strip

13.5.17 Intratec model Tec-9, caliber 9mm Luger

- Test fire two (2) 9mm Luger American Eagle FMJ cartridges
- Test fire two (2) 9mm Luger Federal HST JHP cartridges

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

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

13.5.19 Kel-Tec model P-11, caliber 9mm Luger

- Test fire two (2) 9mm Luger FMJ cartridges

13.5.20 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
- Discuss the manufacturing techniques utilized by Hi-Point and how these may aid in class recognition and comparison analysis.

13.5.21 Ruger P-series, caliber 9mm Luger

- Conduct a 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

13.5.22 Glock model 31, caliber 357 SIG

- Conduct a trigger pull examination
- Cycle two (2) 357 SIG cartridges
- Test fire two (2) 357 SIG cartridges
- Detail strip

13.5.23 Ruger model SR40c, caliber 40 S&W

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

13.5.24 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 FMJ cartridges
- Test fire two (2) 357 SIG cartridges

13.5.25 Smith & Wesson model 1006, caliber 10mm Auto

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

13.5.26 IMI/Magnum Research model Desert Eagle, caliber 357 Magnum

- Test fire two (2) 357 Magnum FMJ cartridges

13.5.27 Colt model 1911A1, caliber 45 Auto

- Test fire two (2) 45 Auto PMC FMJ cartridges
- Test fire two (2) 45 Auto Wolf (pre-striated primers) FMJ cartridges
- Test fire two (2) 45 G.A.P. FMJ cartridges
- Detail strip

13.5.28 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

13.5.29 Heckler & Koch Model USP, caliber 45 Auto

- Test fire two (2) 45 Auto 230 grain FMJ cartridges

13.5.30 Glock pistol with Glock Marking Barrel rifling

- Test fire two (2) cartridges

13.6 Modes of Evaluation

13.6.1 Practical Exercises

13.6.2 Oral sessions

13.7 References

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13.7.2 Welch, A., “History and Manufacturing Process of the Jennings/Bryco/Jimenez Arms Pistols,” AFTE Journal, 2013, 45(3); 260-266.

13.7.3 Greenspan, A., “The Case of the Unsafe Magazine Safety,” AFTE Journal, -1999, 31(3): 379-381.

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14 RIFLES

14.1 Objectives

14.1.1 The trainee will be able to explain the mechanisms of function and safety features of rifles.

14.1.2 The trainee will be able to disassemble, reassemble, and test fire a variety of rifles.

14.1.3 The trainee will be able to restore inoperable rifles to mechanical operating condition.

14.1.4 The trainee will be able to evaluate ammunition components to determine:

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

14.2 Modes of Instruction

14.2.1 Self-directed through assignments and study questions.

14.2.2 Observations

14.3 Assignments

14.3.1 Completion of required reading (14.7)

14.3.2 Provide a written summary describing the following action types to include at least one 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

14.3.3 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 caliber U.S. Rifle M1 Garand
- U.S. Rifle M14 caliber 308 Winchester

14.4 Study Questions

14.4.1 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

14.4.2 Describe the function of a cross bolt safety.

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

14.4.4 Explain the difference between push feed and control feed and provide an example of each.

14.4.5 Why should only cartridges containing blunt-nose bullets be used in tubular magazines?

14.4.6 Describe selective fire.

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

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

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

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

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

14.4.12 List two rifles with free floating firing pins.

14.4.13 Discuss with TC definitions for a short-barreled rifle (SBR) and a “pistol” chambered for a traditionally designed rifle cartridge.

14.5 Practical Exercises

14.5.1 Observe the TC demonstrate how to safely handle, load, and unload some of the firearms listed. Demonstrate these safety techniques to the TC. The TC shall function check all firearms before test firing and returning them to the firearm reference collection.

14.5.2 Obtain a copy of an exploded drawing of each firearm listed below and document each firearm on a firearm worksheet. Describe, in detail, the internal working mechanism of each firearm and specifically how each that safety functions.

14.5.3 Field strip and reassemble each firearm prior to test firing. Follow the instructions listed for each firearm regarding test firing, cycling, ammunition used, disassembling/reassembling, trigger pull, and barrel/overall length measurement. Consult with the TC if the listed ammunition for test firing is not available. Note: If suitable marks are not obtained, test fire additional specimens.

14.5.4 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 extension
- Feed ramp
- Magazine
- Ejection port

14.5.5 Using the test fired cartridge cases and bullets from each firearm perform the following:

14.5.5.1 Record the class characteristics of the fired cartridge cases and bullets.

14.5.5.2 Visually relate the markings imparted to the fired cartridge cases with the part on the firearm that produced the markings.

14.5.5.3 Microscopically compare the test fired cartridge cases from each firearm. Include the following types of markings, as applicable: firing pin impression, breechface markings, chamber marks, anvil marks, extractor marks, ejector marks, ramp marks, ejection port marks, barrel extension marks, and magazine marks. Photograph the results of your conclusions.

14.5.5.4 As applicable, microscopically compare the cycled cartridges with each other and then to the test fired cartridge cases from the same firearm. Photograph the results of your conclusions.

14.5.5.5 Microscopically compare the test fired bullets of the same type from each firearm. As applicable, inter-compare the different types of bullets fired from the same firearm. Each set of comparisons should have appropriate notes and photographs regarding observations and all conclusions. In addition, difficulties encountered within the comparisons should be addressed.

14.5.6 Winchester model 94 caliber 30-30 Winchester

- Test fire two (2) 30-30 Winchester cartridges

14.5.7 Bolt-action rifle, 30 caliber family

- Test fire two (2) cartridges using the remote firing device
- Measure the barrel and overall length of the firearm in accordance with the Firearm/Toolmark Procedures Manual
- Conduct a trigger pull examination

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

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

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

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

14.5.10 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
- Download and test fire two (2) 223 Remington cartridges
- Test fire two (2) 223 Remington cartridges using the remote firing device

14.5.11 Ruger model Mini-14 caliber 223 Remington

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

14.6 Modes of Evaluation

14.6.1 Practical Exercises

14.6.2 Oral sessions

14.7 References

14.7.1 Kabbani, K., “Intelligence and Historical Background on the AK-47 and AK Variants,” AFTE Journal, 2013, 24(3), 222-234

14.7.2 Canfield, B., “The M14: John Garand’s Final Legacy,” American Rifleman, August 2002: 48-55, 95.

14.7.3 Karns, J., “Exploded Views: Springfield M1903 Rifle,” American Rifleman, February 1989: 40-41.

14.7.4 Canfield, B., “100 Years of the ‘03 Springfield,” American Rifleman, March 2003: 42-45, 78.

14.7.5 James, G., “Britain’s Mark III SMLE,” Guns & Ammo, December 2014: 90-99.

14.7.6 Keefe IV, M., “Britain’s ‘New’ Rifle,” American Rifleman, February 1995: 53-55, 66, 67.

14.7.7 James, G., “The Guns of D-Day,” Guns & Ammo, June 2014: 66-85.

14.7.8 McAuley, J., “Krag The Last Cavalry Carbine,” American Rifleman, March 1997: 34-37, 54, 55.

14.7.9 James, G., “Classic Test: Model 1896 Krag-Jorgensen Carbine,” Guns & Ammo, February 2000: 74-76.

14.7.10 Gibson, W., “Altered Arsenal model SLR-100H,” AFTE Journal, Vol. 47, No. 2, Spring 2015, pp. 112-113.

14.7.11 Bartocci, C.R., “Class Characteristics of the 7.62x39mm Cartridge, Telling Whether a Fired Cartridge Case was Fired in an SKS or AK Type Rifle,” AFTE Journal, 2002; 34(2): 144-147.

14.7.12 Wolslagel, P.F., “Class Characteristics Useful in the Differentiation of an Expended Cartridge Case Fired by the AK Series of Rifles from a SKS Semiautomatic Rifle,” AFTE Journal, 1996; 28(2): 77-79.

