



Firearms Section
Firearms Examiner Training Manual
Comparative & Analytical Division



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Introduction to Student

Welcome to the Houston Forensic Science Center. As a Firearms Examiner trainee, you have met the minimum educational, experience, and skills requirements as required by the job posting and have passed a background check and drug screening. This training program allows you, as a Firearms Examiner trainee, to guide yourself through the various areas of knowledge integral to the field of firearm identification. It is paramount that you keep before you the primary and ultimate objective of this training period:

- Independently and competently examine and compare firearms and firearm-related evidence, such as bullets and cartridge cases;
- Independently and competently render an opinion and reach conclusions relating to your examinations and comparisons;
- Give expert testimony in court in matters encompassed within the broad definition of firearm identification;
- Compute duties in a professional, ethical, competent and impartial manner.

The obligation is yours to maximize the effectiveness of the training period as an opportunity to learn everything possible in this field. The extent to which you exert yourself during this training and evaluation period bears directly on the quality of your performance in the laboratory and on the witness stand. Note well that your technical abilities and your testimony, in turn, bear directly on the future situations of accused persons and, especially in the discipline of firearm identification, the lives of accused persons can hang in the balance. You have a moral and ethical obligation to prepare yourself technically and professionally during training to be able to perform according to the most rigid standards.

This training program provides a framework for addressing the most important part of your training: preparing you to independently and competently examine firearm related evidence, independently and competently reach conclusions concerning that evidence, and render opinions concerning those examinations and conclusions. This on-the-job, hands-on experience is the core of your training. You are assigned to work with one or more Principal Instructors during your training period. Principle Instructors are qualified analysts/technicians authorized to perform the tasks you are being trained to do and/or have completed training and have practical experience on the same topics. This ensures that you have sufficiently covered each aspect of this training program and have a basis for continued development after your initial qualification and authorization. Your training will be monitored and assisted by your Principal Instructors, who have primary responsibility for training



matters.

The Firearms Section (FA) Manager, Supervisor, and/or your Principal Instructors will work with you to evaluate your past training, experience, education, published articles and other credentials to establish a base line regarding your knowledge, skills and abilities regarding. Based on this information, an Individual Training Plan (ITP) is prepared for you containing projected completion dates for the established training goals. You receive a copy of this ITP for your information and guidance. You are expected to meet the standards set by your Principal Instructor to successfully complete your training. These standards are set forth in the Training Program.

You are expected to carry out a study of all pertinent section equipment, the Standard Operating Procedures Manual, the HFSC Quality Manual, and the Safety Manual; as well as print, video, and physical reference files. Integral to your course of study are frequent daily contacts with section personnel with special expertise in certain areas. Do not hesitate to ask anyone a question, whether a manager, supervisor, examiner, or technician.

Your study includes many printed and digital references, including the basic material listed within each area of study. It is expected that during the training period you become thoroughly familiar with these basic references. Further, do not restrict your efforts and research to those required references. One of your primary sources of additional information is the section's reference library. Familiarize yourself with the library's contents, including the reference files, related indices, manufacturers' literature, and the journal of the Association of Firearm and Toolmark Examiners.

In addition to maintenance of this manual, you are required to keep a record of your study notes on each of the items shown in the training program for research, discussion, demonstration, study, or practical work. This record can include hand or type-written notes, charts, graphs, photographs, photocopied material, etc. Your training record must address and broaden on each of the required items of study set out in the training program and include the number of hours or days you spend on training (this may be in the form of a calendar or a training schedule). Organization of your records in a format that parallels the training program is suggested. This record assists the documentation of your progress during training and **serves** as a ready reference in the months and even years following the completion of training.

Parts of the training program may be supplemented by a research project or duties assigned as learning experiences. Discuss your ideas regarding projects or duties with your Principal Instructor.



Your dedication and efforts to successfully complete this training program prepares you to: independently and competently examine firearm related evidence; independently and competently reach conclusions; and render opinions concerning those examinations and conclusion.

As you progress through the training program, you will have several opportunities to establish competency. Completion of Units 1, 2, 3, 4, 5, 6, and 8 (or equivalent training and experience) is a prerequisite before the student may show competency. Firearms Examiners are commonly competency tested in: function testing and test firing firearms, bullet/projectile examination and comparison, cartridge case examination and comparison, and serial number restoration. (Competency may also be established in NIBIN acquisition and correlation review, but do not require all the above units are completed. Requirements are listed in the training manual.) Typically, examiners are authorized to do independent work as a primary examiner before being competency tested and authorized as a second examiner and as a reviewer. Firearms Examiners may demonstrate competency and obtain authorization to do work all at once, or in stages, as appropriate for the needs of the student, principal trainers, and the section. If section needs dictate that a trainee establish competency in a sub-section/area, the requirements for establishing competency will be developed by Section Management, documented, and provided to the trainee prior to being given the competency test. Specific requirements for each competency are listed within the training manual.

Written tests or quizzes require a grade of 80% or greater to pass. If a passing grade is not obtained, you will be required to answer the same (or similar) questions verbally to the satisfaction of the trainer. If the oral answers are not satisfactory, the trainer will identify practical exercise (either from the training manual or in addition to those found in the manual) that may assist you in understanding the topics covered by the quiz/test. Once you have completed those exercises, you will repeat the quiz/test.

Before being authorized to do independent casework, a trainee must pass an oral exam. The oral exam questions will be determined by Section Management. The goal of the oral exam is to evaluate your ability to communicate effectively in a courtroom setting as well as evaluate the fundamental knowledge you need to carry out day-to-day job duties. The oral examination questions may cover any aspect of Units 1, 2, 3, 4, 5, 6, and 8, as well as any topic for which you are seeking or have already established competency. (If you are beginning your independent casework in NIBIN Only activities, only those appropriate units will be covered.) More than one oral exam



may be given if you are authorized for independent casework in stages. Each question will be evaluated by Section Management as satisfactory, not satisfactory, or needs improvement. For any answer deemed not satisfactory, you will be required to answer the same (or similar) question in writing to the satisfaction of Section Management. If more than 20% of the questions answered have a needs improvement rating, you will have an attempt to answer the “needs improvement” questions again. If either the written or oral answers are still not satisfactory, Section Management will identify practical exercise (either from the training manual or in addition to those found in the manual) that may assist you in understanding the topics covered. Once you have completed those exercises, you will repeat the oral exam.

If at any point in your training you do not feel that the training has been adequate for you to fully understand the topic(s) covered, it is your duty to notify your trainer and/or a member of Section Management. Never attempt to complete a competency test, written quiz/test, or oral exam if you do not feel fully prepared.

Before being authorized to do independent case work, a trainee must also undergo one or more mock trials. The mock trial(s) will address casework aspects for which you are seeking or have already established competency. Further details on mock trials can be found in Unit 13.



1. Administrative Orientation

1.1. Sections

- Houston Forensic Science Center (HFSC) New Hire Orientation
- Tour
- Firearms Section In-Processing

1.2. Training Objectives

To provide the student with an understanding of the mission of HFSC, the operation of the Firearms Section, as well as the other sections of the HFSC.

1.3. Method of Evaluation

Oral discussion

1.4. Training Methods

- Self-directed study
- Discussion
- Tour of some or all sections of HFSC
- HFSC New Hire Orientation (if applicable)

1.5. Practical Exercises

1.5.1. Houston Forensic Science Center (HFSC) New Hire Orientation

Attend the HFSC New Hire Orientation when scheduled. Discuss any questions you have with your Principal Instructor.

Principal Instructor Signature and Date

1.5.2. Tour

Tour HFSC facilities with your Principal Instructor or designee. Focus on the flow of evidence through HFSC and through the Firearms Section. Tour the HPD Property Room, if permissible.



Principal Instructor Signature and Date

1.5.3. Firearms Section In-Processing

1.5.3.1. The student will read the HFSC Quality Manual and discuss with the Principal Instructor in the context of the job duties of a **Firearms Examiner**.

Principal Instructor Signature and Date

1.5.3.2. The student reads the section's Standard Operating Procedure Manual and discuss the section's mission with the Principal Instructor. Discussions with the student include section and HFSC procedures.

Principal Instructor Signature and Date

1.5.3.3. The student will read HFSC policies and procedures as required by HFSC New Employee On-Boarding and/or at the discretion of the Section Manager or Supervisor. Each manual, policy, and/or procedure read by the student must be documented.

Principal Instructor Signature and Date

1.5.3.4. The student will discuss ethics in forensic science with the Principal Instructor. The student will read the HFSC Code of Ethics, any ethics document issued by HFSC's accrediting bodies, (e.g., ANAB and/or TFSC), and any ethics document issued by the Association of Firearm and Toolmark Examiners with the Principal Instructor.

Principal Instructor Signature and Date

1.5.3.5. The student will define the difference between accreditation, certification, and licensing and discuss these differences with the principle instructor.



Principal Instructor Signature and Date

1.5.3.6. The student will define what kind of organization HFSC is, as well as how it is similar and different from other crime laboratories in the United States and discuss this with the principal instructor.

Principal Instructor Signature and Date

1.6. Required Reading

- HFSC Quality Manual
- Firearms Section Standard Operating Procedures
- HFSC Health and Safety Manual
- HFSC Security Manual
- HFSC Corporate Policies and Procedures
- ANAB Guiding Principles of Professional Responsibility for Crime Laboratories and Forensic Scientists
- AFTE Code of Ethics
- All reading, etc. listed by TFSC as required for the Professional Responsibility of the Technician License Exam.

Student Signature and Date of Reading Completion

1.7. Terminology

Common Acronyms

HFSC	Houston Forensic Science Center
TFSC	Texas Forensic Science Commission
SOP	Standard Operating Procedures
ANSI	American National Standards Institute
ANAB	American National Standards Institute (ANSI) National Accreditation Board



AFTE

Association of Firearm and Toolmark Examiners

1.8. Estimated Training Time

50 hours

2. Background/History of Firearm Identification

2.1. Sections

2.1.1. Introduction to Forensic Firearm Identification

2.1.2. History

2.1.3. Scope of Responsibilities and Conclusions

2.1.4. Association of Firearm and Toolmark Examiners (AFTE)

2.1.5. National Integrated Ballistics Information Network (NIBIN)/Integrated Ballistic Identification System (IBIS)

2.1.6. Proficiency Testing

2.2. Training Objectives

To acquaint the student with the field of forensic firearm identification, its history, the Firearms Examiner's responsibilities, and the scope of the conclusions rendered. This unit provides you with insight into the field in which they you are training by including sections on AFTE, NIBIN (IBIS), proficiency testing, and initiate an on-going study of firearm terminology.

2.3. Method of Evaluation

Written **exercises**

2.4. Training Methods

2.4.1. Self-directed study

2.4.2. Discussion to include:

- Definition of firearm identification
- How marks on projectiles are produced
- Differences in consecutively rifled barrels
- The conclusions that can be reached by Firearms Examiners

2.5. Practical Exercises

2.5.1. Introduction to Forensic Firearm Identification

2.5.1.1. Define the following terms:

- Firearm Identification



- Ballistics

Principal Instructor Signature and Date

2.5.2. History

Read the applicable sections from the basic references and prepare a report on the history, principles, evolution, and scope of firearm identification in its broadest sense. Support your report by data accumulated in your training record. Discuss this with your Principal Instructor.

Principal Instructor Signature and Date

2.5.3. Scope of Responsibilities and Conclusions

2.5.3.1. Formulate an answer to the following questions:

- Is firearm identification an art or science?
- What are the types of conclusions that can be reached in firearm identification comparisons?
- What is the basis for each of the above conclusions?
- **Is firearms examination subjective or objective? Why?**
- Can experts in the field of firearm identification disagree regarding their conclusions? Why or why not?
- How does "probability" relate to firearm identification?

Principal Instructor Signature and Date

2.5.3.2. **Be able to describe the steps of the scientific method involved in the formation of a scientific theory to the satisfaction of your Principal Instructor.**

Principal Instructor Signature and Date



2.5.3.3. Read the AFTE Theory of Identification available in the AFTE Glossary as well as journal articles. Write a summary of the AFTE theory of identification as it applies to impressed and striated tool marks in your own words (firearms examination is a subset of tool mark examination). Discuss your summary with your Principal Instructor.

Principal Instructor Signature and Date

2.5.3.4. Define the following components of the AFTE Theory of Identification in your own words and discuss with your Principal Instructor.

- What is “significant agreement” related to?
- How is the significance of “significant agreement” determined?
- When is agreement deemed significant?
- What does “sufficient agreement” mean?

Principal Instructor Signature and Date

2.5.3.5. Define the following conclusions within the AFTE Range of Conclusions in your own words and discuss with your Principal Instructor:

- Identification
- Elimination
- Inconclusive
- Unsuitable

Principal Instructor Signature and Date

2.5.3.6. With respect to the AFTE Theory of Identification, is a common source conclusion absolute? Why or why not? Discuss with your Principal Instructor.

Principal Instructor Signature and Date



2.5.3.7. Define the foundational premise of uniqueness behind the applied science of Firearms and Tool Mark Identification. Include the following:

- Manufacturing processes
- Working surfaces
- Subclass characteristics
- Chip formation
- Tool wear

Principal Instructor Signature and Date

2.5.3.8. Research the issue of contextual and confirmation bias and respond to the following questions, discussing them with your Principal Instructor.

- Why is there a concern for the potential of contextual and confirmation bias, especially in the pattern matching disciplines?
- In what ways can examiners be influenced by bias?
- What are some of the precautions that can be taken to reduce bias?

Principal Instructor Signature and Date

2.5.3.9. Research empirical and experimental studies of error rates in the field of Firearm Identification, including limitations of studies. Discuss your findings with your Principal Instructor.

Principal Instructor Signature and Date

2.5.3.10. Research the concept of consecutive matching striations (CMS) and respond to the following questions, discussing them with your Principal Instructor.

- Define the concept of consecutive matching striations (CMS).
- For which type of tool marks can CMS be used?
- How do those who utilize CMS differentiate between two dimensional and three-dimensional tool marks?
- What is the minimum conservative quantitative criteria for three-dimensional striated tool marks?



- What is the minimum conservative quantitative criteria for two-dimensional striated tool marks?
- Describe the similarities and differences between “pattern matching” and “CMS”.

Principal Instructor Signature and Date

2.5.4. Association of Firearm and Toolmark Examiners (AFTE)

Familiarize yourself with AFTE, to include its history, current officers, criteria for membership, committees, the AFTE glossary, and the AFTE journal and be able to discuss them.

Principal Instructor Signature and Date

2.5.5. National Integrated Ballistics Information Network (NIBIN)/Integrated Ballistic Identification System (IBIS)

Discuss with your Principal Instructor the status of the ongoing research initiatives to link shootings using computer imagery such as NIBIN/IBIS.

Principal Instructor Signature and Date

2.5.6. Proficiency Testing

- 2.5.6.1. Become knowledgeable about the firearms-related proficiency testing program offered by the service provider chosen by HFSC. Particularly be aware of testing and the results of testing conducted within the field of firearm identification by the outside organization(s). Discuss this with your Principal Instructor.

Principal Instructor Signature and Date

- 2.5.6.2. Initiate an on-going study of the AFTE glossary to develop a practical working knowledge of firearm terminology and know how to use this reference.



Principal Instructor Signature and Date

2.6. Reading

2.6.1. Required Reading

- *Firearms Investigation, Identification, and Evidence* by Hatcher, Jury and Weller; Chapter 1 and page 298.
- Firearms and Toolmark Identification, An Introduction by C.R. Meyers; AFTE Journal; Vol. 25, No. 4 (Fall 1993) pp. 281-285.
- *Firearms Identification* by J. H. Mathews; Vol. I, Part I, Chapters 1-5, pp. 3-87
- *The Identification of Firearms* by J.D. Gunther and Gunther; Introduction, pp. xxiii-xxviii and Chapter 1, pp. 1 & 2.
- *A History of Firearms Identification* by Calvin Goddard; Chicago Police Journal 1936; reprinted in AFTE Journal; Vol. 17, No. 1 (January 1985) pp. 55-68.
- Comments on the Discovery of Striation Matching and on Early Contributions to Forensic Firearms Identification by F. Thomas (M.D.); AFTE Journal; Vol. 12, No. 3 (July 1980) pp. 31-35.
- The Guns of Brownsville by D.H. Garrison; AFTE Journal; Vol. 18, No. 4 (October 1986) pp. 665-71.
- The Missile and the Weapon by A.L. Hall; Buffalo Medical Journal; June 1990: reprinted in AFTE Journal; Vol. 12, No. 4 (October 1980) pp. 85-91.
- AFTE Glossary – Glossary of the Association of Firearm and Toolmark Examiners, AFTE Standardization Committee.
- All the NIBIN Procedures Manuals.
- The History of Firearm and Toolmark Identification by James Hamby and James Thorpe, AFTE Journal; Vol. 31, No. 3 (Summer 1999) pp. 266-284.
- AFTE Criteria for Identification Committee, “Theory of identification, range of striae comparison reports and modified glossary definitions”, *AFTE Journal*, 1992; 24(3): 336-340.
- AFTE Committee for the Advancement of the Science of Firearm and Toolmark Identification, “Theory of identification as it relates to toolmarks: revised,” *AFTE Journal*, 2011; 43(4):287.