15 SHOTGUNS

15.1 Objectives

15.1.1 The trainee will be able to explain the mechanisms of function and safety features of shotguns.

15.1.2 The trainee will be able to disassemble, reassemble, and test fire a variety of shotguns.

15.1.3 The trainee will be able to restore inoperable shotguns to mechanical operating condition.

15.1.4 The trainee will be able to evaluate ammunition components to determine:

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

15.2 Modes of Instruction

15.2.1 Self-directed through assignments and study questions.

15.2.2 Observations

15.3 Assignments

15.3.1 Completion of required reading (15.7)

15.3.2 Provide a written summary describing the following action types, to include a minimum of one example of a firearm which uses each mechanism:

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

15.3.3 Obtain a copy of an exploded drawing of a Savage Stevens model 311E, 410 Bore, side by side shotgun. Be able to identify unique features in its mechanism and cycle of fire.

15.4 Study Questions

15.4.1 Define the following terms:

- Choke
- Choke tube
- Forcing cone
- Forearm
- Forend
- Shotgun
- Double barrel shotgun
- Over/under shotgun
- Side by side shotgun
- Non-Selective single trigger
- Selective single trigger
- Single - Double trigger
- Backboring
- Overbore
- Cartridge stop
- Barrel selector
- Automatic safety
- Barrel guide

- Inertia block
- Ventilated rib
- Barrel porting
- Recoil pad
- Combination gun
- Pistol grip

15.4.2 Describe the magazine cut-off feature and its purpose.

15.4.3 Describe the magazine plug and its purpose.

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

15.4.5 Describe the function of the front trigger and back trigger in a double barrel break open shotgun.

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

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

15.4.8 What is a drilling?

15.4.9 Describe the billiard ball effect.

15.4.10 Describe how a choke functions, different types of chokes, and list common degrees of chokes from most constriction to least constriction.

15.5 Practical Exercises

15.5.1 Observe the TC demonstrate how to safely handle, load, and unload some of the firearms listed. Demonstrate these safety techniques to the TC. The TC shall function check all firearms before test firing and returning them to the firearm reference collection.

15.5.2 Obtain a copy of an exploded drawing of each firearm listed below and document each firearm on a firearm worksheet. Describe, in detail, the internal working mechanism of each firearm and specifically how each safety functions.

15.5.3 Follow the instructions listed for each firearm regarding test firing, cycling, ammunition used, disassembling/reassembling, trigger pull, and barrel/overall length measurement. Note: If suitable marks are not obtained, test fire additional specimens.

15.5.4 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

15.5.5 Using the test fired shotshell components from each firearm perform the following:

15.5.5.1 Record the class characteristics of the fired shotshell cases.

15.5.5.2 Visually relate the markings imparted to the fired shotshell cases with the part on the firearm that produced the markings.

15.5.5.3 Microscopically compare the test fired shotshell cases from each firearm. Include the following types of markings, as applicable: firing pin impression, breechface markings, chamber marks, extractor marks, ejector marks, ramp marks, ejection port marks, and magazine marks. Photograph the results of your conclusions.

15.5.5.4 Conduct appropriate examinations on the remaining fired shotshell components. Take appropriate notes and photographs of observations and all conclusions.

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

- Conduct a trigger pull examination
- Measure the barrel and overall length in accordance with the Firearm/Toolmark Procedures Manual
- Test fire in remote firing device two (2) 12 gauge shotshells with plastic wadding
- Recover wadding for comparison

15.5.7 Remington model 1100, 12 gauge (or other gas-operated shotgun)

- Test fire two (2) 12 gauge shotshells
- Measure the barrel and overall length in accordance with the Firearm/Toolmark Procedures Manual

15.5.8 Browning model Light Twelve or Auto 5, 12 gauge

- Test fire two (2) 12 gauge shotshells
- Field strip

15.5.9 Mossberg model 500A, 12 gauge

- Test fire two (2) 12 gauge shotshells
- Field strip

15.6 Modes of Evaluation

15.6.1 Practical exercises

15.6.2 Oral sessions

15.7 References

15.7.1 Kapelsohn, E., “Shotgun Patterns, Chokes and Performance,” AFTE Journal, 20(4), 421-434.

15.7.2 Waley, L., “More Slide Action Shotguns Behaving Like Semi-Automatics,” AFTE Journal, 44(1), 75-77.

16 UNIQUE SITUATIONS IN FIREARMS EXAMINATIONS

16.1 Objectives

16.1.1 The trainee will become knowledgeable about the following:

- Accidental Discharge / Design Flaws
- Homemade Devices
- Testing Problem Firearms
- Air Guns
- Full Auto Conversions
- Modifications
- Obstructions and Fractures

16.2 Modes of Instruction

16.2.1 Self-directed through assignments and study questions.

16.2.2 Observations

16.3 Assignments

16.3.1 Completion of required reading (16.7)

16.3.2 Provide a written summary defining each term listed below and explaining any specific safety implications for each.

- Excessive headspace
- Bore obstruction
- Barrel bulge
- Broken extractor
- Push 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

16.3.3 Discuss with TC how to conduct an examination to determine if a firearm has been altered to fire full automatic.

16.3.4 Discuss with TC the protocol to be used in determining whether a firearm can be made to fire without pulling the trigger.

16.3.5 Discuss with TC the capabilities and limitations in regard to the following:

- Marking evidence firearms
- 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

16.4 Study Questions

16.4.1 Define the following terms:

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

16.4.2 What is an air gun?

16.4.3 What is a starter gun?

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

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

16.5 Practical Exercises

16.5.1 Four different firearms will be provided. Determine if each firearm is in mechanical operating condition. Document each firearm on a firearm worksheet, if the firearm is not in mechanical operating condition, fix the firearm. Document this fix on the firearm worksheet. Have the TC function check prior to test firing. Test fire each firearm twice.

16.6 Modes of Evaluation

16.6.1 Practical exercises

16.6.2 Oral sessions

16.7 References

16.7.1 Accidental Discharge / Design Flaws

16.7.1.1 Horn, A., Amberger, R., “Firearm Safety Warning for Bryco Arms model Jennings Nine,” AFTE Journal, Vol. 33, No. 2, Spring 2001, pp. 145-147.

16.7.1.2 Flaskamp, J., “Sympathetic Firing in a Rohm RG10 Facilitates an Identification,” AFTE Journal, Vol. 38, No. 4, Fall 2006, pp. 359-361.

16.7.1.3 Lipscomb, J., Harden, L., “Evaluating Trigger Mechanisms for Sensitivity to Shock,” AFTE Journal, Vol. 17, No. 4, pp. 4.

16.7.1.4 Kosachevsky, P., Siso, R., “FN Pistol Accidental Discharge Due to Magazine Safety Mechanism Bypass,” AFTE Journal, Vol. 46, No. 1, Winter 2014, pp. 76-79.9.

16.7.1.5 Wolslagel, P., "Case Report: Accidental Discharge Potential of Lorcin, Bryco, and Related Pistols," AFTE Journal, Vol. 33, No. 1, Winter 2001, pp. 48-49.

16.7.2 Homemade Devices

16.7.2.1 McCombs, N., "An Unusually Disguised Firearm," AFTE Journal, Vol. 45, No. 1, Winter 2013, pp. 59-61.

16.7.2.2 Schecter, B., Pavel, G., Hocherman, G., "A High Quality Home Made or Underground Copy of an M-16," AFTE Journal, Vol. 41, No. 4, Fall 2009, pp. 380-383.

16.7.2.3 Jaikissoon, S., "Unique Firearm Made from Plumbing Supplies, Capable of Firing a 12 Gauge Shotshell," AFTE Journal, Vol. 46, No. 2, Spring 2014, pp. 150-151.

16.7.2.4 Thacik, J., Hagins, R., "A Pair of Improvised Pistols Made Using Common Readily Available Hardware," AFTE Journal, Vol. 45, No. 2, Spring 2013, pp. 181-183.

16.7.2.5 Giverts, P., "An Improvised Shotgun and Ammunition," AFTE Journal, Vol. 44, No. 1, Winter 2012, pp. 72-74.

16.7.3 Testing Problem Firearms

16.7.3.1 Mears, D., "The Restoration of Rusted Firearms: An Evaluation of Different Methods," AFTE Journal, Vol. 45, No. 3, Summer 2013, pp. 203-221.