Student Signature and Date of Reading Completion

2.6.2. Suggested Reading

- *Firearms Identification*, Preface by M.A. Prieto; AFTE Journal; Vol. 14, No. 2 (April 1982) pp. 17-43.
- The Valentine Day Massacre, A Study in Ammunition Tracing by C.H. Goddard; American Journal of Police Science Vol. 1 No. 1 January-February 1930; reprinted in AFTE Journal; Vol. 12, No. 1 (January 1980) pp. 44-59.
- The Drama of Forensic Ballistics by S.O. Berg; AFTE Journal; Vol. 11, No. 3 (July 1979) pp. 44-48.

2.7. Terminology

- Ballistics
- Forensic Science
- Forensic Firearm Identification

Principal Instructor Signature and Date

2.8. Estimated Training Time

80 hours



3. Firearm Development

3.1. Sections

- 3.1.1. History of Firearms
- 3.1.2. **General Knowledge**
- 3.1.3. Long Guns (Single shot to repeating)
- 3.1.4. Long Guns (Semiautomatic)
- 3.1.5. Submachine Guns & Machine Guns
- 3.1.6. Handguns (Revolvers)
- 3.1.7. Handguns (Semiautomatic)
- 3.1.8. Shotguns
- 3.1.9. Manufacturing Techniques

3.2. Training Objectives

To develop in the student a thorough knowledge of firearms of all types so that he/she knows how to assemble and disassemble most firearm types, be familiar with important developments in the firearm field, and have a working knowledge of manufacturing techniques of those weapons most frequently encountered. In addition, a working knowledge of firearm terminology continues to develop.

3.3. Method of Evaluation

- Written/practical **exercises**
- Manual demonstration
- **Discussion**

3.4. Training Method

- Reading
- Discussion
- Practical exercises

3.5. Practical Exercises

In the following practical exercises involving the disassembly of firearms, substitutions of similar types, makes, and models are done if any of the listed firearms cannot be obtained. The use of



the section's videos is recommended if a particular firearm is not available. Use of various assembly/disassembly guides is recommended.

3.5.1. History of Firearms

3.5.1.1. Review firearm safety and test firing rules with your Principal Instructor. Cite the rules and be able to explain the reason for each rule.

Principal Instructor Signature and Date

3.5.1.2. Review the history of early firearm development up to the advent of metallic cartridges, with particular emphasis on lock mechanisms, early rifling techniques, percussion systems, priming methods, and pre-metallic cartridges. Prepare a chronological outline of this early development and discuss it with your Principal Instructor.

Principal Instructor Signature and Date

3.5.2. General knowledge

3.5.2.1. Explain and illustrate the differences between the operations of the following types of actions found in autoloading pistols:

- Blowback action
- Delayed blowback action
- Gas operated action
- Hammer operation
- Double action
- Short recoil action
- Long recoil action
- Striker fired
- Gas-delayed blowback
- Single action

Principal Instructor Signature and Date

3.5.2.2. Define each of the following types of firearms and explain in detail the operations of each type to include the loading of cartridges and the subsequent movement of the cartridge case and/or bullet after firing.

- Revolver, single and double action
- Percussion revolver
- Various single shot rifles
- Submachine gun



- Derringer and single shot pistols
- Bolt action rifle
- Pump action rifle
- Assault rifle
- Muzzle loading firearm
- Autoloading pistol, single and double action

Principal Instructor Signature and Date

3.5.2.3. Describe the differences and similarities between a flash suppressor and a sound suppressor. Discuss this with your principal instructor.

Principal Instructor Signature and Date

3.5.2.4. Research, define, and/or determine the implications of the following terms as they relate to safety in the operation of a firearm:

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

Principal Instructor Signature and Date

3.5.2.5. Identify the various types of internal and external safety mechanisms found in pistols, revolvers, rifles, and shotguns. Learn the manufacturer's nomenclature for each safety mechanism. The AFTE Glossary may be used when needed. Classify each safety as active or passive. Include the following:

- Cross bolt
- Disconnect
- Decocker
- Drop safety



- Firing pin block
- Half cock
- Lever
- Manual
- Sliding button
- Thumb
- Trigger lock
- Rebound/rebounding hammer
- Grip
- Key lock
- Magazine
- Quarter cock
- Tang
- Transfer bar
- Wing

Principal Instructor Signature and Date

3.5.2.6. Demonstrate your knowledge of the basic nomenclature of handguns, rifles, and shotguns.

3.5.2.6.1. Include, but do not restrict your study to the following:

- Anvil
- Bolt
- Breechbolt
- Butt
- Choke
- Clip
- Crown
- Ejection port
- Extractor
- Firing pin
- Forcing cone
- Grooves
- Lands
- Muzzle
- Ramp
- Rifling
- Sear
- Striker
- Barrel
- Bore
- Breechface
- Chamber
- Choke tube
- Comb
- Cylinder
- Ejector
- Feed ramp
- Firing pin aperture
- Frame
- Hammer
- Magazine
- Percussion nipple
- Receiver
- Safeties
- Slide
- Trigger

3.5.2.6.2. Point out these parts in several handguns, rifles, and shotguns (as applicable).



3.5.2.6.3. Discuss the manufacturing techniques that would have been used to fabricate and finish each of the parts and note the machining marks on each part.

3.5.2.6.4. Point out any "mark of abuse" which could contribute to the uniqueness of each part.

3.5.2.6.5. Identify areas that machining marks might "carry over" to another firearm.

Principal Instructor Signature and Date

3.5.2.7. Review the history and current significances of proof marks as they relate to the manufacture of firearms. Discuss this with your Principal Instructor.

Principal Instructor Signature and Date

3.5.2.8. Review and record the references in the Firearms Section library which can be used to identify the manufacturer and/or source of a firearm using the following criteria:

- Proof marks
- Inspector marks
- Part numbers
- Firearm importer/exporter names
- Catalogue numbers
- Manufacturer names
- Company logos
- Serial number
- Factory numbers and markings
- Serial numbers (including hidden)
- Work-stamp numbers
- Manufacturer numbers

Principal Instructor Signature and Date

3.5.3. Long Guns (Single shot to repeating)

3.5.3.1. Tour the firearm reference collection noting in particular the types of firearms that are representative of commercial and military firearm development since the advent of metallic cartridges.

Principal Instructor Signature and Date



3.5.3.2. The student function tests, identifies parts (3.5.2.6.1), disassembles, and reassembles the following types of firearms:

- Bolt action rifle with a wing on bolt safety (i.e. Springfield 1903)
- Lever action rifle with a half cock safety (i.e. Model 1894 Winchester)
- Lever action rifle with a sliding button on the tang (i.e. Savage Model 99)
- Pump action rifle (i.e. Savage Model 170 Series A)
- Slide action carbine (i.e. Remington 760)

Principal Instructor Signature and Date

3.5.3.3. **The trainee must verbally demonstrate their understanding of** at least two of the above listed firearms **to the satisfaction of the principal instructor**. The student discusses all the safety features of the selected firearms, as well as the operating method/system and how the individual parts interact.

Principal Instructor Signature and Date

3.5.4. Long Guns (Semiautomatic)

3.5.4.1. The student function tests, identifies parts (3.5.2.6.1), disassembles, and reassembles the following types of firearms:

- Gas operated carbine with a crossbolt safety (i.e. M-1 Carbine)
- Gas operated rifle with a trigger guard lever and hammer block (i.e. Ruger Mini-14)
- Gas operated rifle with a crossbolt safety (i.e. Remington 742)
- Gas operated rifle with a trigger guard lever (i.e. AKS/SKS type)

Principal Instructor Signature and Date

3.5.4.2. **The trainee must verbally demonstrate their understanding of** at least two of the above listed firearms **to the satisfaction of the principal instructor**. The student discusses all the safety features of the selected firearms, as well as the operating method/system and how the individual parts interact.



Principal Instructor Signature and Date

3.5.5. Submachine Guns & Machine Guns

3.5.5.1. The student function tests, identifies parts (3.5.2.6.1), disassembles, and reassembles the following types of firearms:

- Gas operated rifle having different firing modes (i.e. AR-15, both selective fire and semiautomatic)
- Full automatic gas operated rifle (i.e. AK 47)
- Full automatic submachine gun that fires from open bolt (i.e. Uzi Model A)

Principal Instructor Signature and Date

3.5.5.2. **The trainee must verbally demonstrate their understanding of** at least two of the above listed firearms **to the satisfaction of the principal instructor.** The student discusses all the safety features of the selected firearms, as well as the operating method/system and how the individual parts interact.

Principal Instructor Signature and Date

3.5.5.3. Discuss with your Principal Instructor how to conduct an examination to determine if a firearm has been altered to fire full automatic. Using a firearm that has been altered to fire full automatic, conduct this type of examination and verbally report your findings.

Principal Instructor Signature and Date

3.5.6. Handguns (Revolvers)

3.5.6.1. Prepare an overview of the recent developments in handguns, such as electrochemical rifling, polygonal rifling, double action only, striker fire, etc., and how this information might be of significance to the Firearm Examiner. **Be prepared to discuss these with your Principal Instructor.**



Principal Instructor Signature and Date

3.5.6.2. The student function tests, identifies parts (3.5.2.6.1), disassembles, and reassembles the following types of firearms:

- Smith & Wesson single action/double action revolver (i.e. Model 10-5)
- Colt single action/double action revolver (i.e. Detective Special)
- Ruger single action/double action revolver (i.e. Security Six)
- "Old Style" Ruger single action revolver (i.e. Blackhawk)
- "New Style" Ruger single action revolver (i.e. New Model Blackhawk)

Principal Instructor Signature and Date

3.5.6.3. **The trainee must verbally demonstrate their understanding of** at least two of the above listed firearms **to the satisfaction of the principal instructor**. The student discusses all the safety features of the selected firearms, as well as the operating method/system and how the individual parts interact.

Principal Instructor Signature and Date

3.5.7. Handguns (Semiautomatic)

3.5.7.1. The student function tests, identifies parts (3.5.2.6.1), disassembles, and reassembles the following types of firearms:

- Single action only recoil operated pistol (i.e. Model 1911/1911A1)
- Blowback operated pistol (i.e. Walther PPK/S)
- Blowback pistol (i.e. SWD/Cobray M-11)
- Gas operated pistol (i.e. 44 Magnum or 50 AE IMI Desert Eagle)
- Recoil operated double action only pistol (**striker fired**) (i.e. Glock 17)
- Recoil operated double action only pistol (**striker fired**) (i.e. **Taurus Millennium**)
- Recoil operated single action/double action pistol **with hammer** (i.e. Beretta 92S)



- Recoil operated pistol with a magazine disconnect (i.e. Browning Hi-Power)
- A single action only blowback pistol (i.e. Raven MP-25)

Principal Instructor Signature and Date

3.5.7.2. **The trainee must verbally demonstrate their understanding of** at least two of the above listed firearms **to the satisfaction of the principal instructor**. The student discusses all the safety features of the selected firearms, as well as the operating method/system and how the individual parts interact.

Principal Instructor Signature and Date

3.5.8. Shotguns

3.5.8.1. The student function tests, identifies parts (3.5.2.6.1), disassembles, and reassembles the following types of firearms:

- Single shot shotgun
- Gas operated shotgun (i.e. Remington 1100)
- Pump action shotgun with a crossbolt safety (i.e. Remington 870)
- Semiautomatic shotgun (i.e. Winchester 1200)
- Pump action shotgun (i.e. Ithaca 37)
- Browning Auto 5
- Side-by-side or over/under shotgun

Principal Instructor Signature and Date

3.5.8.2. **The trainee must verbally demonstrate their understanding of** at least two of the above listed firearms **to the satisfaction of the principal instructor**. The student discusses all the safety features of the selected firearms, as well as the operating method/system and how the individual parts interact.



Principal Instructor Signature and Date

3.5.8.3. Explain and illustrate the differences between a gas operated and recoil operated autoloading shotgun.

Principal Instructor Signature and Date

3.5.9. Manufacturing Techniques

3.5.9.1. Research some of the materials used to manufacture firearms. Gain a general understanding of molecular structure by reading about atoms, molecules, compounds and crystals. Define and be familiar with the general composition, qualities and limitations of these materials as they relate to firearms and tool marks. Include, but do not limit your study to the following:

- Alloy
- Bar stock
- Carbon (as an element)
- Ferrous alloy
- Iron crystals
- Pig iron
- Stainless steel
- Tin
- Tungsten carbide
- Zinc alloy (i.e., ZAMAK)
- Aluminum
- Barrel stock (Chromium-molybdenum)
- Ceramic (as used in molds)
- Iron (as an element)
- Iron ore
- Polymer
- Steel
- Titanium
- Zinc (as an element)

Principal Instructor Signature and Date

3.5.9.2. Numerous techniques are used in the manufacture of modern firearms. Study these procedures and discuss them in your notes. Research, identify and briefly define the listed processes using the AFTE Glossary and other reliable references. Be familiar with the tool mark patterns (both striated and impressed) that some of these processes leave on the bearing surfaces of a firearm that are in direct contact with ammunition prior to and after discharge. In addition, you are encouraged to view on-line videos for these manufacturing processes, if available. Include, but do not



restrict your study to, the following machining methods: **Be prepared to discuss these with your Principal Instructor.**

- Abrasive machining
- **Ballizing**
- Broaching (excluding barrel broaching)
- **Chamfering**
- **Cope and drag (as used in casting)**
- Electrochemical machining (ECM)
- **Extrusion**
- **Fine forming operations**
- **Hammer forging**
- Investment and die casting (parts)
- **Lead lapping**
- Metal injection molding (MIM)
- **Molding**
- **Powdered metal technology (PMT)**
- **Sacrificial waxes & runners**
- Sawing
- **Stamping**
- **Subcontract manufacturing**
- Turning
- **Annealing**
- Boring
- **Casting**
- **Computer numeric control (CNC)**
- **Drilling (excluding barrel/deep hole drilling)**
- Electrical discharge machining (EDM)
- Filing
- **Grinding**
- **Honing**
- **Investment die casting (IC)**
- **Machine hammer forging**
- Milling (face milling and peripheral/slab)
- Planing
- Reaming
- **Sanding**
- Shaping
- **Stoning**
- Swaging
-

Principal Instructor Signature and Date

3.5.9.3. **Define the terms “isgar chip formation” and “cutting edge build-up”. Write a summary describing the impact of these phenomena in the field of firearms machining and identification. Be prepared to discuss with your Principal Instructor.**

Principal Instructor Signature and Date



3.5.9.4. Research in detail and briefly define the following terms as they pertain to barrel production and rifling methods. Prepare to explain how some tools and procedures were used in the past and identify the more common methods currently used. Consider how each method may affect the ammunition component(s) they may be in contact with.

- Barrel deep-hole drilling
- Burnishing
- Contouring/Polishing
- Cut rifling methods
- ECM
- Honing
- Mandrel (and drawn over mandrel)
- Reaming
- Tungsten carbide swaging (microgroove)
- Barrel straightening
- Chambering and throating
- Crowning
- Damascus barrel
- EDM
- Lead lapping
- Polygonal
- Single point tools (hook/scrape)

Principal Instructor Signature and Date

3.5.9.5. Research some of the common manufacturing tools (buttons, broaches, mandrels, etc.) used in rifling processes. Select firearms from the laboratory reference collection which were produced using each method (if possible). Examine the rifling of each firearm with a stereo scope and bore scope (if available) to observe the differences in the class characteristics produced by the various rifling methods. Test fire the firearms and examine the effects these rifling methods have on the bearing surfaces of fired bullets. Mark the test fired bullets with both the firearm and the rifling method. Obtain any rifling tools available for study from the section training materials and examine these in conjunction with firearms rifled with a similar tool. Be prepared to discuss these with your Principal Instructor.

Principal Instructor Signature and Date

3.5.9.6. Research and document how and why the following manufacturing processes or methods are used in the finishing process of firearms.

- Anodizing
- Barrel straightening



- Bluing
- Chrome plating
- Electroplating
- Lead lapping
- Nickel plating
- Patina
- Powdered metal technology
- Case hardening
- Cosmetic finish
- Honing
- Microstamping
- Parkerizing
- Polishng
- Sand blasting

Principal Instructor Signature and Date

3.5.9.7. Research the term “subclass”. Prepare a **written** report describing if and why (or why not) each of the manufacturing techniques studied in Practical Exercise 3.5.9.2 lends itself to subclass carry-over. Include a discussion of why subclass carry-over is a concern to the Firearms Examiner. **Be prepared to discuss these with your Principal Instructor. This exercise is meant to be an introduction to the subject. Subclass carry-over will be covered again in Units 9 and 10.**

Principal Instructor Signature and Date

3.5.9.8. **If possible, tour the manufacturing facilities of at least two firearms and/or barrel manufacturers. Document your experience and produce a written report of each visit. Emphasis should be placed on manufacturing and rifling techniques used by each manufacturer. Note the methods that may leave individual manufacturing tool marks on firearm parts. which, in turn, produce individual microscopic marks on bullets and cartridge cases.**

Principal Instructor Signature and Date

3.6. Reading

3.6.1. Required Reading for History of Early Firearms

- *Small Arms of the World*, 9th or 10th Edition by Smith; pp. 15-43.



- *The Book of Rifles* by Smith; pp. 5-36.
- *The Story of Firearm Ignition* by James Edsall; Pioneer Press, 1974.
- *The Age of Firearms, A Pictorial History* by Robert Held; Gun Digest Company, 1970.
- *Cartridges; A Pictorial Digest of Small Arms Ammunition* by Herschel C. Logan; pp. 1-10; Standard Publication, 1959.
- *Firearms Investigation, Identification, and Evidence* by Hatcher, Jury, and Weller; Chapter 2 pp. 23-39.
- *The Development of Firearms* by H.L. Peterson; Parts 1-3; American Rifleman, March-April-May, 1960.
- *The Complete Handgun by Ian V. Hogg*; – 1300 to the Present; Peerage Books, 1984.
- *The Story of the Gun* on the Arts & Entertainment (A&E) Channel - (Video).
- *Guns and How They Work* by Ian V. Hogg; Everest House (1979); pp. 6-25.

Student Signature and Date of Reading Completion

3.6.2. Required Reading for Long Guns (Single shot to repeating)

- *Small Arms of the World*, 9th or 10th Edition by Smith; pp. 33-35, 41-57, and 61-81.
- *The Book of Rifles* by Smith; Chapters 4 and 5 and p. 78.
- *Firearms Investigation, Identification, and Evidence* by Hatcher, Jury, and Weller; Chapter 3 pp. 40-62.
- *American Rifle Design and Performance*, Part I by L.R. Wallack; pp. 3-122; Winchester Press, 1977.
- *Guns and How They Work* by Ian V. Hogg; Everest House (1979); pp. 26-39, 68-77.

Student Signature and Date of Reading Completion

3.6.3. Required Reading for Long Guns (Semiautomatic)

- *Small Arms of the World*, 9th or 10th Edition by Smith; Chapter 7 and Chapter 8 pp. 93, 104-107, and 641-642.
- *The Book of Rifles* by Smith; Chapter 6 and pp. 86-88.
- *Guns and How They Work* by Ian V. Hogg; Everest House (1979); pp. 125 (2nd paragraph)-131 and 148-157.



Student Signature and Date of Reading Completion

3.6.4. Required Reading for Submachine Guns & Machine Guns

- *Small Arms of the World*, 9th or 10th Edition by Smith; Chapters 8 and 9.
- *Guns and How They Work* by Ian V. Hogg; Everest House (1979); pp. 58-67, 80-89, 108-125, and 132-147.
- *The Worlds Submachine Guns*, Vol. I by Thomas B. Nelson, and Hans B. Lockhaven; T.B.N. Enterprises (1977); pp. 1-28; and briefly review remainder of text as necessary.
- *The Worlds Machine Pistols and Submachine Guns* Vol. Ila by Thomas B. Nelson and Daniel D. Musgrave; T.B.N. Enterprises (1980); Chapter III, pp. 95-104; Chapter V, pp.297-354; Chapter X, pp. 647-658; and briefly review remainder of text as necessary (esp. pp. 407-416, 507-522).
- *The Terrifying Three* by Duncan Long; Paladin Press (1989).

Student Signature and Date of Reading Completion

3.6.5. Required Reading for Handguns (Revolvers)

- *Book of Pistols and Revolvers* by Smith; pp. 6-24 and 43-52.
- *Small Arms of the World*, 9th or 10th Edition by Smith; Chapters 10 and 11.
- *Military Pistols and Revolvers* by Ian V. Hogg; pp. 13-33.
- *American Pistol and Revolver Design and Performance* by L.R. Wallack; Chapters 1 and 2.
- *Guns and How They Work* by Ian V. Hogg; Everest House (1979); pp. 40-57.

Student Signature and Date of Reading Completion

3.6.6. Required Reading for Handguns (Semiautomatic)

- *Small Arms of the World*, 9th or 10th Edition by Smith; Chapter 12, pp. 179-192.
- *Military Pistols and Revolvers* by Ian V. Hogg; pp. 7-11 and 35-77.
- *American Pistol and Revolver Design and Performance* by L.R. Wallack; Chapters 3 and 4 and pp. 51, 69-70.
- *Book of Pistols & Revolvers* by Smith; pp. 36-43.



- *Guns and How They Work* by Ian V. Hogg; Everest House (1979); pp. 90-107.

Student Signature and Date of Reading Completion

3.6.7. Required Reading for Shotguns

- *American Shotgun Design and Performance* by L.R. Wallack; Chapters 1-9 and 13.
- *NRA Firearms Fact Book*, 3rd Edition, pp. 169-181.
- *The World's Fighting Shotguns* by Thomas F. Swearingen; Ironside International Publishers (1978); pp. 1-19 and review remainder as necessary.

Student Signature and Date of Reading Completion

3.6.8. Required Reading for Manufacturing Techniques

- *Toolmarks: Examining the Possibility of Subclass Characteristics* by J. Miller and G. Beach; AFTE Journal; Vol. 37, No. 4 (Fall 2005) PP. 296-345.
- *The Effect of Vibratory Finishing on Broaching Marks as a Function of Time* by J.A. Winn; AFTE Journal; Vol. 45, No. 4 (Fall 2013) pp. 350-360.
- *Machine Shop Practice* Vol. 1 & 2 by K. H. Moltrecht.
- *Machinist's Handbook* Revised 21st Edition by Oberg, Jones and Horton.
- *Firearms Identification* Part I, Vol. I, by Mathews.
- AFTE Journals (as identified by Principal Instructor).
- AFTE Glossary.
- *Hatcher's Notebook* by Hatcher, Chapters VII to IX, pp. 180-231.
- Ruger Investment Casting (Company Brochure).
- Choke Tube Roundup! from Guns & Ammo (July 1994).

Student Signature and Date of Reading Completion

3.6.9. Review as necessary

- AFTE Glossary Current Edition; (as identified by Principal Instructor).
- *Firearms Investigation, Identification, and Evidence by Hatcher*, Jury and Weller; The Stackpole Company (1957); Chapter 5, pp. 106-136 and 187-196.



- *The Identification of Firearms by Gunther and Gunther*; John Wiley & Sons, Inc. (1935); pp. 13-19.
- *Firearms Identification Vol. I* by J. Howard Mathews; Charles C. Thomas (1962); Part I, Chapter 1, pp. 3-9.
- *Firearms Identification Vol. II* by J. Howard Mathews; Charles C. Thomas (1962); Part VI, pp. 467-492.
- *Firearms Identification Vol. III* by J. Howard Mathews; Charles C. Thomas (1962); Part VII, pp. 703-714.
- *American Pistol & Revolver Design and Performance* by L.R. Wallack; Winchester Press (1978); pp.71-80.
- *American Shotgun Design and Performance* by L.R. Wallack; Winchester Press (1977); pp.69-80.
- *American Rifle Design and Performance* by L.R. Wallack; Winchester Press (1977); pp.71-88.
- *The Standard Directory of Proof Marks* by Gerhard Wirncherger; Blacksmith Publishers.
- *Gunmarks* by David Byron Crown Publishers (1979).
- *The Identification and Registration of Firearms* by Vaclav “Jack” Krcma; Charles C. Thomas (1971).
- *Encyclopedia of Modern Firearms, Parts and Assembly, Vol. 1* by F.R. “Bob” Brownell; (1959).

3.7. Terminology

Be familiar with the following terms:

3.7.1. History of Early Firearms

Barrel	Bore	Bore Diameter
Buckshot	Bullet	Bullet Diameter
Bullet Mold	Butt	Butt Plate
Caliber	Cap, Percussion	Cartridge
Charge	Cock	Delayed Fire (Hangfire)
Derringer	Discharge	Dram Equivalent
Firearm	Flash Hole	Full Cock
Fulminate of Mercury	Gauge	Gunpowder
Half Cock	Hammer	Land and Groove Impression
Land	Load	Lock



Malfunction	Misfire	Muzzle
Nitrates	Obturation	Percussion
Pistol	Powder, Black	Primer Flash
Priming Mixture	Priming Powder	Projectile
Propellant	Pyrodex	Salt peter
Shot	Shotgun	Smooth Bore
Stock		

Principal Instructor Signature and Date

3.7.2. Long Guns (Single shot to repeating)

Barrel	Bolt Body	Bolt Carrier
Bolt Face	Bolt Handle	Bolt Head
Bolt Release	Bolt Stop	Bolt Throw
Bore	Breech	Breechblock
Breech Bolt	Breech Face	Butt Plate
Feed Ramp	Finger Lever	Firearm
Firing Pin	Forearm	Frame, Solid
Full Cock	Function Testing	Hammer
Hinged Frame	In Battery	Locked
Locking Block	Locking Bolt	Muzzle
Muzzle Loader	Out of Battery	Pattern
Percussion	Percussion Cap	Rifle
Single Action	Stock	Stock Bolt
Stripper Clip	Tang	Through Bolt
Trigger	Trigger, Double Pull	Trigger Guard
Trigger Pull		

Principal Instructor Signature and Date

3.7.3. Long Guns (Semiautomatic)

Blowback	Bore Diameter	Brass
Breechface Markings	Carrier	Chamber Marks



Chamber Throat	Clip	Clip Guides
Cock	Delayed Blowback	Delayed Fire
Discharge	Disconnecter	Ejection
Ejection Port	Ejector	Ejector, Automatic
Extraction	Extractor	Firing Pin Protrusion
Gas	Gas Operated	Gas Piston
Gas Port	Magazine	Magazine, Box
Magazine, Detachable	Magazine, Rotary	Magazine Floorplate
Magazine Follower	Magazine Lock	Magazine Well
NATO Cartridge	Open Bolt System	Operating Handle
Orifice	Pistol	Piston
Piston Ring	Port	Receiver
Recoil	Recoil Energy	Recoil Operation, Long
Recoil Operation, Short	Recoil Spring	Recoil Spring Guide
Recoil Spring Plug	Retarded Blowback	Rifle
Rotating Barrel	Safety, Magazine	Short Recoil
Simple Blowback	Slide	Slide Lock
Slide Lock Safety	Stock	

Principal Instructor Signature and Date

3.7.4. Submachine Guns & Machine Guns

Accelerator	Automatic	Action Bar
Actuator	Assault Rifle	Autoloading
Barrel Band	Blowback	Cyclic Rate
Disconnecter	Flash Suppressor	Gas Operated
Gas Piston	Gas Port	Lock
Machine Gun	Magazine, Box	Magazine, Detachable
Magazine, Drum	Magazine, Rotary	Magazine Floorplate
Magazine Follower	Open Bolt System	Operating Handle
Selector Switch	Semiautomatic	Stripping
Submachine Gun	Solid Frame (Handguns)	



Principal Instructor Signature and Date

3.7.5. Handguns (Revolvers)

Action – Revolver	Alloy	Backstrap
Barrel Length – Revolver	Blow-by	Chamber Marks
Chamber Reamer	Chamber Throat	Crane
Cylinder	Cylinder Alignment	Cylinder Axle
Cylinder Bolt	Cylinder End-play	Cylinder Frame
Cylinder Gap	Cylinder Latch	Cylinder Stop Notch
Double Action	Ejector Rod	Floating Firing Pin
Firing Pin	Forcing Cone	Front Strap, Grip
Full Cock	Gas Cutting	Grip (Handguns)
Grip Frame	Half Cock	Hammer Block
Hammer Fall	Hammer Shroud	Hammer Notch
Hammerless	Hammer Spur	Hand
Handgun	Hand Slot	Hinged Frame
Indexing – Revolver	Inertia	Inertia Firing Pin
Loading Gate – Revolver	Mainspring	Misalignment Marks
Out-of-Time Marks	Overtravel	Ratchet
Rebound Lever	Rebound Slide	Rebounding Hammer
Recoil	Revolver	Rifling
Rifling Methods (6)	Safety	Sear
Sear Spring	Sideplate	Single Action
Skid Marks	Slippage Marks	Sympathetic Firing
Top Strap	Transfer Bar	Trigger
Yoke		

Principal Instructor Signature and Date

3.7.6. Handguns (Semiautomatic)

ACP	Anvil	Anvil Marks
Autoloading	Blowback	Blowback, Delayed



Blowback, Retarded	Blowback, Simple	Cocking Indicator
Cocking Lever	Disconnecter	Ejection
Ejection Pattern	Ejection Port	Ejector
Firing Pin Retaining Plate	Full Auto	Function Testing
Grip Safety	Hammer Strut	Inertia
Inertia Firing Pin	Link Assembly	Link Pin
Lock	Lock, Rebounding	Lug, Barrel
Magazine	Magazine, Box	Magazine, Detachable
Magazine, Staggered Column	Magazine Floorplate	Magazine Follower
Magazine Lock	Safety, Automatic	Semiautomatic
Tip Up Pistol		

Principal Instructor Signature and Date

3.7.7. Shotguns

Action, Slide or Pump	Barrel	Barrel Band
Barrel Extension	Barrel Guide	Barrel Length
Barrel Threads	Bore Diameter, Shotguns	Butt (Long Guns)
Butt Plate	Carrier	Choke
Choke Tube	Crossbolt	Discharge
Extraction	Forearm	Leading
Lifter	Magazine Plug	Over and Under
Overall Length of a Firearm	Safety, Automatic	Selector (Shotguns)
Shotgun	Smooth Bore	Subcaliber Device
Trigger Bar		

Principal Instructor Signature and Date

3.7.8. Manufacturing Techniques

Alloy	Barrel Manufacturing	Barrel Swaging
Bore Slugging	Boring	Broach
Broaching	Button	Cast
Casting	Chamber Casting	Chambering



Chamber Throat	Crown	Cut-Out
Die	Draw Marks	Drift Punch
Drilling	ECM	EDM
Escutcheon	Extrusion Marks	Factory Markings
Filing	Forcing Cone	Gage
Grinding	Honing	Investment Casting
Inspector Mark	Knurling, Knurl	Lead Lapping
Logo	Mandrel	Milling, Face
Milling, Peripheral	Muzzle Crown	Neck Annealing
Part Number	Planing	Proof Mark
Reamer	Reaming	Recoil Plate
Rifling	Rifling Methods	Rifling, Polygonal
Sanding	Sawing	Serial Number
Serration	Shaping	Subclass
Swaging	Turning	Vernier Caliper

Principal Instructor Signature and Date

3.8. Estimated Training Time

584 hours total

- History of Early Firearms (32 hours)
- Long Guns (Single shot to repeating) (72 hours)
- Long Guns (Semiautomatic) (72 hours)
- Submachine Guns & Machine Guns (72 hours)
- Handguns (Revolvers) (72 hours)
- Handguns (Semiautomatic) (72 hours)
- Shotguns (72 hours)
- Manufacturing Techniques (**120**)



4. Ammunition Development and Identification/Cartridge Loading and Ballistics

4.1. Sections

- History of Gunpowder and Cartridge Primers
- Cartridge Manufacture and Identification
- **Gunpowder Manufacture Morphology**

4.2. Training Objectives

- To develop in the student a thorough knowledge of the developments of gunpowder and ammunition, the relationship of cartridge improvement to firearm design, manufacturing methods of cartridges, and firearm terminology.
- To teach the student the terminology used in cartridge loading and ballistics.