16.7.3.2 Voth, A., "Testing a Ruptured Shotgun Barrel," AFTE Journal, Vol. 29, No. 2, Spring 1997, pp. 188-189.

16.7.3.3 Dragan, P., "Identification of Fire Damage Firearm," AFTE Journal, Vol. 31, No. 3, Summer 1999, pp. 376-377.

16.7.4 Air Guns

16.7.4.1 Phetteplace, S., "History, Development, and Types of Airguns, with a Forensic Study of Big Bore Airguns; Part I," AFTE Journal, Vol. 43, No. 1, 2011, pp. 28-36.

16.7.5 Full Auto Conversions

16.7.5.1 Finor, J., "Uncontrollable Full Automatic Fire Occurring in a Walther Pistol Model PP," AFTE Journal, Vol. 28, No. 1, January 1996, pp. 48-54.

16.7.5.2 Lutz, M., "Full Automatic Conversions for AR-15 Rifles," AFTE Journal, Vol. 17, No. 2, April 1985, pp. 18-21.

16.7.5.3 DeFrance, C., Van Arsdale, M., "Full Auto Conversion of Colt AR-15 and Norinco MAK-90," AFTE Journal, Vol 34, No. 2, Spring 2002, pp. 170-171.

16.7.5.4 Chenow, R., "Full Auto Conversion of the Intratec Tec 9: An Update," AFTE Journal, Vol. 20, No. 2, April 1988, pp. 165-166.

16.7.5.5 Monturo, C., "Glock Conversion to Full Automatic," AFTE Journal, Vol. 38, No. 3, Summer 2006, pp. 245-49.

16.7.6 Modifications

16.7.6.1 Rivera, G., “Air Pistols Converted to Fire 25 Auto Caliber Cartridges in Conjunction with a Homemade Device,” AFTE Journal, Vol. 41, No. 2, Spring 2009, pp. 188-192.

16.7.6.2 Greenspan, A., “Conversion of a 25mm Flare Gun to a Rifle,” AFTE Journal, Vol. 43, No. 2, Spring 2011, pp. 179-181.

16.7.7 Obstructions and Fractures

16.7.7.1 Berg, S., “Rifle Barrel Obstruction Tests and Experiments,” AFTE Journal, Vol. 23, No. 4, October 1991, pp. 951-957.

16.7.7.2 Edwards, R., “Circumferential Fractures,” AFTE Journal, Vol 23, No. 3, Summer 1991, pp. 806-807.

16.7.7.3 Ben-Moshe, T., Giverts, P., Hocherman, G., and Schecter, B. “Cracks Observed in Glock Pistols,” AFTE Journal, Vol. 42, No. 1, Winter 2010, pp. 74-76.

16.7.7.4 French, M., “Obstructed Barrel Tests Using 25 Caliber Pistols,” AFTE Journal, Vol. 33, No. 1, Winter 2001, pp. 58-59.

17 BULLET, SHOTSHELL COMPONENTS & CARTRIDGE CASE EXAMINATIONS

17.1 Objectives

17.1.1 The trainee will be able to explain features of bullets, shotshell components, and cartridge cases.

17.2 Modes of Instruction

17.2.1 Self-directed through assignments and study questions.

17.2.2 Observations

17.3 Assignments

17.3.1 Completion of required reading (17.7)

17.3.2 Read sections 2, 3, 5, and 11 of the Firearm/Toolmark Procedures Manual

17.3.3 Read Sections 9, 10 and 11 of the NIJ/NFSTC/AFTE Firearms Analyst Training. (https://projects.nfstc.org/firearms/)

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

17.4 Study Questions

17.4.1 Provide a written summary 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
- nominal caliber
- specific caliber
- manufacturer
- pitch of rifling
- depth of rifling
- jacket construction/composition
- leading edge and trailing edge
- land
- groove
- land impression / groove impression
- indexing

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

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

17.4.4 Explain the use of the mathematical formula $C=\pi d$, defining “C” and “d”.

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

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

17.4.7 Define, in your own words, the following terms and summarize how each may be significant to the comparison of fired bullets.

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

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

17.4.9 What are class characteristics as they apply to cartridge cases/shotshell cases? As applied to bullets?

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

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

17.4.12 Be able to define and understand the relevance of the following terms from the current version of the AFTE Glossary:

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

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

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

17.4.15 What types of examinations 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

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

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

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

17.4.19 What does “not suitable” for comparison mean? What types of projectile evidence does this effect, why?

17.4.20 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?

17.4.21 What conclusions can be reached from a fired slug?

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

17.4.23 What firearms manufacturers use elliptical shaped firing pins?

17.4.24 What firearms manufacturers use teardrop shaped firing pin apertures?

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

17.4.26 What is the significance of manufacturing marks on cartridges/shotshells and cartridge cases/shotshell cases? What are potential sources of subclass characteristics on cartridges from the manufacturing process and which manufacturers produce them?

17.4.27 What is the significance of bunter marks?

17.4.28 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?

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

17.4.30 Provide a written summary describing the reloading and remanufacturing processes of ammunition. The summary should include a discussion on identifying reloading/remanufacturing type marks as well as their potential impact on comparison examinations.

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

17.5 Practical Exercises

17.5.1 Ten cartridge cases will be provided by the TC. Properly document the cartridge cases on a worksheet noting the class characteristics of the breechface and firing pin marks. Propose the manufacturing process that may have produced those marks and provide the reason why.

17.5.2 Ten bullets will be provided by the TC. Properly document the bullets on a worksheet.

17.5.2.1 Determine the weight, diameter, number of lands and grooves and direction of twist and measure the land and groove impressions for each bullet. Using all available laboratory resources, determine the style of bullet, caliber, possible manufacturer, and a listing of the possible brands of firearms from which the bullet could have been fired.

17.5.2.2 Use the appropriate report writing section of the Firearm/Toolmark Procedures Manual to document your final conclusions.

17.5.2.3 Discuss problems encountered when using the ammunition reference collection, GRC file, and/or DFS database.

17.5.3 Obtain ten sets of two firearms of the same make and model from the reference collection.

17.5.3.1 For each firearm, make tests for comparison to one another using a variety of different bullet/cartridge case compositions. The ammunition types chosen should include lead, nickel jacketed, brass jacketed and copper jacketed projectiles and at least two different cartridge case/primer metals.

17.5.3.2 Compare the Known Same Source (KSS) specimens. Photograph each comparison, delineating the areas of agreement observed. Relate the area(s) depicted in the photographs to the tool working surface that is represented.

17.5.3.3 Compare the Known Different Source (KDS) specimens.. Photograph and delineate the best correspondence that is found.

17.5.4 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)
- Luger Springfield (XDS with elliptical FP)

17.5.5 Using the test fired cartridge cases provided from the following firearms, examine the cartridge cases microscopically. First, compare the KSS to each other, next compare the KDS within the same make/model set to each other, and then inter-compare the test fires from the different makes/models of 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)-2 sets
- 9mm Luger Smith & Wesson (M&P series with Hemispherical FP and teardrop shaped aperture)-2 sets
- 9mm Luger Glock (D shaped FP and teardrop shaped aperture)-2 sets

17.5.6 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 sheet to record the answers. Compare the known test fires to each other, observe the differences and similarities in the striations among the bullets and document the consecutive matching stria. Provide photographic and consecutive matching stria documentation of your conclusions and be prepared to discuss your findings and observations.

17.6 Modes of Evaluation

17.6.1 Practical exercises

17.6.2 Oral sessions

17.6.3 Practical examinations

17.7 References

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18 NIBIN

18.1 Objectives

18.1.1 The trainee will successfully complete the BATFE/Ultra Electronics/FTI NIBIN System Training Courses.

18.1.2 The trainee will become proficient in NIBIN entries and correlation reviews.

18.2 Modes of Instruction

18.2.1 Completion of the BATFE/Ultra Electronics/FTI NIBIN System Training Courses.

18.2.2 Self-directed study through assignments and study questions.

18.2.3 Observations

18.3 Assignments

18.3.1 Complete NIBIN System pre-course material.

18.3.2 Study and become familiar with the NIBIN training guide.

18.4 Study Questions

18.4.1 Describe (briefly) the history of the NIBIN program.

18.4.2 What is IBIS and how does it relate to the NIBIN program?

18.4.3 Describe the different components of the IBIS System and how they are used.

18.4.4 Describe the proper orientation for NIBIN entry for the following:

- Centerfire: Parallel BFM
- Centerfire: Arched BFM
- Centerfire: Circular/Granular BFM
- Rimfire: Circular FPI
- Rimfire: Rectangular FPI

18.4.5 What is the procedure for documenting and reporting a potential NIBIN association?

18.4.6 Explain how the current scoring system is calculated and its significance.

18.4.7 What factors affect the correlation of images in the IBIS BrassTrax system? Explain how each of these factors affects the correlation search and results.