4.3. Method of **Evaluation**

Written/practical **exercises**

4.4. Training Methods

- Self-directed study
- Practical exercises
- Discussion

4.5. Practical Exercises

4.5.1. History of Gunpowder and Cartridge Primers

Review the history of early ammunition development up to the advent of metallic cartridges, with particular emphasis on percussion systems, priming methods and pre-metallic cartridges. Prepare a chronological outline of this early development and discuss it with your Principal Instructor.

Principal Instructor Signature and Date

- 4.5.1.1. Trace the evolution of the rimfire cartridge from the mid-nineteenth century to the current generation of modern .22 caliber rimfire cartridges. **Be prepared to discuss these with your Principal Instructor.**



Principal Instructor Signature and Date

4.5.1.2. Study the history of centerfire cartridge development starting with black powder cartridges to the current generation of modern centerfire cartridges. Make notes to show the chronological history of this development and discuss this with your Principal Instructor.

Principal Instructor Signature and Date

4.5.2. Cartridge Manufacture and Identification

4.5.2.1. Modern metallic cartridges are primarily constructed of brass and lead. Brass is an alloy of copper and zinc. Research and identify the percentage of each, copper and zinc, typically used to manufacture the following a typical copper bullet jacket, cartridge case, and primer. Be prepared to discuss your findings with your Principal Instructor.

Principal Instructor Signature and Date

4.5.2.2. Assess the typical manufacturing procedures used to construct a cartridge. Identify those areas on new cartridges that may have manufacturing marks. Search AFTE Journal Articles for the key word "subclass" in relation to manufacturing marks on ammunition. Prepare a list of articles that specifically identify an area on cartridges where repeating manufacturing marks may be found.

Principal Instructor Signature and Date

4.5.2.3. Become familiar with section's electronic standard ammunition file (SAF), CartWinPro™. Practice using the CartWinPro™ program to search for headstamps at the direction of your Principal Instructor.



Principal Instructor Signature and Date

4.5.2.4. Refer to the AFTE Glossary and reloading manuals. Identify and define the following words and terms with regard to cartridge case nomenclature/ manufacturing.

- Cartridge case
- Headstamp
- Mouth
- Extractor groove
- Neck
- Flash hole
- Cannelure
- Head
- Bunter
- Web
- Shoulder
- Primer pocket
- Primer (types and sizes)

Principal Instructor Signature and Date

4.5.2.5. Prepare a list of common cartridge head stamps and identify their marketers. Research and group those marketers to further identify their past and present corporate owners. Consider why a cartridge head stamp may only represent the cartridge marketer and not necessarily the cartridge manufacturer. Be prepared to discuss with your Principal Instructor.

Principal Instructor Signature and Date

4.5.2.6. Identify, define and assemble a collection of representative cartridges that best display these cartridge types. Discuss the significance of each with your instructor:

- Belted
- Rebated-rim
- Rimmed
- Centerfire
- Bottleneck
- Rimless
- Semi-rimmed
- Rimfire



Principal Instructor Signature and Date

4.5.2.7. For each type of cartridge listed in 4.5.2.5, identify how/where the cartridges headspace.

Principal Instructor Signature and Date

4.5.2.8. With the assistance of your Principal Instructor, use a bullet puller and calipers to measure various cartridges. Discuss the difference between the actual bullet caliber and casing length measured to its commercial cartridge name applicable to those measurements. Research why some cartridges are tapered. Prepare a list of at least five tapered cartridges by name, caliber and case length. Be prepared to discuss these with your Principal Instructor.

Principal Instructor Signature and Date

4.5.2.9. Sketch the cross-section of Berdan and Boxer primers, showing their relationship to the head of the cartridge.

Principal Instructor Signature and Date

4.5.2.10. Discuss the purpose and essential ingredients of priming mixtures used in modern cartridges with your Principal Instructor. Include those that no longer use lead styphnate. Identify some ammunition manufacturers that employ lead free primers.

Principal Instructor Signature and Date

4.5.2.11. Research and identify what is meant by the term "proof cartridge." Why is it different than a commercial cartridge? What is it used for? What authority governs the characteristics of a proof cartridge? Be prepared to discuss these with your Principal Instructor.



Principal Instructor Signature and Date

4.5.2.12. Discuss with your instructor a variety of bullet coatings. Make appropriate notes.

Principal Instructor Signature and Date

4.5.2.13. Identify the following words and terms with regard to the manufacture of lead bullets:

- Swaging
- Casting seam
- Cutter quill
- Casting
- Sprue
- Bullet sizing

Principal Instructor Signature and Date

4.5.2.14. Identify, define and assemble a collection of representative bullets that best displays each of the following bullet types. Discuss the purpose and effect of each bullet design with your Principal Instructor.

- Full metal jacket
- Jacketed round nose
- Hollow point
- Wadcutter
- Copper coated lead
- Frangible
- Soft-point
- Nickel plated
- Concave base
- Boattail
- Total metal jacket
- Semi-jacketed soft point
- Jacketed hollow point
- Semi-wadcutter
- Brass coated lead
- Truncated nose
- Nylon coated
- Heel
- Lead round nose
- Spitzer

Principal Instructor Signature and Date



4.5.2.15. Discuss what the NATO designation on cartridges indicates with your Principal Instructor. Prepare a list of cartridges that have a NATO designation.

Principal Instructor Signature and Date

4.5.2.16. Identify the meaning of a +P (and similar) designations on cartridges. What does "match grade" ammunition mean? Discuss these with your Principal Instructor.

Principal Instructor Signature and Date

4.5.2.17. Define these words and terms. Be able to identify those areas on applicable bullets. Discuss with your Principal Instructor.

- Meplat
- Cannelure (types and purposes)
- Bearing surface
- Driving band
- Core
- Mold line/Mold marks
- Ogive
- Diameter
- Crimp
- Shank

Principal Instructor Signature and Date

4.5.2.18. Research commercial names and manufacturers for cartridges with unique bullet designs including but not limited to the following. Summarize the problems involved with describing a fired bullet by the commercial name versus the bullet design. Be prepared to discuss with your Principal Instructor.

- Black Talon
- Nyclad
- SXT
- Hydra-Shok
- RIP
- Critical Defense
- Silver tip
- Gold Dot
- Golden Saber
- Lubaloy
- Guard Dog
- DRT Terminal Shock



Principal Instructor Signature and Date

4.5.2.19. Research the typical terminology used when discussing shotgun ammunition. Use the AFTE Glossary to define and be able to identify shot shell nomenclature. Do not limit your research to only this list.

- Shotshell
- Battery cup
- High brass/cup
- Overpowder wad
- Overshot wad
- Cup wad
- Shot collar
- Shot size
- Buck shot
- Cup wad
- Power Piston wad
- Low brass/cup
- Undershot wad
- Filler wad
- Buffer
- Crimp
- Slug
- Bird shot

Principal Instructor Signature and Date

4.5.2.20. Research modern shot compositions, manufacturing methods, and preferred uses. Define and be able to explain the following words and terms to the satisfaction of your Principal Instructor:

- Bliemeister method
- Antimony
- Arsenic (as related to shot)
- Chilled shot
- Steel shot
- Rule of 17
- Dram equivalent
- Bismuth shot
- Tungstun shot
- Lead shot

Principal Instructor Signature and Date

4.5.2.21. Discuss different specific caliber designations that are similar to each other (e.g., 38 Auto vs 38 Super, 223 Remington vs 5.56x45mm) with your Principal Instructor.



Include in your discussion how the cartridges are similar, how they are different, and the implications of using them interchangeably when test firing.

Principal Instructor Signature and Date

4.5.2.22. Know and discuss the difference between caliber and caliber class. Illustrate this difference by relating these terms to a discussion of the .22 caliber, .30 caliber and .38 caliber families of cartridges. **Be prepared to discuss these with your Principal Instructor.**

Principal Instructor Signature and Date

4.5.2.23. **If possible, visit at least one ammunition manufacturing facility. Observe the manufacture of the various components and the final assembly of rimfire and centerfire cartridges and shotshells. Emphasis should be placed on the manufacture of pellets, bullets, shotshells, and cartridge cases and the steps involved in the assembly of cartridges and shotshells. Take detailed notes of the manufacturing processes and generate a written report. Completion of this exercise is not required to show competency as a Firearms Examiner.**

Principal Instructor Signature and Date

4.5.3. Gunpowder Manufacture and Morphology

4.5.3.1. **Research and prepare a brief report describing the difference in composition between single base, double base and triple base smokeless powders.**

Principal Instructor Signature and Date

4.5.3.2. **Research and identify the purpose for various gunpowder grain shapes and coatings. Identify and list from slow burning to fast burning for each shape and discuss with your instructor.**



Principal Instructor Signature and Date

- 4.5.3.3. **The student is given practical exercises involving smokeless gun powder recognition under the stereo microscope and/or comparison microscope. Complete assigned exercise(s) to the satisfaction of your Principal Instructor.**

Principal Instructor Signature and Date

4.6. Reading

4.6.1. Required Reading for History of Gunpowder and Cartridge Primers

- *Small Arms of the World*, 9th or 10th Edition, by Smith; Chapter 1 and pp. 31-38.
- *Cartridges of the World*, 5th Edition, by Barnes; Chapters 11 and 12.
- *Cartridges of the World*, 7th Edition, by Barnes; Chapter 12; 8th Edition, Chapter 13.
- *Speer Reloading Manual*, Number Nine, pp. 35-43.
- *Ammunition Making* by George E. Frost; NRA, 1990.
- *Firearms Investigation, Identification, and Evidence* by Hatcher, Jury, and Weller; Chapter 4 pp. 63-105.
- The Manufacturing of Conventional Smokeless Powder and Black Powder Background by John H. Dillon; AFTE Journal; Vol. 23, No. 2 (Spring 1991) pp. 682-693.
- *Book of Pistols and Revolvers* by Smith; pp. 21-23.
- *Cartridges; "A Pictorial Digest of Small Arms Ammunition"* by Herschel C. Logan; read introduction to each section and review sections; Standard Publication, 1959.
- The Development of Firearms – Part 4 by H. L. Peterson; American Rifleman, June 1960.

Student Signature and Date of Reading Completion

4.6.2. Required Reading for Cartridge Manufacture and Identification

- *Book of Pistols and Revolvers* by Smith; pp. 23-25.
- *Cartridges for Collectors* by Datig; pp. 9 through 18.
- *Pistol and Revolver Cartridges, Vols. I and II*, by White and Munhall; revised by Bearse; pp. 1-13 in each volume.



- *Small Arms of the World*, 9th or 10th Edition, by Smith; pp. 43-47.
- *Centerfire Pistol and Revolver Cartridges*, by White, Munhall and Bearse; pp. 140-146.
- *Cartridges of the World* 7th Edition, by Barnes; Chapter 11; 8th Edition, Chapter 12; 7th Edition, Chapter 10.
- *Ammunition Making* by H. L. Peterson; NRA, 1990.
- *Firearms Investigation, Identification, and Evidence* by Hatcher, Jury, and Weller; Chapter 4 pp. 63-105.

Student Signature and Date of Reading Completion

4.6.3. Required Reading for Terminology Used in Cartridge Loading and Ballistics

- *Lyman Reloaders Manual* and *Sierra Reloading Manual*.
- *Cartridges of the World* 5th Edition by Barnes; Chapter 14.
- *NRA Handloaders Guide*, Chapters 1-8.
- *Centerfire Pistol and Revolver Cartridges*, by White, Munhall and Bearse, Volume II, Chapter 1.
- *NRA Handloaders Guide*, Chapter 9.
- *Cartridges of the World* 7th Edition by Barnes; Chapter 10.

Student Signature and Date of Reading Completion

4.6.4. Review as necessary

- *Military Small Arms Ammunition of the World* by P. Labbett; 1945-1980; Presidio Press, 1980.

4.7. Terminology

Be familiar with the following terms

4.7.1. History of Gunpowder and Cartridge Primers

Ammunition	Antimony	Barium Nitrate
Test Barrel	Black Powder	Cap
Cap, Percussion	Charge	Detonate
Double Base Powder	Explosion	Explosive
Gunpowder	Inhibitor	Nitrates



Nitrite Powder Charge Powder, Flake Progressive Burning Powder Powder, Tubular Priming Powder	Nitrocellulose Powder, Ball Powder, Cracked Ball Powder, Irregular Flake Powder, Single Base Primer Propellant	Nitrocellulose Powder Powder Burning Rate Powder, Disc Powder Measure Powder, Smokeless Priming Mixture Pyrodex
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Principal Instructor Signature and Date

4.7.2. Cartridge Manufacture and Identification

Antimony Bottleneck Cartridge Bullet Cannelure Cast Lead Bullet Crimp Gauge High Brass, Low Brass Lubaloy Nylon-Coated Lead Bullet Rebated Rim Cartridge Rule of 17 Shot Collar Shoulder Soft Point Bullet Truncated-Nosed Bullet	Arsenic Brass Bullet Sizing Cartridge Chilled Shot Dram Equivalent Head Hollow-Point Bullet Mouth Ogive Rimmed Cartridge Semi-Rimmed Cartridge Shotshell Silvertip Bullet Spitzer Bullet Wadcutter Bullet	Boattail Bullet Brass-Coated Lead Bullet Bunter Cartridge Case Copper Coated Lead Bullet Extractor Groove Headstamp Jacketed Bullet Neck Primer Round-Nosed Bullet Semi-Wadcutter Bullet Shotshell Case Single Base, Double Base Tapered Cartridge Wadding
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Principal Instructor Signature and Date

4.7.3. Terminology Used in Cartridge Loading and Ballistics

Ammunition Color Code Ammunition, Match	Ammunition Lot Ammunition, Metallic	Ammunition, Ball Ammunition, National Match
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Ammunition, Reference	Ammunition, Small Arms	Annular Rim
Annulus	Anvil	Ball Cartridge
Ball Powder	Ball, Frangible	Base
Base Wad	Battery Cup	BB
Bearing Surface	Belted Case	Berdan Primer
Bird Shot	Blank Cartridge	Body-Case
Bore	Boxer Primer	Brass
Brass Washed Bullet	Brass, High	Brass, Low
Buckshot	Buffer	Bullet Casting
Bullet Core	Bullet Diameter	Bullet Jacket
Bullet Puller	Bullet, Armor Piercing	Bullet, Coated
Bullet, Copper Jacket	Bullet, Copper Washed	Bullet, Expanding
Bullet, Flat-Nosed	Bullet, Full Metal Case	Bullet, Full Metal Jacket
Bullet, Gas Check	Bullet, Hollow Base	Bullet, Hollow Point
Bullet, Incendiary	Bullet, Lead	Bullet Ogive
Bullet, Partition	Bullet, Plated	Bullet, Round Nose
Bullet, Soft Point	Bullet, Semi-Wadcutter	Bullet, Semi-Jacketed Hollow Point
Bullet, Spitzer	Bullet, Steel Jacketed	Bullet, Swaged
Bullet, Truncated	Bullet, Wadcutter	Bunter
C.U.P.	Caliber	Cartridge
Cartridge Case Length	Cartridge Case Mouth	Cartridge Case Head Clearance
Cartridge Case Neck	Cartridge Case Shoulder	Cartridge Case Head Expansion
Cartridge Case, Rebated	Cartridge Case, Rimless	Cartridge Case, Semi-Rimmed
Cartridge Case, Tapered	Cartridge Designation	Cartridge, Center Fire
Cartridge, Magnum	Cartridge, Metallic	Cartridge, NATO
Cartridge, Rimfire	Cartridge, Shot	Cartridge, Wildcat
Double Base Powder	Dram Equivalent	Express Cartridge
Flake Powder	Flash Hole	Fluting
Formula, Bullet Energy	Formula, Recoil Energy	Grain
Grease Groove	Headspace	Headspace Gage
L.U.P.	Lead Styphnate	Load, Squib
Misfire	Muzzle Blast	Necking Down
Over Shot Wad	Paper Disc	Powder Lot
Pressure	Primer Cup	Primer Pocket
Primer, Rimfire	Primer, Centerfire	Projectile



Reload	Reloading Components	Reloading Powders
Rim	SAAMI	Sabot
Shot	Shot Column	Shot Cup
Shot Protector Wad	Shot Size	Shot, Bird
Shot, Coated	Shot, Drop	Shot, Lead
Shot, Plated	Shot, Steel	Slug
Subcaliber Device	Wad, Base	Wad, Card
Wad, Column	Wad, Combination	Wad, Cup
Wad, Filler	Wad, Nitro	Wad, Over-Powder
Wad, Top		

Principal Instructor Signature and Date

4.8. Estimated Training Time

176 hours total

- History of Gunpowder and Cartridge Primers (16 hours)
- Cartridge Manufacture and Identification (120 hours)
- **Gunpowder Manufacture Morphology (40 hours)**



5. Handling of Evidence and **Biohazards**

5.1. Training Objectives

To instruct the student in the proper methods of handling, preserving, and marking of evidence. Also, the safe handling of firearms, how to **complete the “log in” process**, and a working knowledge of firearm terminology.

5.2. Method of **Evaluation**

5.2.1. **Discussion**

5.2.2. Written/practical **exercises**

5.2.3. **Written quiz**

5.3. Training Methods

- Self-directed study
- Practical exercises
- Discussion

5.4. Practical Exercises

5.4.1. The student is taken through the procedure of receiving evidence. Emphasis is placed on handling evidence discrepancies, checking for an unloaded condition in submitted firearms, handling evidence in unusual circumstances, and Biological Evidence handling procedures.

Principal Instructor Signature and Date

5.4.2. Review the procedure for handling biohazardous substances with your Principal Instructor.

Principal Instructor Signature and Date

5.4.3. **Review procedures to be followed before an item marked as a biohazard is processed for NIBIN or casework with your Principal Instructor. Develop a workflow for yourself on what to check/do before an item can be processed and review the workflow with your Principal Instructor. Demonstrate your knowledge of this process by completing all the**



checks/steps prior to processing on at least 10 requests that include biohazard firearm(s) and/or fired cartridge case(s). The requests must include at least one item that has been swabbed and one item that has not been swabbed already.

Principal Instructor Signature and Date

5.4.4. Review procedures for decontaminating, preserving, and repackaging (potentially) biohazardous items with your Principal Instructor. Your review must include procedures for decontaminating firearms, magazines, and fired cartridge cases. Demonstrate your ability to properly decontaminate at least 5 firearms and magazines by decontaminating the surface, as well as at least 5 firearms and magazines that require field stripping the items. Demonstrate your ability to properly document the decontamination of these items.

Principal Instructor Signature and Date

5.4.5. The student reviews all procedures pertaining to the inventorying and marking of evidence and be given practical exercises in marking bullets, cartridge cases, firearms, and other evidence with the Principal Instructor. Bullets and cartridge cases (including test fires) are typically marked by engraving. The student will practice marking evidence, but more extensive practice will be obtained in Section 7.5.5.5.

Principal Instructor Signature and Date

5.4.6. The student is given practical exercises on how to properly document attributes of firearms using Justice Trax. Include a variety of firearms such as: autoloading shotguns, sawed off shotguns, top break shotguns, semiautomatic pistols, revolvers, and rifles. The student shall handle the firearms they are documenting, demonstrating safe firearm handling procedures. Demonstrate your ability to do this to the satisfaction of your principal instructor.



Principal Instructor Signature and Date

5.4.7. The student is given practical exercises on how to properly document attributes of cartridge cases using Justice Trax. Include a variety of calibers, brands, and item numbers. Demonstrate your ability to do this to the satisfaction of your principal instructor.

Principal Instructor Signature and Date

5.4.8. The student is given practical exercises on how to properly document attributes of bullets using Justice Trax. Include a variety of calibers, bullet types (including fragments and cores), rifling type, and item numbers. Demonstrate your ability to do this to the satisfaction of your principal instructor.

Principal Instructor Signature and Date

5.4.9. The student is given practical exercises on how to properly document attributes of shotwads, shot carriers, and shot pellets/slugs using Justice Trax. Include a variety of calibers, types, and item numbers. Demonstrate your ability to do this to the satisfaction of your principal instructor.

Principal Instructor Signature and Date

5.5. Reading

Review as necessary

- HFSC Quality Manual
- Firearms Section Standard Operating Procedures
- HFSC Health and Safety Manual

5.6. Terminology

None

5.7. Estimated Training Time

64 hours



6. LIMS and Report Writing

6.1. Sections

- Overview of the Laboratory Information Management System (LIMS) and other systems
- Examination Documentation
- Writing reports

6.2. Training Objective

To instruct the student in the use of LIMS. The student also gains experience in writing reports.

6.3. Method of Evaluation

Written/practical exercises

6.4. Training Method

- Self-directed study
- Practical exercises
- Discussion

6.5. Practical Exercises

6.5.1. Overview of the Laboratory Information Management System (LIMS)

6.5.1.1. The student is taken through the procedure of creating a request in portal, a case and a request in LIMS, entering items and sub-items of evidence. The student is shown how to associate evidence items with the assignments. The student is shown how to do proper chain of custody transactions in LIMS. The student is shown how to add attachments, comm log, and case events in LIMS. The student is shown how to create items of evidence in EMS. Demonstrate your ability to perform these tasks to the satisfaction of your Principal Instructor.

Principal Instructor Signature and Date

6.5.1.2. The student is show how to complete a review DUI in LIMS for a request, and how to view a review DUI report. Demonstrate your ability to perform these tasks to the satisfaction of your Principal Instructor.



Principal Instructor Signature and Date

6.5.1.3. The student is shown how to query LIMS **and/or Dashboards** for the following: pending **and completed** requests assigned to him/her, pending **and completed verifications and reviews** assigned to him/her, **evidence in his/her custody**, common reports, and methods for searching the database for information. **Demonstrate your ability to perform these tasks to the satisfaction of your Principal Instructor.**

Principal Instructor Signature and Date

6.5.1.4. The student is taken through the procedure for querying LIMS, **Portal, and EMS** for case/evidence information. **Demonstrate your ability to perform these tasks to the satisfaction of your Principal Instructor.**

Principal Instructor Signature and Date

6.5.2. Examination Documentation

6.5.2.1. The student will be shown how to complete the appropriate fields in LIMS associated with NIBIN Only requests and Firearms Examination requests for function testing and test firing firearms. The student will be shown how to create appropriate worksheets in LIMS. **Demonstrate your ability to perform these tasks to the satisfaction of your Principal Instructor.**

Principal Instructor Signature and Date

6.5.2.2. The student will be shown how to complete the appropriate fields in LIMS associated with NIBIN Only requests and Firearms Examination requests for evaluating fired evidence cartridge cases for NIBIN entry. The student will be shown how to create appropriate worksheets in LIMS. **Demonstrate your ability to perform these tasks to the satisfaction of your Principal Instructor.**



Principal Instructor Signature and Date

6.5.2.3. The student will be shown the process of completing other DUIs utilized in Firearms Examination requests for documenting results and writing reports. Demonstrate your ability to perform these tasks to the satisfaction of your Principal Instructor.

Principal Instructor Signature and Date

6.5.2.4. The student will be shown the process for generating a GRC list for cartridge cases and bullets, as well as how to include the list in a LIMS report. Demonstrate your ability to perform these tasks to the satisfaction of your Principal Instructor. You will gain more practice doing this in Units 9 and 10.

Principal Instructor Signature and Date

6.5.3. Writing reports

Read through copies of reports for familiarization with report format and phraseology. Read the applicable portions of the SOPs for reporting guidelines. Discuss this with your Principal Instructor. Demonstrate your ability to generate 5 simple reports in LIMS to the satisfaction of your Principal Instructor. Do not concern yourself with technical correctness at this time. Focus on formatting, how to use auto-text, what DUI fields create language in a report and which do not, what language is automatically generated in the reports, and how to generate an amended report, and how to attach a GRC to a report. It may benefit you to attempt to create copies of real reports issued by examiners.

Principal Instructor Signature and Date

6.6. Reading

Review as necessary

- Firearms Section Standard Operating Procedures



- HFSC Quality Manual

6.7. Terminology

None

6.8. Estimated Training Time

40 hours



7. **Function Testing, Test Firing and Specimen Recovery**

7.1. Sections

- Test Firing Rules
- Ammunition Selection
- Test Firing and Bullet Recovery Methods
- **Function Testing Firearms (Mock Cases)**
- Basic Firearm Repair, Malfunctions, and Test Firing Unsafe or Hazardous Firearms
- **Competency**

7.2. Training Objectives

To instruct the student in the proper methods of range safety procedures, basic firearm repair, preparing firearms for test firing, ammunition selection for test firing, test firing, bullet recovery devices, special equipment for firing unsafe weapons, and firearm terminology.

7.3. Method of **Evaluation**

7.3.1. **Discussion**

7.3.2. Written/practical **exercises**

7.3.3. **Competency test(s)**

7.4. Training Methods

- Self-directed study
- Discussion
- **Observation**

7.5. Practical Exercises

7.5.1. Test Firing Rules

Review the test firing safety rules, cite the rules, and explain the reason for each rule. **Do this to the satisfaction of your Principal Instructor. Demonstrate your ability to check a variety of firearms to make sure they are not loaded.**

Principal Instructor Signature and Date

7.5.2. Ammunition Selection



7.5.2.1. Discuss you're your Principal Instructor how to select the best brand(s)/style(s) of cartridge for test firing a firearm for casework. Demonstrate your ability to locate stock cartridges for test firing. Discuss the reasons for and limitations of using stock and/or evidence ammunition for test firing with your Principal Instructor.

Principal Instructor Signature and Date

7.5.2.2. Become familiar with the use of the inertia bullet puller. Use it to pull a variety of bullet types to examine the entire bullet. Determine what types of ammunition are and are not suitable for use with the inertia bullet puller. Discuss all your findings with your Principal Instructor.

Principal Instructor Signature and Date

7.5.3. The student will be shown how to properly measure the barrel and overall length of long guns. Practice measuring barrel and overall length on a variety of firearms, including those under and/or near the legal limit.

Principal Instructor Signature and Date

7.5.4. Discuss uncertainty of measurement, when it must be included in examination documentation, when it must be included in reports, and the requirements for expressing it.

Principal Instructor Signature and Date

7.5.5. Test Firing and Bullet Recovery Methods

7.5.5.1. Become knowledgeable about the capabilities in the section for the recovery of fired test bullets. Know when and how to use the water recovery tank and shooting range. Observe and assist your Principal Instructor in the recovery of fired bullets using each of these methods. Know and observe all safety rules.



Principal Instructor Signature and Date

- 7.5.5.2. Review with your principal instructor how to set up a firearm to be fired using any remote firing devices available for use. Demonstrate your ability to the satisfaction of your principal instructor. Discuss when it would be appropriate to use the remote firing device.

Principal Instructor Signature and Date

- 7.5.5.3. Discuss reasons you would not fire a firearm with your principle instructor. Include, but do not limit your discussion to the condition of the firearm, ammunition, shooting tank, and shooting range.

Principal Instructor Signature and Date

- 7.5.5.4. The student recovers bullets fired from handguns and rifles into the various recovery mediums utilized by the Firearm Section.

Principal Instructor Signature and Date

- 7.5.5.5. Practice marking bullets and cartridge cases with both a forensic case number and item number. The firearms section marks bullets and cartridge cases by engraving. There are two types of engravers available to use: powered and manual. You may use either or both kinds, but your engraving must be consistently legible (you may need to use a magnifying tool or stereoscope. Practice engraving as many bullets and cartridge cases as needed until your primary trainer is satisfied you can do so reliably.

Principal Instructor Signature and Date



7.5.6. Function Testing Firearms (Mock Cases)

7.5.6.1. Perform function tests (under the direct supervision of a trained analyst), including trigger pull, on at least 25 pistols and record the work performed in LIMS. Firearms tested should be a variety of firearms that are representative of pistols routinely seen casework. Pistols selected should include a majority of semiautomatic pistols, an automatic pistol, single action only revolver, single/double action revolver, and a derringer. More than 25 pistols may be assigned to the student at the discretion of the Section Manager or primary trainer.

Principal Instructor Signature and Date

7.5.6.2. Test fire at least 25 pistols (under the direct supervision of a trained analyst) and record the results in LIMS. Collect, engrave and retain these test fires for future training activities. Firearms tested should follow the guidelines listed in 7.5.6.1. More than 25 pistols may be assigned to the student at the discretion of the Section Manager or primary trainer.

Principal Instructor Signature and Date

7.5.6.3. Perform function tests (under the direct supervision of a trained analyst), including trigger pull and barrel/overall length measurement, on at least 15 rifles and record the work performed in LIMS. Firearms tested should be a variety of firearms that are representative of rifles routinely seen in casework. Rifles selected should include a majority of semiautomatic pistols, a rifle that can fire in either automatic or 3-round burst mode, a rifle with a tube magazine, bolt action; and lever action rifles. More than 15 rifles may be assigned to the student at the discretion of the Section Manager or primary trainer.

Principal Instructor Signature and Date

7.5.6.4. Test fire at least 15 rifles (under the direct supervision of a trained analyst) and record the results in LIMS. Collect, engrave and retain these test fires for future



training activities. Rifles selected should follow the guidelines listed in 7.5.6.3 More than 15 rifles may be assigned to the student at the discretion of the Section Manager or primary trainer.

Principal Instructor Signature and Date

7.5.6.5. Perform function tests (under the direct supervision of a trained analyst), including trigger pull and barrel/overall length measurement on at least 10 shotguns and record the work performed in LIMS. Firearms tested should be a variety of firearms that are representative of shotguns routinely seen in casework. Shotguns selected should include semiautomatic, pump action, over-under, double barrel, and single shot shotguns. More than 10 shotguns may be assigned to the student at the discretion of the Section Manager or primary trainer.

Principal Instructor Signature and Date

7.5.6.6. Test fire at least 10 shotguns (under the direct supervision of a trained analyst) and record the results in LIMS. Collect, engrave and retain these test fires for future training activities. Shotguns selected should follow the guidelines listed in 7.5.6.5 More than 15 rifles may be assigned to the student at the discretion of the Section Manager or primary trainer.

Principal Instructor Signature and Date

7.5.7. Basic Firearm Repair, Malfunctions, unloading firearms that cannot be unloaded.

7.5.7.1. Research, define, and/or determine the implications of the following terms as they relate to the safety of operating a firearm.

- Excessive headspace
- Barrel bulge
- Push off
- False half-cock
- Poor sear engagement
- Barrel obstruction
- Broken extractor
- Trigger shoe
- Slam fire
- Defective safety



- High primer
- Hairline cracks
- Excessive pressure
- Jar-off
- Dirty firearm
- Broken/defective sear tip
- Subcaliber ammunition
- Rail splitting
- Improper timing
- Dented barrel
- Hang fire/delayed fire
- Loose-fitting parts
- Broken/defective sear notch
- Rusted firearm

Principal Instructor Signature and Date

7.5.7.2. Define the term “misfire”. Research and summarize the possible causes of a misfire, the actions taken in the event of a misfire, and when a firearm should be fired remotely. Discuss your summary with your Principal Instructor.

Principal Instructor Signature and Date

7.5.7.3. Discuss with your Principal Instructor the use of a primed cartridge case/shotshells for testing the potential accidental/unintentional discharge of a firearm. Include, but do not limit your discussion to:

- Drop test and related problems
- Jar off
- Slam fire
- Push off
- Defective safety
- False half cock
- Broken parts
- Loose fitting parts

Principal Instructor Signature and Date

7.5.7.4. Discuss how to test fire modified, damaged, or potentially unsafe firearms with your Principal Instructor. Demonstrate using a safe firearm provided by the Principal



Instructor. Observe at least one case where a firearms examiner has to test fire a damaged or potentially unsafe firearm.

Principal Instructor Signature and Date

7.5.7.5. Explore the possibility of restoring an inoperable firearm obtained in casework to an operable condition. Note the limitations and reservations which must be considered and discuss these with your Principal Instructor.

Principal Instructor Signature and Date

7.5.7.6. Discuss the requirements and limitations if a request is made to determine if a firearm can be made to fire without pulling the trigger with your Principal Instructor.

Principal Instructor Signature and Date

7.5.7.7. Visit the current AFTE Recall/Safety Warning List on the AFTE website. Familiarize yourself with the structure of the list and the sources of the recalls and warnings. Prepare a summary of the 5 most recent firearm recalls/warnings listed.