18.4.8 Explain the DFS policy on search and review parameters and the origins of those parameters.

18.4.9 How do you recognize subclass characteristics and how might they affect your opinion regarding a potential association?

18.4.10 How do you use the NIBIN image database to support and report potential firearms from the cartridge case class and what are the limitations of this database?

18.5 Practical Exercises

18.5.1 Trainee will review 10 KDS images and discuss with the TC the areas of potential sub-class present.

18.5.2 Trainee will review 10 correlation results of cases entered by other examiners.

18.5.3 Trainee will enter 10 cases, review the correlation results and have the results verified by a qualified examiner.

18.6 Modes of Evaluation

18.6.1 Practical Exercises

18.6.2 Oral Sessions

18.7 References

18.7.1 IBIS BrassTrax User Guide

18.7.2 IBIS Matchpoint User Guide

19 GUNSHOT RESIDUE AND DISTANCE DETERMINATION

19.1 Objectives

19.1.1 The trainee will become proficient in the visual and microscopic examinations of objects / materials for projectile defects.

19.1.2 The trainee will become proficient in the microscopic examination and chemical processing of objects / materials for gunpowder, lead and copper residues (gunshot residues).

19.1.3 The trainee will become proficient in the generation and interpretation of gunshot residue patterns.

19.1.4 The trainee will become proficient in the generation and interpretation of pellet patterns.

19.2 Modes of Instruction

19.2.1 Self-directed through assignments and study questions.

19.2.2 Observations

19.3 Assignments

19.3.1 Completion of required reading (19.7)

19.3.2 Read Sections 7, 11, and Appendix C of the Firearm/Toolmark Procedures Manual

19.4 Study Questions

19.4.1 Describe the chemical reactions for the following chemical tests:

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

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

19.4.3 Describe the Modified Griess test, its purpose, and the specific steps to perform this test.

19.4.4 Describe the Sodium Rhodizonate test, its purpose, and the specific steps to perform this test.

19.4.5 When would you use the Bashinsky transfer?

19.4.6 What problems may be encountered in the analysis of gunshot residue patterns on bloody clothing? Discuss any techniques that could be used to improve the exam.

19.4.7 What are the typical characteristics of a contact shot?

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

19.4.9 What is bullet wipe?

19.4.10 What is a maximum distance determination?

19.4.11 How might choke affect pellet spread?

19.4.12 Discuss with the 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
- Environmental factors (e.g., weather)

19.5 Practical Exercises

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

19.5.2 Complete the microscopic evaluation and direct chemical processing of a white fabric sample(s). Document using appropriate worksheets and photographs. Explore at least one of the factors listed in the Study Questions.

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

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

19.5.5 Test fire and evaluate “complex” gunshot residue samples, to include possible fabric folds, angle influence, flash suppressors, and cylinder flash. Discuss results with the TC.

19.5.6 Receive a firearm, ammunition, and an unknown pattern from the TC to complete a distance determination. Conduct all appropriate visual, microscopic and chemical examinations on the unknown and generated known patterns. Document using appropriate worksheets and photographs. Use the appropriate report writing section of the Firearm/Toolmark Procedures Manual to document your final conclusions.

19.5.7 Evaluate the pellet patterns provided and discuss results with the TC.

19.5.8 Discuss the effect of a rifled barrel on pellet patterns. Evaluate the provided patterns and discuss with the TC.

19.5.9 Receive a firearm, ammunition, and an unknown pattern from the TC to complete a distance determination. Using the approximate 1” per 1 yard criteria, determine an approximate distance. Generate known pellet patterns and determine the distance for the unknown pattern. Discuss any differences in conclusions. Document using appropriate worksheets, and photographs. Use the

appropriate report writing section of the Firearm/Toolmark Procedures Manual to document your final conclusions

19.6 Modes of Evaluation

19.6.1 Practical Exercises

19.6.2 Oral Sessions

19.6.3 Practical Examination

19.7 References

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20 NUMBER RESTORATION

20.1 Objectives

20.1.1 The trainee will become knowledgeable in the theory behind the restoration of obliterated characters.

20.1.2 The trainee will be proficient in the different methods used to restore obliterated characters.

20.2 Modes of Instruction

20.2.1 Self-directed study through assignments and study questions.

20.2.2 Observations

20.3 Assignments

20.3.1 Completion of required reading (20.7)

20.4 Study Questions

20.4.1 Define the following as they pertain to number restoration:

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

20.4.2 Explain the theory for the restoration of characters.

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

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

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

20.4.6 Provide a table listing the available chemical etchants, each etchant's content, and the types of material they would most commonly be used for. Cite at least one (1) brand of firearm for each etchant.

20.4.7 Briefly explain the principle of magnetic particle inspection.

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

20.5 Practical Exercises

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

20.5.2 Using laboratory specimens, conduct several number restorations. Document with appropriate worksheets and photographs the following: obliteration method (several methods may be evaluated), material evaluated (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).

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

20.5.4 Using the barcode appendix from the Firearm/Toolmark Procedures Manual, select a firearm from the reference collection and decode the associated serial number. Document with appropriate worksheets and photographs.

20.5.5 Discuss with the 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.

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

20.5.7 Complete an assigned unknown barcode for serial number decryption. Document with appropriate worksheets and photographs. Use the appropriate report writing section of the Firearm/Toolmark Procedures Manual to document your final conclusions.

20.5.8 Complete an assigned unknown serial number restoration. Document with appropriate worksheets and photographs. Use the appropriate report writing section of the Firearm/Toolmark Procedures Manual to document your final conclusions.

20.6 Modes of Evaluation

20.6.1 Practical Exercises

20.6.2 Oral Sessions

20.7 References

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21 REPORT WRITING, EXPERT TESTIMONY, AND PROFESSIONALISM

21.1 Objectives

21.1.1 To familiarize the trainee with the QM in regards to note taking, chain of custody and report writing.

21.1.2 To familiarize the trainee with the Firearm/Toolmark Procedures Manual in regards to note taking, chain of custody and report writing.

21.1.3 To familiarize the trainee with the Department of Forensic Science LIMS.

21.1.4 To familiarize the trainee with technical and administrative review of case files.

21.1.5 The trainee will become proficient in presenting findings in court.

21.2 Modes of Instruction

21.2.1 Self-directed study through assignments and study questions.

21.2.2 Observations

21.3 Assignments

21.3.1 Completion of required reading (21.7)

21.4 Study Questions

21.4.1 Define the following:

- Expert witness
- Opinion
- Voir dire
- Ethics
- Forensic science
- Ballistics and the 3 specific types

21.4.2 Discuss potential juror bias of forensic scientists and its potential effect on testimony.

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

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

21.4.5 Discuss the general examination documentation requirements in the QM and the Firearm/Toolmark Procedures Manual.

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

21.5 Practical Exercises

21.5.1 Discuss with the TC the accreditation requirements regarding note taking, chain of custody and report writing.

21.5.2 Discuss with the TC the standards regarding file maintenance and location and courtroom testimony monitoring as they relate to the QM.

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

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

21.5.5 When possible, observe examiners testifying; discuss with the TC their demeanor and professionalism.

21.5.6 Coordinate a round table discussion with one examiner from each lab to ask and answer Daubert and evidentiary hearing type questions.

21.5.7 Discuss with the TC the United States Department of Justice Uniform Language for Testimony and Reports for the Forensic Firearms/Toolmarks Discipline Pattern Examination.

21.5.8 Summarize various court decisions from the last 3-5 years that have limited the expert testimony of a firearm/toolmark examiner and include the court's opinion on why the expert was limited.