Principal Instructor Signature and Date

7.5.7.8. Review the process for receiving a firearm that has been submitted to be rendered safe with your Principal Instructor. Discuss the tools and other resources available to you to ensure the firearm is handled and unloaded in a safe manner. Observe at least five cases where a firearms examiner has to render a firearm safe. (HFSC firearms refers to these as "locker guns".)

Principal Instructor Signature and Date



7.5.7.9. If possible, attend at least one armorer's course covering a firearm typically seen for casework. Take notes and ask questions regarding manufacturing practices. Prepare a summary of what you learned. Ideally, a Firearms Examiner should attend an armorer's course for one semiautomatic pistol, one semiautomatic rifle, one revolver, and one pump action or semiautomatic shotgun. Be prepared to discuss this with your Principal Instructor. Completion of this exercise is not required to show competency as a Firearms Examiner.

Principal Instructor Signature and Date

7.6. Competency

- 7.6.1. Competency in function testing and test firing any or all types of firearms requires that the trainee has completed the relevant portions of this Unit, as well as Units 1, 2, 3, 4, 5, 6, 8, 13 and Section 10.5.1. Students may show competency in one or more types of firearms, but must show competence before being authorized to do independent work on that firearm type.
- 7.6.2. For each section/type of firearm, the trainer will choose the firearms and create a "key" of all expected answers to appear in function testing examination documentation. The trainer will observe the trainee as they test fire each firearm function tested, demonstrating safe firearm handling, appropriate ammunition selection, and test firing procedures. How the firearm functioned during test firing must be accurately documented. The trainer will pre-select any items he/she would not choose for NIBIN imaging. The trainer must be able to identify the items that would be inappropriate for imaging without indicating them to the trainee.
- 7.6.3. Successful completion:
- 7.6.3.1. Chain of custody, examination documentation, and Firearms Examination reports must be generated for each firearm tested. Each test fire must be collected, engraved, and retained for future training activities. Successful completion means the trainee engraves each test fire legibly, completes the examination documentation with no technical errors with a high or moderate impact (as defined by section guidelines). The values for trigger pull and barrel/overall length measurements obtained must be within the uncertainty range as defined by current section uncertainty studies. A maximum of one technical error with low impact may



be made per firearm tested. Technical errors include examination documentation that does not conform to the expected answers in the answer key. A maximum 2 administrative errors per firearm tested are allowed.

- 7.6.3.2. The trainee then selects which items he/she would choose for NIBIN imaging. If the trainee selects one of the items the trainer has pre-selected as not appropriate for imaging (or if the trainee selects more than one item for imaging), the trainee must provide the trainer with specific, sound reasons why (this may be provided in writing or orally). If the trainer is satisfied with the reasoning, the selection is considered satisfactory. If the trainer is not satisfied with the reasoning, or none is given, the selection is considered unsatisfactory.
- 7.6.4. If a trainee does not successfully complete the competency, he/she must re-do the competency with the same (or similar) firearms. If the trainee does not successfully complete a competency on the second attempt, the trainer will evaluate the area(s) of concern and assign appropriate practical exercise for the trainee to complete before he/she attempts the competency again.
- 7.6.5. Number of firearms required to demonstrate competency in function testing and test firing:
 - 7.6.5.1. At least 10 pistols selected from the list in sections 3.5.3.2 and/or 3.5.7.1. At least one handgun must be treated as a biohazard. Demonstrate familiarity with HFSC and Firearms Section policies and procedures when handling biohazard items. At least one handgun must be treated as a "locker gun". Demonstrate familiarity with HFSC and Firearms Section policies and procedures when handling such firearms. More than 10 pistols may be assigned to the student at the discretion of the Section Manager or primary trainer.
 - 7.6.5.2. At least 7 rifles selected from the list in sections 3.5.3.2, 3.5.4.1, and/or 3.5.5.1. At least one rifle must have a tube magazine. At least one rifle must be treated as a biohazard. Demonstrate familiarity with HFSC and Firearms Section policies and procedures when handling biohazard items. More than 7 rifles may be assigned to the student at the discretion of the Section Manager or primary trainer.
 - 7.6.5.3. At least 5 shotguns selected from the list in section 3.5.8.1. More than 5 shotguns may be assigned to the student at the discretion of the Section Manager or primary trainer.

7.7. Required Reading



- Textbook of Firearms Investigation, Identification and Evidence by Hatcher, Jury and Weller; (Pennsylvania: Stackpole company, 1957) pp. 235-239, Chapter 1.
- Hatcher’s Notebook by Hatcher; (Pennsylvania: Stackpole Company, 1962), Chapters 7, 8, 12, 29, and 35.
- Problems and Advantages of Test Firing Weapons into Water, Journal of The Forensic Science Society, Vol. 6, No. 2, April 1966.
- Horizontal Water Recovery Tank by J.C. Cayton; AFTE Journal; Vol. 6, No. 1 (February 1974) pp. 23-24.
- Water Penetration Test, by L.R. Harden; AFTE Newsletter; Vol. 3, No. NL14 (June 1971) pp. 12-15.
- The Use of Dip-Pak as a Means of Bullet Recovery, by R.W. Skolrood; AFTE Newsletter; Vol. 3, No. NL17 (December 1971) pp. 16-20.
- Firing Chamber and Safety Measures Taken in the Firearm and Toolmark Work Environment, by John Cayton; AFTE Journal; Vol. 17, No. 3 (July 1985), pp. 95-99.
- Firearms Safety in the Laboratory, by Gerard Dutton; AFTE Journal; Vol. 29, No. 1 (Winter 1997) pp. 37-41.
- The Identification of Firearms by Gunther & Gunther; (New York: John Wiley and Sons, 1935), p. 55.
- NRA Guide to Firearms Assembly, Vol. 3, 221.
- NRA Guide to Firearms Assembly, pp.117 and 239.
- **Current Firearms Section Uncertainty of Measurement Studies for Trigger Pull and Barrel/Overall Length Measurement**

Student Signature and Date of Reading Completion

7.8. Terminology

Be familiar with the following terms

Bullet Recovery System	Bullet Splash	Cotton Box
Face Shield	Full Auto	Function Testing
Grip Safety	Load	Plugged Barrel
SAF	Test Fire	Tubular Magazine
Vise	Water Tank	



Principal Instructor Signature and Date

7.9. Estimated Training Time

80 hours



8. Instrumentation

8.1. Sections

- Instrumentation
- Measuring Devices
- Uncertainty of Measurement

8.2. Training Objectives

To instruct the student in the operation and maintenance of the instruments used in the Firearms Section and continue development of his/her knowledge of firearm terminology. To instruct the student in the proper use of measuring devices and the meaning of the associated uncertainty.

8.3. Method of Evaluation

Practical **exercises**

8.4. Training Methods

- Self-directed study
- Demonstration
- Discussion

8.5. Practical Exercises

8.5.1. Microscopes

8.5.1.1. Differentiate between the following:

- Compound microscope
- Stereo microscope
- Comparison microscope

Principal Instructor Signature and Date

8.5.1.2. Familiarize yourself with the mechanical and optical aspects of the comparison microscopes and stereo microscope in the Firearms Section.



Principal Instructor Signature and Date

8.5.1.3. Familiarize yourself with the light sources that are available in the Firearm Section on the comparison microscopes.

Principal Instructor Signature and Date

8.5.1.4. Examine the following items using a comparison microscope, manipulating the above light sources (8.5.1.3) with respect to angle and varying the intensity of the light source, if possible. Your Principal Instructor demonstrates the effects of varying the angle and intensity for each light source. Discuss this with your Principal Instructor.

- Lead bullets
- Jacketed bullets
- Cartridge cases (with various primer types) with impressed marks
- Cartridge cases (with various primer types) with striated marks

Principal Instructor Signature and Date

8.5.1.5. Set up a comparison microscope for your vision requirements. Prepare the microscope for your personal use and familiarize yourself with each set of objective lenses on your comparison microscope. Become familiar with the imaging software (Mideo) and capabilities of the Firearms Section with the comparison microscopes. Using all the objective lenses, take images of the same objects while varying the intensity and angle of the light sources. **Record your images and observations using Mideo. Be prepared to discuss your observations with your Principal Instructor.**

Principal Instructor Signature and Date

8.5.2. Measuring Devices



8.5.2.1. Digital Force Gauge and NRA weights

8.5.2.2. The student will be shown how to use the digital force gauge and the NRA weights to determine trigger pull. Include common troubleshooting tips in the instruction. Student must be shown and then demonstrate the ability to change the hook on the digital force gauge. The student must demonstrate their ability to properly record trigger pull using the digital force gauge and NRA weights before proceeding.

Principal Instructor Signature and Date

8.5.2.3. Practice using the both the digital force gauge and NRA weights on a variety of semiautomatic pistols (single action, double, action, and striker fired), revolvers, semiautomatic rifles, and shotguns. Record all your observations using the Trigger Pull Gauge Worksheet and associated software (digital force gauge) and in writing (NRA weights). Each firearm must be tested using both methods.

Principal Instructor Signature and Date

8.5.2.4. Discuss the benefits and limitations of using a digital force gauge and the NRA weights for trigger pull determination with your principal instructor.

Principal Instructor Signature and Date

8.5.2.5. Digital balance

8.5.2.5.1. The student will be shown how to use the digital balance. The student must demonstrate their ability to properly use the balance before proceeding.

Principal Instructor Signature and Date

8.5.2.5.2. Practice weighing a variety of bullets, bullet fragments, shot pellets, and slugs. Record your observations. Be prepared to discuss these with your Principal Instructor.



Principal Instructor Signature and Date

8.5.2.5.3. Prepare a written report discussing the variety of reasons why obtaining a weight for projectiles is important. Be prepared to discuss your report with your Principal Instructor.

Principal Instructor Signature and Date

8.5.2.6. Calipers

8.5.2.6.1. The student will be shown how to use both dial and digital calipers. The demonstrations must include how to measure bullet diameter and land/groove width (air gap), shot pellet diameter, and cartridge case dimensions. If the section utilizes an electronic equivalent for land and groove width measurements, the student will be shown how to measure applicable regions using the software and any associated examination documentation. Student must demonstrate their ability to use these instruments before proceeding.

Principal Instructor Signature and Date

8.5.2.6.2. Practice using dial and digital calipers (and electronic equivalent, if available) on a variety of items. Record all your observations. Be prepared to discuss these with your Principal Instructor.

Principal Instructor Signature and Date

8.5.2.7. NIST traceable rulers

8.5.2.7.1. The student will be shown how to properly measure the barrel and overall length of long guns. The student must demonstrate their ability to follow proper procedure in measuring both barrel and overall length.



Principal Instructor Signature and Date

8.5.2.7.2. Practice measuring barrel and overall length on a variety of firearms, including those under and/or near the legal limit. Record your observations. Be prepared to discuss these with your Principal Instructor.

Principal Instructor Signature and Date

8.5.2.7.3. Discuss the importance of obtaining accurate barrel and overall length of long guns with your Principal Instructor.

Principal Instructor Signature and Date

8.5.3. Calibration and Performance Checks

8.5.3.1. Prepare a written report defining calibration and performance checks. Include in your report the differences between the two, how calibration is related to NIST traceability, what requirements there are for entities that perform calibrations for HFSC firearms instruments and equipment, the instruments and equipment in the firearms section that require calibration, the instruments and equipment in the firearms section that require performance checks, and how often each is required. Be prepared to discuss this with your principal instructor.

Principal Instructor Signature and Date

8.5.3.2. The student will be shown how to perform and properly document all required performance checks for equipment in the section. The student will demonstrate their ability to conduct and properly document a performance check under the direct supervision of an analyst that routinely performs the check. The student will document each instrument/piece of equipment they have done this for. The principal instructor will sign when the student has performed at least one performance check for each item requiring it.



Principal Instructor Signature and Date

8.5.4. Uncertainty of Measurement

8.5.4.1. Discuss uncertainty of measurement with your Principal Instructor, focusing on the measurements in the Firearms Section that have a determined uncertainty. Read all current Uncertainty of Measurement studies issued by HFSC Firearms Section.

Principal Instructor Signature and Date

8.5.4.2. Prepare a written explanation of uncertainty. **Your report must include a list of each type of uncertainty obtained by the HFSC firearms section, an overview of how (and how often) those studies are completed, what uncertainty means, and what 95% and 99% confidence levels mean. Be prepared to discuss this with your Principal instructor.**

Principal Instructor Signature and Date

8.6. Required Reading

- *The Stereomicroscope Instrumentation and Techniques*, by Schlueter & Gumpertz; American Laboratory, April 1976
- Manufacturer's Procedure and Operation Manuals
- **Section SOPs and any published OSAC guidance documents pertaining to measurement methods discussed in this section.**
- *The Microscope A Practical Guide*, by G. H. Needham
- *Firearms Identification*, by Mathews; (Wisconsin: University Wisconsin Press, 1962), Vol. 1, Chapter 4.
- *Firearms Investigation Identification and Evidence*, by Hatcher, Jury and Weller; (Pennsylvania: The Stackpole Company, 1957); Chapter 10.
- Basic Optics by Claude Cook; AFTE Journal; Vol. 17, No. 4 (October 1985) pp. 24-29 and 38-52.



Student Signature and Date of Reading Completion

8.7. Terminology

Be familiar with the following terms

Air Gap Method	Balances	Binocular Microscope
Calibration	Comparison Microscope	Compound Microscope
Digital Micrometer	Fluorescent	Hairline
Incandescent	Interia Bullet Puller	Juxtaposition
Magnification	Monocular	Mounting State
Objective	Oblique Angle	Ocular lens
Optics	Orient	Photomicrograph
Prism	Resolution	Resolving Power
Reticle	Scales (Grain/Gram)	Speed Micrometer
Stage Micrometer	Steel Rule	Stereo Microscope
Uncertainty of Measurement		

Principal Instructor Signature and Date

8.8. Estimated Training Time

64 hours



9. **Projectile Examination and Comparison**

9.1. **Sections**

- 9.1.1. **Bullet Examination and Comparison**
 - **Terminology and General Knowledge**
 - Class Characteristics
 - Individual Characteristics
- 9.1.2. Shotshell **Component Examination and Comparison**
 - Class Characteristics
 - Individual Characteristics
- 9.1.3. **Competency**

9.2. **Training Objectives**

To instruct the student in the methods used in the classification and identification of fired bullets and to allow sufficient practical experience to enable the student to conduct these examinations independently.

9.3. **Method of Evaluation**

Practical exercises

9.4. **Training Methods**

- Self-directed study
- Practical exercises
- Discussion

9.5. **Practical Exercises**

9.5.1. **Terminology and General Knowledge**

- 9.5.1.1. **Define the term “consecutive matching striae” (CMS). What is it and what are the implications of utilizing it or not utilizing it as a lab/examiner. Discuss this with your Principal Instructor. (This is the same exercise as 10.5.3.1. It does not need to be repeated.)**



Principal Instructor Signature and Date

- 9.5.1.2. What does the term “consecutively manufactured” mean in relation to firearms? What are the implications of firearms/firearms parts that are consecutively manufactured? Locate at least 5 articles published in peer-reviewed scientific journals regarding consecutively manufactured firearms parts that make markings on cartridge cases during the firing process (at least one article must be on breechfaces). Prepare a summary report on the articles. Be prepared to discuss your report with your Principal Instructor. (This is the same exercise as 10.5.3.2. It does not need to be repeated.)

Principal Instructor Signature and Date

- 9.5.1.3. Define the term “best known non-match”. What does it mean? Write a paragraph or two describing what is meant by best known non-match without using the term in your writing. Be prepared to discuss this with your Principal Instructor. (This is the same exercise as 10.5.3.3. It does not need to be repeated.)

Principal Instructor Signature and Date

- 9.5.1.4. Define the terms “Identification”, “Elimination”, “Inconclusive”, “Insufficient”, and “Unsuitable” as it relates to firearms and the AFTE Theory of Identification (and HFSC SOPs). Write a short essay defining each of the above terms in your own words. Attempt to write an explanation that would be understood by a non-expert. Be prepared to discuss this with your Principal Instructor. (This is the same exercise as 10.5.3.4. It does not need to be repeated.)

Principal Instructor Signature and Date

- 9.5.1.5. Review the **relevant** section(s) of the Standard Operating Procedures covering the examination of bullets. Discuss with your Principal Instructor.



Principal Instructor Signature and Date

9.5.1.6. Define what is meant by or determine the significance of the following terms or phrases as they relate to the examination and comparison of fired bullets. Discuss these with your Principal Instructor.

- Slippage
- Leading edge
- Trailing edge
- Melting
- Blow-by/gas cutting
- Striation
- Individual microscopic marks
- Ogive
- Bearing surface
- Class characteristics
- General rifling characteristics
- Lacquers, sealants, painted tips
- Insufficient individual characteristics
- Obturation
- Corrosion
- Leading
- Single action firing
- Double action firing
- Knurled and grooved cannellure
- Stab crimp
- Boattail
- Open base
- Closed base
- Recessed base
- Axial engraving
- Sabot, accelerator cartridge

Principal Instructor Signature and Date

9.5.1.7. As they relate to the examination and comparison of fired bullets or bullet fragments, know the importance of and limitations of determining the following and discuss this with your Principal Instructor:

- Weight
- Caliber
- Caliber class/family
- Manufacturer
- General rifling characteristics
- Pitch of rifling
- Depth of rifling
- Jacket construction/composition

Principal Instructor Signature and Date



9.5.1.8. The student receives a plastic bag containing mutilated bullets, bullet fragments, and bullet cores of various calibers. Categorize each of the items present in the assignment bag. Be as complete and thorough as possible, **including the information you would complete during “log in” as well as the item description you would include in your report. Make notes of any additional observations on the style or type of bullet item.** Prepare notes of your findings **and use** examination documentation **where appropriate.**

Principal Instructor Signature and Date

9.5.1.9. **Practice using the CartWinPro™ program to determine the manufacturer of fired bullets. Demonstrate your ability to use this file to your Principal Instructor.**

Principal Instructor Signature and Date

9.5.2. Bullet Examination and Comparison, Class and Subclass Characteristics

9.5.2.1. **Describe “class characteristics” as the phrase applies to markings on fired bullets. Determine the types of marks that can be left on a bullet during loading/extracting and firing. Review video or animations showing the slow-motion sequences of using semiautomatic/automatic pistols and rifles, bolt/pump action rifles, and revolvers. Prepare a written report (may be in outline form) of the types of markings you may find on fired and unfired bullets, what area(s) of the firearms produce those marks, and if they are from loading/extracting, firing, or both. Be prepared to discuss your report with your Principal Instructor.**

Principal Instructor Signature and Date

9.5.2.2. **Your principal instructor will demonstrate how to use the GRC database to generate a manufacturers list of firearms based on bullet class characteristics. Practice generating a “GRC” list for bullets with class characteristics provided by your Principal Instructor. Discuss the benefits and limitations of generating a GRC list for bullets.**



Principal Instructor Signature and Date

9.5.2.3. What do the terms “consecutively manufactured” and “subclass carry-over” mean in relation to firearms? What are the implications of firearms/firearms parts that are consecutively manufactured? Locate at least 5 articles published in peer-reviewed scientific journals regarding consecutively manufactured firearms parts that make markings on bullets during the firing process. Prepare a summary report on the articles. Be prepared to discuss your report with your Principal Instructor.

Principal Instructor Signature and Date

9.5.2.4. Research what type(s) of manufacturing processes (Section 3.5.9.2) lend themselves to subclass carry-over in firearms (focusing on areas that contact bullets). Discuss how to avoid areas and types of markings that are (or may be) prone to subclass. Information regarding subclass potential is constantly developing/changing. Consult available resources to find any additional types of manufacturing techniques that should be included in your discussion. Prepare extensive notes on your discussion and review your notes with your Principal Instructor.

Principal Instructor Signature and Date

9.5.2.5. Locate at least 5 articles published in peer-reviewed scientific journals regarding firearm manufacturers/models with known potential for subclass carryover (on barrels or other areas that contact bullets). Prepare a summary report on the articles. Be prepared to discuss your report with your Principal Instructor.

Principal Instructor Signature and Date

9.5.2.6. Test fire three of each of the following firearms, as available. Your Principal Instructor may incorporate additional firearms (or additional/comparable test fires if the firearms are not available). With your Principal Instructor, evaluate the test fired



bullets, focusing on all markings that may (or may not) exhibit the potential for subclass carry-over. If the firearms/test fires are not available, review literature/AFTE forum discussions on them. Prepare extensive notes on your discussion and review your notes with your Principal Instructor. (Some of the firearms listed are the same as exercise 10.5.4.6.)

- Lorcin model L380 or L9mm pistol
- Raven and/or Phoenix 25 Auto
- Colt revolver
- Ruger LC9 and LCP
- Glock (polygonal and hybrid)
- Smith & Wesson M&P 15-22
- Colt type
- Smith & Wesson Sigma series
- Sig Sauer (made in USA and Germany)
- Bushmaster AR type
- FN Herstal pistol
- AMT backup
- Smith & Wesson revolver
- Taurus revolver
- Beretta Model 92 or 96 pistol
- Taurus (Millennium or similar)
- Bersa Thunder Series
- Hi-Point
- Clerk 1st
- 7.62x39mm AK type
- DPMS-Panther AR type
- Bryco/Jennings

Principal Instructor Signature and Date

9.5.2.7. Select 5 of the above pistols (do not select multiples of the same manufacture and model) and cast the barrels. If the barrel is too long to cast in its entirety, cast the last two or three inches closest to the muzzle. Examine the markings on the casts and test fires from the firearm and prepare notes and images describing the reason(s) the barrels do or do not exhibit the potential for subclass carry-over. Discuss your findings with your principal instructor.

Principal Instructor Signature and Date

9.5.2.8. Microscopically intercompare test bullets from at least two sets "consecutively-made" barrels. Document your results of inter-comparison, specifically noting any similarities in the striations of bullets you believe were fired in different firearms. Discuss this with your Principal Instructor. If available, complete the "Ruger 10 Barrel Test" and send your results to the test administrator.



Principal Instructor Signature and Date

9.5.3. Bullet Examination and Comparison, Individual Characteristics

9.5.3.1. Using the test fired bullets from Practical Exercises 9.5.2.6, microscopically intercompare all the markings with each other (compare ALL bullets from firearms of the same/similar class to each other, even those known to have been fired in different firearms). Begin by comparing bullets from the same firearm to each other prior to comparing them to bullets from different firearms. Include the following types of markings in your microscopic comparisons: land impression, groove impression, slippage/forcing cone marks, and any other markings you may see on the bullets. Use appropriate examination documentation and imaging software to record your findings. Record class characteristics of the bullets from each firearm test fired (you only need to do this once for each firearm, no matter how many sets of test fires you have for that firearm). Generate a GRC list based on your class characteristic observations. Note if the type of firearm is on the list or not. This exercise is a significant undertaking. You must take your time and be diligent in your record keeping. Review all your documentation and findings with your Principal Instructor.

Principal Instructor Signature and Date

9.5.3.2. Using one 22 caliber firearm, test fire two each of the following cartridges and attempt to identify the test bullets with each other. Prepare notes of your findings using appropriate examination documentation and review your results with your Principal Instructor.

- 22 Long Rifle Remington with lead bullets
- 22 Long Rifle Winchester with lead bullets
- 22 Long Rifle Remington with brass-coated lead bullets
- 22 Long Rifle Winchester with copper-coated lead bullets
- 22 Long Remington with lead bullets



Principal Instructor Signature and Date

9.5.3.3. Using one 357 Magnum caliber revolver, test fire two each of the following cartridges and attempt to identify the test bullets with each other. Prepare notes of your findings using appropriate examination documentation **and review your results with your Principal Instructor.**

- 38 Special Remington lead round-nosed bullet
- 38 Special Remington jacketed bullet
- 357 Magnum Remington jacketed bullet
- 357 Magnum Winchester Silvertip bullet

Principal Instructor Signature and Date

9.5.3.4. Using one 9mm Luger pistol, test fire two each of the following 9mm Luger cartridges and attempt to identify the test bullets with each other. **If the listed cartridge brands/styles are not available your Principal Instructor will substitute appropriate ammunition. He/She may also add additional cartridges at his/her discretion.** Prepare notes of your findings using appropriate examination documentation, **including measuring the land and groove widths for each cartridge style.** Prepare a report on how exterior bullet coatings/composition/style may **or may not** impact a firearms examiner's conclusions. **Discuss your results with your Principal Instructor.**

- Federal Hydra-Shok
- Remington Golden Saber
- Winchester Silvertip
- Federal Syntech
- DRT Frangible
- **Speer Gold Dot**
- Remington full metal jacket
- CCI total metal jacket
- Winchester Ranger SXT
- G2 Research RIP
- Wolf full metal jacket
- **Hornady Critical Defense**

Principal Instructor Signature and Date



9.5.3.5. Using the same 9mm Luger pistol from above, test fire two each of the following cartridges. Attempt to match the brand, style, and jacket types as best as possible. Prepare notes of your findings using appropriate examination documentation, including measuring the land and groove widths for each cartridge style. Prepare a report on how exterior bullet coatings/composition/style may or may not impact a firearms examiner's conclusions. Discuss your results with your Principal Instructor.

- 115 grain full or total metal jacket
- 124 grain full or total metal jacket
- 147 grain full or total metal jacket
- 115 grain hollow point style
- 124 grain hollow point style
- 147 grain hollow point style

Principal Instructor Signature and Date

9.5.3.6. Review the firearms section SOPs on downloading cartridges. Using one 223 Remington rifle, test-fire two each of the following cartridges and compare the tests with each other. Prepare notes of your findings using appropriate examination documentation., including measuring the land and groove widths for each cartridge style. Prepare a report on how bullet style and powder load may or may not impact a firearms examiner's conclusions. Discuss your results with your Principal Instructor.

- Jacketed soft-point bullet, normal powder load
- Jacketed soft point bullet, downloaded powder load
- Jacketed hollow point bullet, normal powder load
- Jacketed hollow point bullet, downloaded powder load
- Full metal jacket bullet, normal powder load
- Full metal jacket bullet, downloaded powder load

Principal Instructor Signature and Date

9.5.3.7. Test fire and inter-compare steel jacketed bullets and copper jacketed bullets from the same barrel (if available). Prepare notes of your findings using appropriate examination documentation and discuss them with your Principal Instructor. If steel jacketed bullets are not available, this exercise may be skipped.



Principal Instructor Signature and Date

9.5.3.8. Using a **38 Special or 357 M&M** caliber revolver, test fire two each of the following cartridges, compare the test bullets with each other, and compare the lead bullets to the jacketed bullets. Prepare notes of your findings using appropriate documentation. **Discuss your results with your Principal Instructor.**

- **Lead round nose bullet**
- **Full metal case/jacketed bullet**

Principal Instructor Signature and Date

9.5.3.9. Using test bullets fired from **three** polygonal rifled barrels, demonstrate your ability **to** accurately determining the rifling characteristics of these fired bullets. Compile a list of firearms that could have been used to fire these bullets using the GRC database and make microscopic inter-comparisons of the bullets to determine if **what conclusions you can reach (Identification, Elimination, Inconclusive)**. Prepare notes of your findings using appropriate examination documentation. **Discuss your results with your Principal Instructor.**

Principal Instructor Signature and Date

9.5.3.10. If available, test fire bullets in a firearm with and without a removable silencer and compare them. If a removable silencer is not available, test fire bullets in a firearm with an affixed silencer (if available) and compare them. Prepare notes of your findings using appropriate examination documentation. **If a test fired bullets from a silencer are not available, research at least three articles in scientific peer reviewed journals that discuss markings left on bullets by silencers. Prepare a summary report on the articles. Be prepared to discuss your report with your Principal Instructor.**



Principal Instructor Signature and Date

9.5.3.11. Choose **one semiautomatic pistol, one revolver, and one rifle from the firearms you test fired in 9.5.2.6. Make sure you have the test fires from that exercise, or test fire the them again. Then clean the entire breech and bore and test fire the firearms again.** Compare test fired bullets from before the breech and bore are cleaned and after the breech and bore are cleaned. The cartridge cases created may be used in exercise 10.5.5.5. Prepare notes of your findings **using appropriate examination documentation. Discuss your results with your Principal Instructor.**

Principal Instructor Signature and Date

9.5.3.12. **This exercise may only be conducted to the extent that the mediums are available and there is a safe space to test fire in.** Obtain different types of mediums to use in test firing. These include aluminum, sheet metal, plastic, glass (plain and laminated), **drywall, and wood.** Using firearms of several different calibers (22 Long Rifle, 25 Auto, 9mm Luger, and 45 Auto), test fire each into the test mediums. Determine the feasibility of determining caliber and/or rifling characteristics of a fired bullet from an examination of these bullet holes. Discuss how much information you could provide to an investigator from your examination of these holes **with your Principal Instructor. If some or all the mediums are not available, the Principal Instructor will still conduct a discussion with the trainee.**

Principal Instructor Signature and Date

9.5.3.13. **If completed, retrieve as many projectiles as possible from exercise 9.5.3.12. Microscopically examine the projectiles and compare them to pristine test fires from the same firearms. Prepare notes of your findings using appropriate examination documentation. If projectiles from exercise 9.5.3.12 are not available, your Principal Instructor will make sure you have exposure to damaged bullets from casework. Prepare notes on any casework samples you are able to view. Discuss your results with your Principal Instructor.**



Principal Instructor Signature and Date

9.5.3.14. Based on what you have learned in this unit, **write a summary of** reasons why bullet identifications or eliminations cannot be made in some cases, and why some barrels and bullets can preclude or tend to preclude identifications or eliminations. **Be prepared to discuss your report with your Principal Instructor.**

Principal Instructor Signature and Date

9.5.3.15. **Complete 15 mock cases designed by your principal instructor. Each mock case should contain multiple bullet items from between 1 and 4 firearms of the same/similar class that mark similarly. At least 5 cases should include a firearm for comparison. The 15 cases should include a variety of calibers. Each mock case must be worked like real casework, including chain of custody, examination documentation, and generating reports. The cases will be completed in a training LIMS or in a LIMS training case. Complete each case to the satisfaction of your Principal Instructor. These mock cases may be completed together with the mock cases from exercise 10.5.5.10 as long as each case contains cartridge cases and bullets.**

Principal Instructor Signature and Date

9.5.4. Shotshell Examination and Comparison, Class Characteristics

9.5.4.1. Determine what type of examinations can be conducted and what conclusions can be reached from an examination of the following components. Discuss this with your Principal Instructor.

- Unfired shotshells
- Shot collar and shot cup
- Shut buffer material
- Fired plastic wads
- Fired card or fiber wads
- Deformed shot
- Non-deformed shot



Principal Instructor Signature and Date

9.5.4.2. Familiarize yourself with resources **available for** the determination of gauge and manufacturer of fired shotshell components. Know the limitations regarding making such determinations. **Discuss this with your Principal Instructor.**

Principal Instructor Signature and Date

9.5.4.3. Research the current U.S. shot sizes and weights and obtain a chart reflecting the data. Familiarize yourself with the variations worldwide in shot size and composition. Learn the significance of the "Rule of 17" as it applies to shot size. **Demonstrate your understanding of the rule to the satisfaction of your principal instructor.**

Principal Instructor Signature and Date

9.5.4.4. **Review and familiarize yourself with the methods listed in the Section SOPs to determine shot size. Your instructor will provide you with shot pellets of a variety of know (as marked on the shotshell) shot sizes. Use each method from the SOPs to determine the shot size of each sample. Document all your findings. Your instructor will maintain an answer key. Compare the shot sizes you determined based on methods from the SOP with the shot sizes in the answer key. Write a summary of the findings and include a discussion on any limitations in determining shot size.**

Principal Instructor Signature and Date

9.5.5. Shotshell Examination and Comparison, Individual Characteristics

9.5.5.1. Test fire a sawed-off shotgun using a Remington shotshell with a power piston wad. Recover the test shotshell wads and slugs. Make microscopic comparisons of marks imparted to the test wads and slugs. **Microscopically intercompare the markings and**



document your findings as in Practical Exercise 9.5.2.6. Be prepared to discuss these with your Principal Instructor.