21.5.9 Discuss testimony techniques that could be used to effectively testify to specific findings within the constraints of the previously discussed court limitations.

21.5.10 Using current accreditation criteria, the QM and Firearm/Toolmark Procedures Manual, discuss with the TC how the laboratory meets the accreditation standards.

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

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

21.5.13 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

21.5.14 Discuss with the TC the Department of Forensic Science's proficiency testing program as it relates to the firearms and toolmarks section.

21.5.15 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 the technical training file. The case files shall be technically reviewed by an authorized examiner pursuant to QM prior to release.

21.5.16 Complete an Audit Trail Worksheet on at least one case.

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

21.6 Modes of Evaluation

21.6.1 Practical Exercises

21.6.2 Oral Sessions

21.7 References

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21.7.27 ANAB AR 3125 ISO/IEC 17025:2017 Forensic Science Testing Laboratories Accreditation Requirements - Sections 7.5 Technical Records, 7.7 Ensuring the validity of results, 7.8 Reporting Results and 7.11 Control of data and information management

21.7.28 ISO/IEC 17025:2017 – 7.5 Technical Records, 7.7 Ensuring the validity of results, 7.8 Reporting of results and 7.11 Control of data and information management

21.7.29 United States Department of Justice Uniform Language for Testimony and Reports for the Forensic Firearms/Toolmarks Discipline Pattern Examination

22 UNCERTAINTY OF MEASUREMENT

22.1 Objectives

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

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

22.2 Modes of Instruction

22.2.1 Self-directed assignments and study questions.

22.2.2 Observation

22.3 Assignments

22.3.1 Completion of required reading (22.7)

22.4 Study Questions

22.4.1 Define the following terms:

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

22.4.2 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.

22.4.3 What is the purpose of Uncertainty of Measurement? What are potential sources of uncertainty?

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

22.4.5 Write a brief description of the traceability of the equipment used for measurements.

22.4.6 Discuss measurement uncertainty and how it relates to distance determinations. How was it calculated and why is it not reported?

22.5 Practical Exercises

22.5.1 Measurements of various overall and barrel lengths and trigger pulls are included in Module 12, 13, 14 and 15.

22.5.2 Describe the section's use of Uncertainty of Measurement as you would in a courtroom testimony situation.

22.6 Modes of Evaluation

22.6.1 Practical exercises

22.6.2 Oral sessions

22.7 References

22.7.1 Presentations and Record of Procedure in the Qualtrax System, Uncertainty of Measurement folder

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

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23 TOOLMARK EXAMINATIONS AND COMPARISONS

23.1 Objectives

23.1.1 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

23.2 Modes of Instruction

23.2.1 Self-directed study through assignments and study questions.

23.2.2 Observations

23.3 Trace Evidence

23.3.1 Assignments

23.3.1.1 Completion of required reading (23.7.1)

23.3.2 Study Question

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

23.4 Casting Techniques

23.4.1 Assignments

23.4.1.1 Completion of required reading (23.7.2)

23.4.2 Study Questions

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

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

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

23.4.3 Practical Exercise

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

23.5 Tool and Toolmark Examinations and Comparisons

23.5.1 Assignments

23.5.1.1 Completion of required reading (23.7.2-23.7.12)

23.5.2 Study Questions

23.5.2.1 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

23.5.2.2 For each tool action listed in 23.5.2.1, describe the class characteristics of the tool and the toolmarks produced. Highlight the differences between shearing and pinching.

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

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

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

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

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

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

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

23.5.2.10 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?

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

23.5.2.12 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)

23.5.3 Practical Exercises

Label all photographs with the specimen type, microscope, magnification, initials and date. Thoughts and observations made regarding this study may be delineated in the form that the trainee feels is most appropriate for future reference and should be used to answer related study questions. The purpose of these exercises is to build criteria for identification and explore the factors that affect the production of a toolmark.

23.5.3.1 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 worksheet, using the 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. Document how the test marks are made and how the tool working surfaces were labeled for examination purposes.

23.5.3.2 Using both the tools selected for each tool type, make two tests in lead with each tool for comparison to one another. Compare the each set of test marks made by the same tool working surface to each other. These toolmarks represent Known Same Source (KSS) specimens. Photograph each comparison and delineate the areas of agreement observed. Document how the area(s) depicted in the photographs relate to the tool working surface that is represented.

23.5.3.3 Compare the test marks made by different tools, but the same tool type, to each other along with marks made by the same tool, but different working surfaces. These toolmarks represent Known Different Source (KDS) specimens. Photograph the best correspondence observed.

23.5.3.4 Make casts of the test marks and repeat the steps listed in 23.5.3.2 and 23.5.3.3 comparing the casts to one another. Document all comparisons with photography. Delineate the areas of correspondence on each photograph.

23.5.3.5 For shearing and pinching action tools: After making initial test cuts in lead wire, use copper wire to make cuts. Attempt to identify the cuts in the copper wire as having been made by the same tool as the cuts in the lead wire. Photograph each comparison and delineate the areas of agreement observed. Note any lighting considerations necessitated by the color difference between copper and lead.

23.5.3.6 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 the test marks in the brass or copper sheeting with the test marks in the lead. Attempt to identify the appropriate marks with the appropriate tool. Make additional test marks in lead, varying the angle and force with which each tool is used, and compare them with the original lead tests. Photograph the comparisons and comment on the difference in the quality of marks made by each tool in each medium.

23.5.3.7 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. Photograph the results.

23.5.3.8 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. Photograph the results.

23.5.3.9 Obtain a section of large-diameter telephone cable, 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.

23.5.3.10 Using the saws and blades provided, properly document each saw/blade type on a tool worksheet. 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. Attempt to compare these marks with the original lead test marks. Photograph the areas of correspondence.

23.5.3.11 Repeat exercise 23.5.3.10 with the various files provided, documenting each file type on a tool worksheet.

23.5.3.12 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.

23.5.3.13 Using a Knife Identification Project (KIP) test kit, compare the test cuts made in cellulose acetate butyrate of the consecutively manufactured blade specimens 2 through 9 to one another, documenting the areas of correspondence and non-correspondence between specimens. Five questioned specimens will be provided 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.

23.5.3.14 The TC will provide casts and toolmarks in lead 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, considering the manufacturing process of the tool that created them. Compare marks from the same tool and different tools, and document the observations with notes and photographs.

23.6 Modes of Evaluation

23.6.1 Practical Exercises

23.6.2 Oral Sessions

23.6.3 Practical Examinations

23.6.3.1 Each trainee will successfully complete at least 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. Use the appropriate report wording section of the Firearm/Toolmark Procedures Manual to document your final conclusions.

23.7 References

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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.

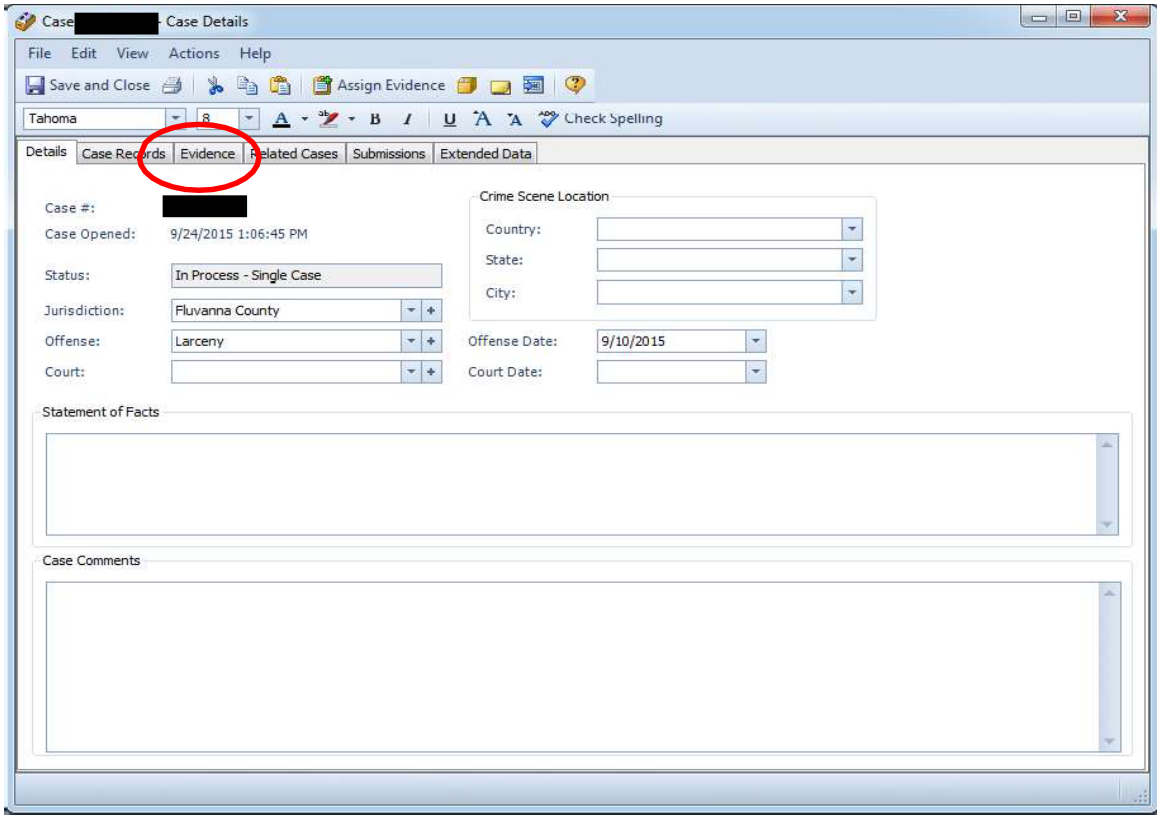
Quality Manual / Firearms Safety
Evidence Handling
Cognitive Factors in Comparative Analysis
Instrumentation
Machining Processes
Introduction to Firearm and Toolmark Identification
Firearm and Toolmark Evidence Admissibility Criteria and Defense
History of Firearms Identification and Current Trends
Historical Development
Ammunition
Firearm Manufacturing
Revolvers
Pistols
Rifles
Shotguns
Examinations
NIBIN
Gunshot Residue and Distance Determination
Number Restoration
Uncertainty of Measurement
Report Writing, Expert Testimony and Professionalism
Toolmark Examinations and Comparisons

The expected completion date of this training plan is _____.

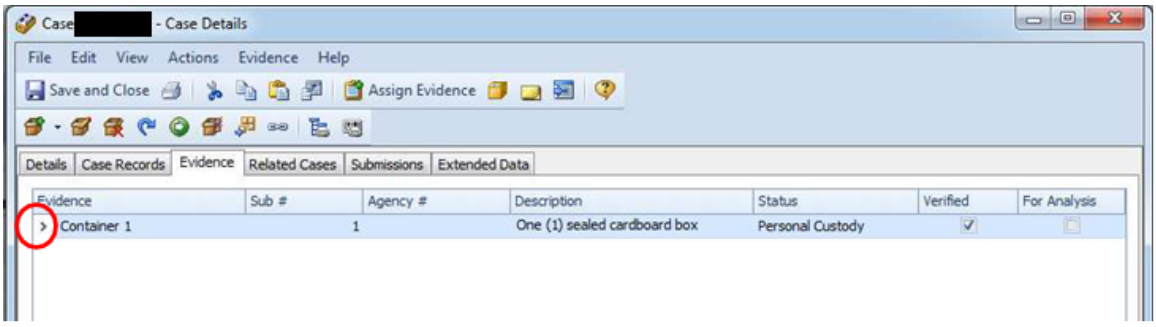
Appendix B – Creating Sub-Items in Forensic Advantage

From the "Case Detail" screen:

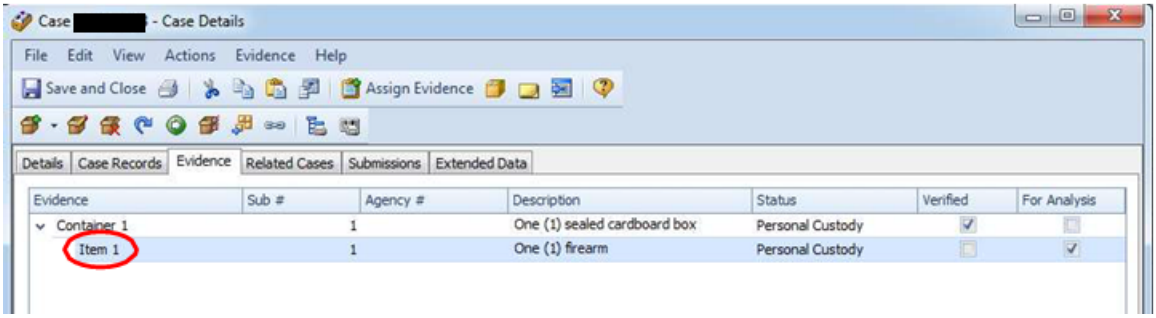
1. Go to the "Evidence" tab



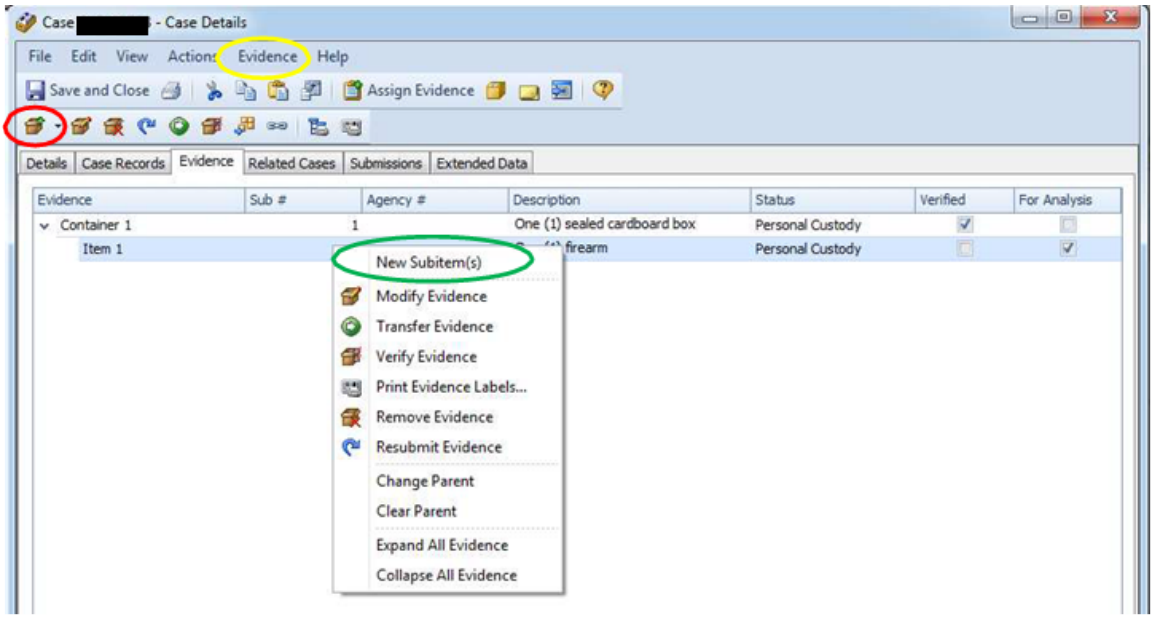
2. Click on the ">" next to the appropriate Container # in order to see all the Items in that container.



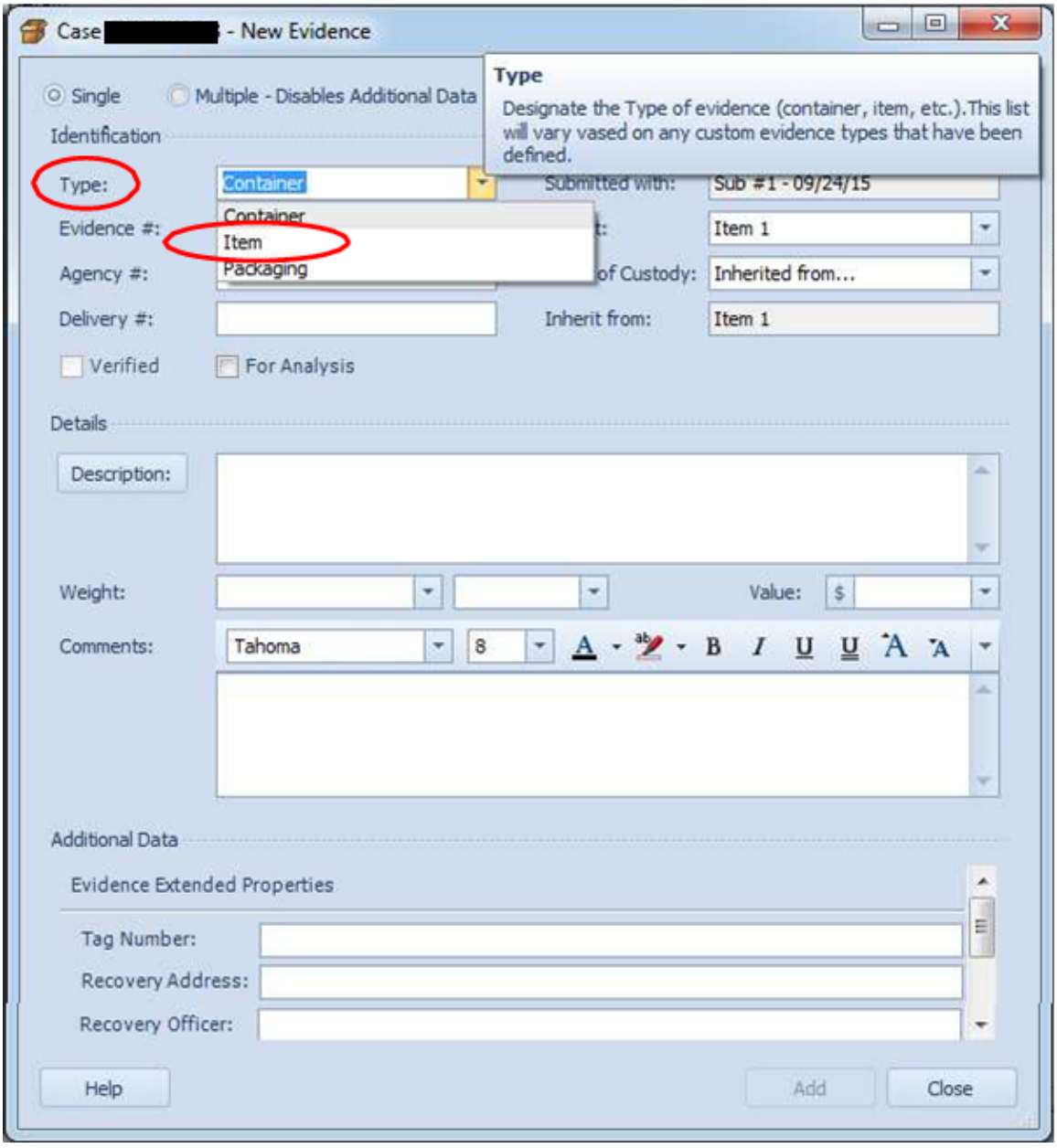
3. Highlight the item for which you need to create a sub-item.



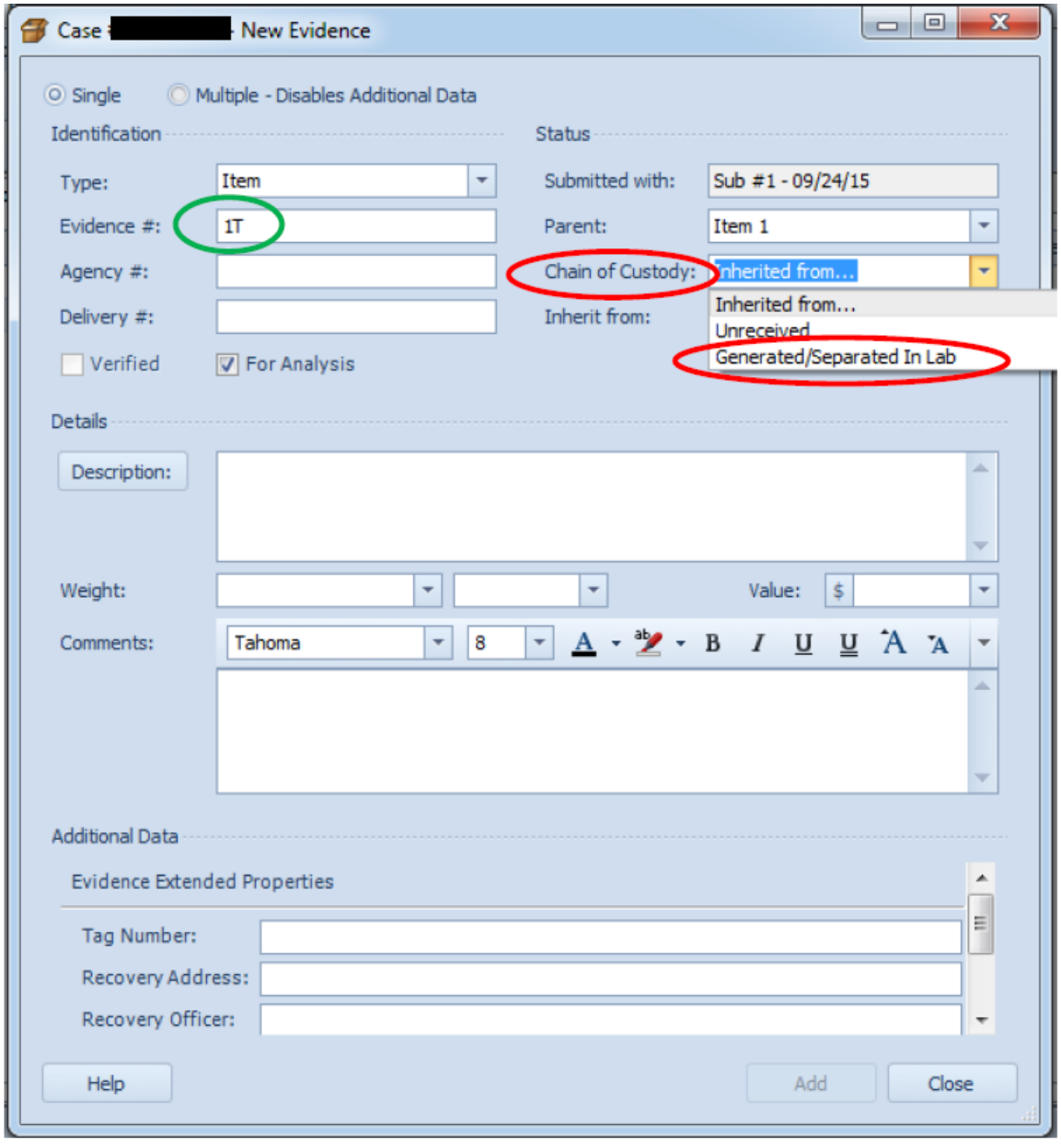
4. Create a new sub-item by any of the following methods:
   a. Right-click and select "New Subitem(s)" (circled in green below)
   b. Select the box with green plus icon (circled in red below)
   c. Select the "Evidence" menu from the top toolbar, then select "New Evidence" and "New Subitem(s)" (circled in yellow below)



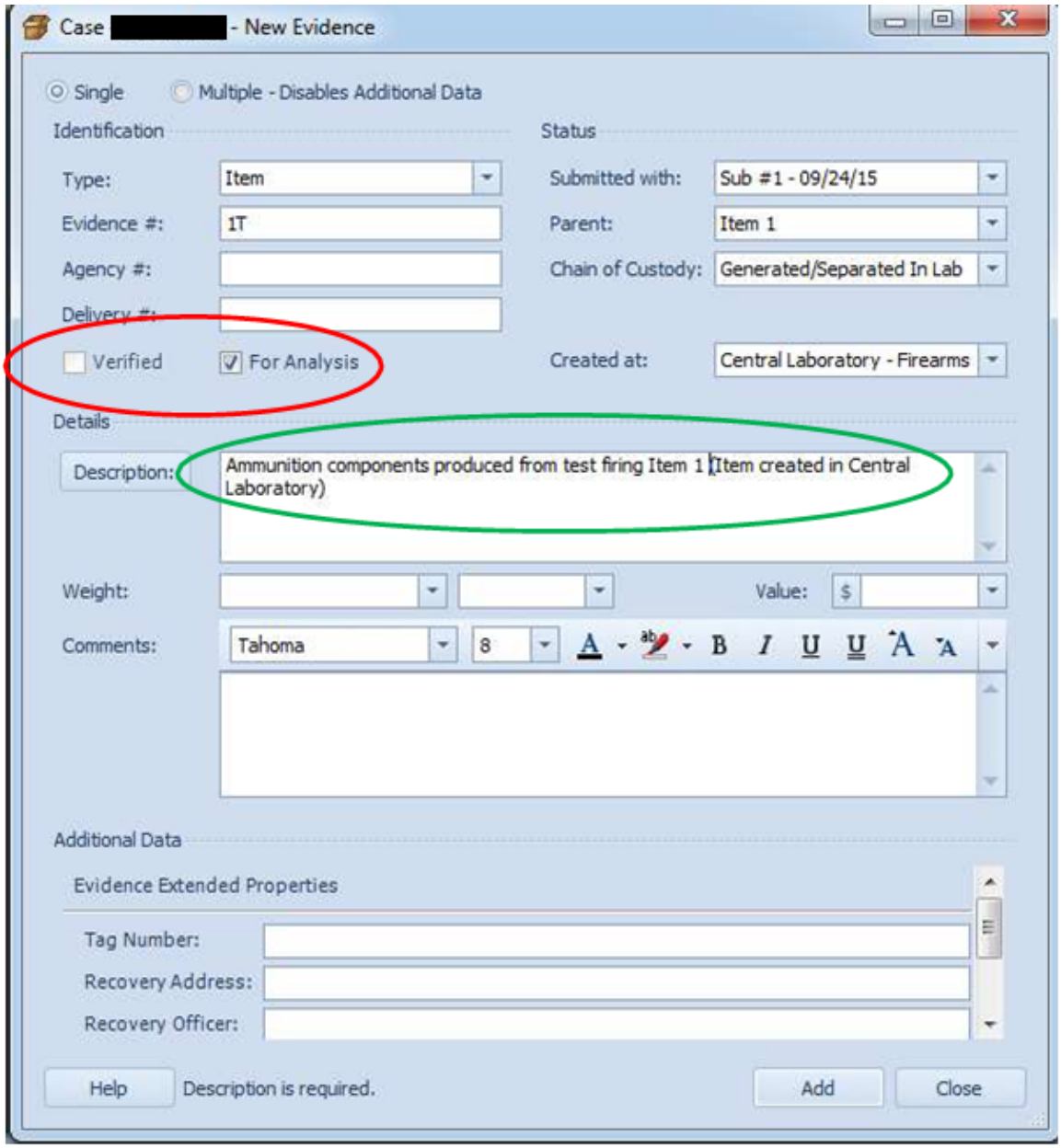
5. This box will appear. NOTE: The “Type” will default to “Container”. You need to change this to “Item” manually in the dropdown.



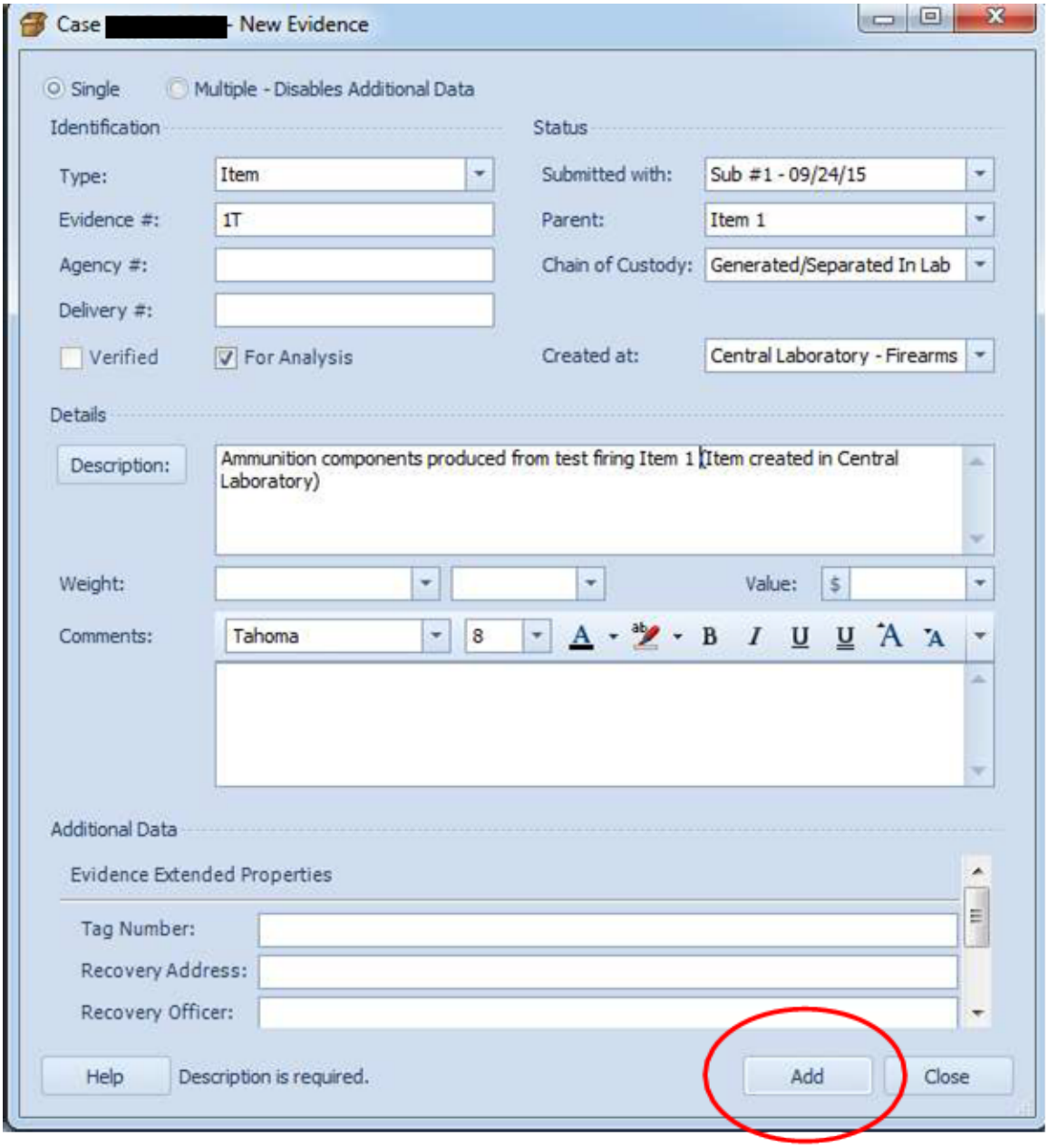
6. Enter the Item # for the sub-item into the “Evidence #” box. (circled in green below).
7. Select “Generated/Separated in Lab” from the “Chain of Custody:” dropdown (circled in red below).
    a. This will create a NEW chain of custody for the sub-item starting on the day that you create it.
    b. Do NOT remove the parent item from “Parent:” dropdown. It should remain the item from which you have created the evidence. These items will now travel together from this point forward unless they are separated manually at a later time.
    c. This does NOT need to be done on the day the tests were created. Specific dates on which the tests were created will be documented in the examination documentation. It is acceptable to create the sub-items when you are preparing the CoA. The date the sub-item is created does not need to match the examination documentation.



8. Add the Item Description to the “Description” box (circled in green below).
9. Make sure the “Verified” and “For Analysis” boxes are checked. NOTE: “For Analysis” should be automatically checked when you create an “Item”. “Verified” will need to be checked manually and it is recommended to do so in this step (circled in red below).



10. BEFORE selecting “Add”, make sure the Item # is correct.
11. Select “Add” (circled in red below).



Reminder: The system will default to adding a subsequent item, defaulting to the next item number. Select “Close” if no additional items need to be added.