Principal Instructor Signature and Date

9.5.5.2. Test fire a 12-gauge shotgun using at least two 12 Gauge 2 ¾" shotshells with each of the following types of ammunition, if available. Also recover a representative number of the fired pellets and fired wadding from each test firing. Compare markings on these test shotshell cases with each other. Examine the fired components that were recovered and compare them to unfired components of the same type. Discuss the significance of your findings. Prepare notes of your findings using appropriate examination documentation. **Be prepared to discuss these with your Principal Instructor.**

- Remington, Magnum, 00 Buck
- Federal, Magnum, 00 Buck
- Activ, Field load, #7 ½ shot
- Winchester, Xpert, #6 shot
- Remington, Shur-Shot, #8 shot
- Federal, Field load, #9 shot
- Activ, Magnum, BB shot
- Winchester, Super-X, #7 ½ shot

Principal Instructor Signature and Date

9.5.5.3. **Complete 5 mock cases designed by your principal instructor. Each mock case should contain multiple shotshell components where you determine gauge and/or shot size. Each mock case must be worked like real casework, including chain of custody, examination documentation, and generating reports. The cases will be completed in a training LIMS or in a LIMS training case. Complete each case to the satisfaction of your Principal Instructor.**

Principal Instructor Signature and Date

9.5.6. **Competency Primary Examiner – Fired Bullets and Shotshell Components (Projectiles)**
Competency as a primary examiner for projectiles may be done separately from cartridge cases/shotshells or at the same time. If done at the same time, they may



be combined in any way, as long as the trainee completes 5 mock cases with cartridge cases and 5 mock cases with projectiles. The trainee must have completed Units 1, 2, 3, 4, 5, 6, 8, 13, and this Unit. It is preferable he/she has also completed Unit 7. The student must complete 5 mock cases. Each mock case should contain multiple projectiles from between 1 and 3 firearms, including at least two mock cases that contain bullets from different firearms of the same/similar class that mark similarly. One mock case must contain shotshell components. The student should be given mock cases with a variety of expected results (i.e., Identification, Elimination, Inconclusive, Insufficient, Unsuitable).

- 9.5.6.1.1. The trainer will create an answer key for each case record that includes the expected results of all comparisons for each mock case. The trainer will also create a checklist for any other expected documentation where there may not be a "correct" answer (chain of custody).
- 9.5.6.1.2. Chain of custody, examination documentation (including "log in"), and reports must be generated for each mock case. Successful completion means the trainee reaches the expected results for all comparisons in the case. If the expected result is not reached, the result must be technically sound and properly documented. If the trainer is satisfied with the conclusions, the selection is considered satisfactory. If the trainer is not satisfied with the reasoning, the selection is considered unsatisfactory. No technical errors with a high or moderate impact (as defined by section guidelines) may be made. A maximum of two technical errors with low impact may be made per mock case, and a maximum 5 administrative errors per mock case are allowed.
- 9.5.6.1.3. If the above criteria are not met, the student must repeat the competency. If the student does not successfully complete a competency on the second attempt, the trainer will evaluate the area(s) of concern and assign appropriate practical exercise for the trainee to complete before he/she attempts the competency again.

9.6. Reading

9.6.1. Required reading

- 32 SWL Caliber F.I.E. Corporation Titanic Revolver by V.J. Lomoro; AFTE Newsletter; Vol. 4, No. NL20 (June 1972) p. 46.
- The Reproduction of Characteristics in Signatures of Cooley Rifles by J.A. Churchman; AFTE Journal; Vol. 13, No. 1 (January 1981) pp. 46-52.



- Thoughts on Bullet Comparisons and 'No Gun' Cases by R.F. Stengel; AFTE Journal; Vol. 19 No. 3 (July 1987) pp. 306-307.
- Sub Class Characteristics of Sequentially Rifled .38 Special S&W Revolver Barrels by F.A. Tulleners and J.S. Hamiel; AFTE Journal; Vol.31, No. 2 (Spring 1999) pp. 117-122.
- An Examination of Two Consecutively Rifled Barrels and a Review of the Literature by J. Miller; AFTE Journal; Vol. 32, No. 3 (Summer 2000) pp. 259-270.

Student Signature and Date of Reading Completion

9.6.2. Review as necessary

- Firearms Identification Vol. I, by Mathews
- Firearms Investigation, Identification and Evidence by Hatcher, Jury and Weller
- Introduction to Tool Marks, Firearms and the Striagraph by Davis
- Identification of Firearms and Forensic Ballistics by Burrard
- The Identification of Firearms by Gunther and Gunther
- Hatcher's Notebook, by Hatcher
- AFTE Glossary

9.7. Terminology

None

9.8. Estimated Training Time

640 hours



10. Cartridge Case/Shotshell Examination and Comparison

10.1. Sections

10.1.1. Evaluation of cartridge cases for NIBIN entry

- Test fire cartridge case evaluation for entry
- Fired evidence cartridge case evaluation for entry (Competency)

10.1.2. Terminology and General Knowledge

10.1.3. Cartridge/Cartridge Case Examination and Comparison

- Class Characteristics
- Individual Characteristics

10.1.4. Shotshell Examination and Comparison

- Class Characteristics
- Individual Characteristics

10.1.5. Competency

10.2. Training Objectives

To instruct the student in the methods used in the identification of cartridge and shotshell cases, the operation of the National Integrated Ballistics Identification Network (NIBIN), and sufficient practical experience to enable the student to conduct these examinations independently.

10.3. Method of Evaluation

10.3.1. Practical exercises

10.3.2. Competency

10.4. Training Methods

- Self-directed study
- Practical exercises
- Discussion

10.5. Practical Exercises

10.5.1. Test fire cartridge case evaluation for NIBIN entry

Using the test fired cartridge cases created during completion of sections 7.5.6.2, 7.5.6.4, and 7.5.6.6, microscopically inter-compare the markings on each set of test fires



with each other. (Restrict this exercise to test fires from NIBIN-eligible firearms only.) If the student does not have the sets of test fires referenced above, the trainer may provide test fires from 20 pistols, 10 rifles, and 10 shotguns.

10.5.1.1. Include the following types of markings in your microscopic comparisons:

- Firing pin impression
- Breechface marks
- Extractor marks
- Ejector marks

10.5.1.2. Describe “individual characteristics” as the phrase applies to markings on a fired cartridge case, limiting your focus to NIBIN regions of interest.

10.5.1.3. For each set of test fires, identify the item or items you would select for NIBIN imaging. Depending on the markings, it may be necessary to select more than one representative item. Be prepared to discuss your choices with your Principal Instructor. Include in your discussion any items you would not image and why.

Principal Instructor Signature and Date

10.5.2. Fired evidence cartridge case evaluation for entry

The trainee must have already completed the exercises above in section 10.5.1 prior to proceeding with this section.

10.5.2.1. Your principal instructor will select test fires from firearms commonly seen for NIBIN processing. Any set of test fires selected must have at least two accompanying set of test fires of the same class and have similar types of marks (e.g., the trainee must be provided with test fires from at least 3 glock-type firearms). The trainer will provide groups of test fired samples from the following types of firearms (the manufacturers in parenthesis are examples to provide guidance to the trainer in test fire selection, the samples do not have to be from that type of firearm):

- Elliptical firing pin with shear (Glock)
- Heavy parallel marks (Hi-point)
- Smooth or gross marks on breechface with hemispherical firing pin (Jimenez/Jennings/Bryco/Lorcin)
- Granular breechface with or without arches (Beretta)
- Teardrop shape firing pin orifice with shear (M&P)



- Fine parallel markings on breechface, usually with a drag and sometimes shear (Colt, Taurus)
- Circular marks on a breechface resulting from a rotating bolt (7.62x39mm and 223 Rem/5.56 caliber firearms should be represented)
- 22 Rim fire (Rectangular and circular should be represented)
- Smooth marking breechface (Shotguns)

10.5.2.2. Evaluate each test fire grouping for individual characteristics and identify which items you would select for NIBIN imaging. Your goal is to identify one cartridge case from each firearm represented. Depending on the markings, it may be necessary to select more than one representative item for each firearm. Be prepared to discuss your choices with your principal instructor.

Principal Instructor Signature and Date

10.5.3. Terminology and General Knowledge

10.5.3.1. Define the term “consecutive matching striae” (CMS). What is it and what are the implications of utilizing it or not utilizing it as a lab/examiner. Discuss this with your Principal Instructor. (This is the same exercise as 9.5.1.1. It does not need to be repeated.)

Principal Instructor Signature and Date

10.5.3.2. What does the term “consecutively manufactured” mean in relation to firearms? What are the implications of firearms/firearms parts that are consecutively manufactured? Locate at least 5 articles published in peer-reviewed scientific journals regarding consecutively manufactured firearms parts that make markings on cartridge cases during the firing process (at least one article must be on breechfaces). Prepare a summary report on the articles. Be prepared to discuss your report with your Principal Instructor. (This is the same exercise as 9.5.1.2. It does not need to be repeated.)



Principal Instructor Signature and Date

10.5.3.3. Define the term “best known non-match”. What does it mean? Write a paragraph or two describing what is meant by best known non-match without using the term in your writing. Be prepared to discuss this with your Principal Instructor. (This is the same exercise as 9.5.1.3. It does not need to be repeated.)

Principal Instructor Signature and Date

10.5.3.4. Define the terms “Identification”, “Elimination”, “Inconclusive”, “Insufficient”, and “Unsuitable” as it relates to firearms and the AFTE Theory of Identification. Write a short essay defining each of the above terms in your own words. Attempt to write an explanation that would be understood by a non-expert. Be prepared to discuss this with your Principal Instructor. (This is the same exercise as 9.5.1.4. It does not need to be repeated.)

Principal Instructor Signature and Date

10.5.4. Cartridge/Cartridge Case Examination and Comparison, Class and Subclass Characteristics

10.5.4.1. Review the section(s) of the Standard Operating Procedures covering the examination of cartridges and cartridge cases. Discuss with your Principal Instructor.

Principal Instructor Signature and Date

10.5.4.2. Describe "class characteristics" as the phrase applies to markings on a cartridge or a fired cartridge case. Determine the types of marks that can be left on a cartridge case/cartridge during loading/extracting and firing. Review video or animations regarding the slow motion of firing sequences using semiautomatic/automatic firearms, bolt/pump action firearms, and revolvers. Prepare a written report (may be in outline form) of the types of markings you may find on cartridges and cartridge cases, what area(s) of the firearms produce those marks, and if they are from



loading/extracting, firing, or both. Be prepared to discuss your report with your Principal Instructor.

Principal Instructor Signature and Date

10.5.4.3. Your principal instructor will demonstrate how to use the GRC database to generate a manufacturers list of firearms based on cartridge case class characteristics. Review the codes for breechface, firing pin, extractor and ejector positions with your instructor and make sure you know how to find them for future reference. Practice generating a "GRC list" for cartridge cases with class characteristics provided by your Principal Instructor. Discuss the benefits and limitations of generating a GRC list for cartridge cases.

Principal Instructor Signature and Date

10.5.4.4. Research what type(s) of manufacturing processes (Section 3.5.9.2) lend themselves to subclass carry-over in firearms (focusing on areas that contact cartridge cases). Discuss how to avoid areas and types of markings that are (or may be) prone to subclass. Information regarding subclass potential is constantly developing/changing. Consult available resources to find any additional types of manufacturing techniques that should be included in your discussion. Prepare extensive notes on your discussion and review your notes with your Principal Instructor.

Principal Instructor Signature and Date

10.5.4.5. Locate at least 5 articles published in peer-reviewed scientific journals regarding firearm manufacturers/models with known potential for subclass carryover on the breechface and/or firing pin. Prepare a summary report on the articles. Be prepared to discuss your report with your Principal Instructor.



Principal Instructor Signature and Date

10.5.4.6. Test fire **three** of each of the following firearms, **as available**. Your Principal Instructor may incorporate additional firearms (**or additional/comparable test fires if the firearms are not available**). **You should include test fires created in exercise 10.5.2.1**. With your Principal Instructor, evaluate the test fired cartridge cases, focusing on all markings that may (or may not) exhibit the potential for subclass carry-over. **If the firearms/test fires are not available, review literature/AFTE forum discussions on them**. Prepare **extensive** notes on your discussion **and review your notes with your Principal Instructor**. (Some of the firearms listed are the same as exercise 9.5.2.6.)

- Lorcin model L380 or L9mm pistol
- Raven model P-25 or MP-25 pistol
- **Colt revolver**
- Ruger model MKII pistol
- **Glock (any model with elliptical FP)**
- **Smith & Wesson M&P 15-22**
- **Colt type**
- **Smith & Wesson M&P (tear drop)**
- **Cobray style pistol**
- **7.62x39mm SKS type**
- **Desert Eagle (parallel and arches)**
- Smith & Wesson Sigma Series pistol
- Smith & Wesson revolver
- **Taurus revolver**
- Beretta Model 92 or 96 pistol
- **Taurus (Millennium or similar)**
- **Jimenez JA Nine**
- **Hi-Point**
- **Taurus TX-22**
- **7.62x39mm AK type**
- **223 Rem/5.56 AR type**
- **Bryco/Jennings**

Principal Instructor Signature and Date

10.5.4.7. **Select 5 of the above pistols (do not select multiples of the same manufacture and model) and cast the breechface**. Examine the markings on the casts and test fires from the firearm and prepare notes and images describing the reason(s) the breechfaces do or do not exhibit the potential for subclass carry-over. **Discuss your findings with your principal instructor**.

Principal Instructor Signature and Date



10.5.4.8. Test fire each of the following firearms at least twice. Using the test fired cartridge cases, visually relate the markings imparted to the fired cartridge case with the part on the firearm which produced these markings. Also load and extract at least two cartridges from each of the following firearms and visually relate the markings imparted to the unfired cartridges with the part on the firearm that produced these markings.

- SWD Inc. Model M11/Nine pistol
- Glock pistol
- 45 Auto Colt Model O (1911) or similar type pistol
- 22 Long Rifle Ruger Model MKII pistol
- 22 Long Rifle Ruger Model 10/22 rifle
- 7.62x39mm firearm with a rotating bolt
- 223 Rem/5.56x45mm AR-15 type firearm
- 30 carbine
- Taurus Millennium Series or similar

Principal Instructor Signature and Date

10.5.4.9. Discuss the feasibility and value of comparing and identifying manufacturing toolmarks on a fired cartridge case from the scene of a crime with recovered unfired cartridges. Identify the various types of manufacturing toolmarks that may be present on cartridges or cartridge cases. Look at, and try to identify, the headstamp bunter marks in a box of cartridges. **Write a summary of your findings, including a discussion on the limitations of this kind of examination.**

Principal Instructor Signature and Date

10.5.4.10. Read the following two articles in the October, 1989 issue of the AFTE journal and discuss them with your Principal Instructor.

- *"Firing Pin Impressions - Their Measurement and Significance"*
- *"Firing Pin Impressions - Their Relation to Hammer Fall Conditions"*



Principal Instructor Signature and Date

10.5.5. Cartridge/Cartridge Case Examination and Comparison, Individual Characteristics

10.5.5.1. Using the test cartridge cases and cartridges from Practical Exercises 10.5.2.1 and 10.5.4.6, microscopically intercompare all the markings with each other (compare ALL cartridge cases from firearms of the same/similar class to each other, even those known to have been fired in different firearms). Begin by comparing cartridge cases from the same firearm to each other prior to comparing them to cartridge cases from different firearms. Include the following types of markings in your microscopic comparisons: firing pin impression, breechface marks (on both headstamp and primer), chamber marks, anvil marks, extractor marks, ejector marks, chambering marks, ramp marks, drag marks, ejection port marks, and magazine lip marks. Use appropriate examination documentation and imaging software to record your findings. Record class characteristics of the cartridge cases from each firearm test fired (you only need to do this once for each firearm, no matter how many sets of test fires you have for that firearm). Generate a GRC list based on your class characteristic observations. Note if the type of firearm is on the list or not. This exercise is a significant undertaking. You must take your time and be diligent in your record keeping. Review all your documentation and findings with your Principal Instructor.

Principal Instructor Signature and Date

10.5.5.2. Test fire at least seven of each of the firearms listed in exercise 10.5.4.6 using CCI (aluminum case), Remington, Federal, Winchester, +P (any manufacturer), CBC (or other type with pre-stamped markings on primer, if available), and wolf (or other type of cartridge with parallel manufacturing marks, if available) ammunition of the appropriate caliber type for each firearm. Additional commonly encountered ammunition that may mark differently but not listed here should also be included at the discretion of the Principal Trainer. Be sure your selections include cartridges with both nickel and brass primers. Test fire each firearm at least twice using each



brand of ammunition. Microscopically intercompare the markings and document your findings as in Practical Exercise 10.5.5.1.

Principal Instructor Signature and Date

10.5.5.3. Test fire a 357 Magnum revolver with 38 Special and 357 Magnum cartridges, using every cylinder position. If possible, use the same style and brand of cartridge. Mark each cylinder position of the firearm and each cartridge to note the chamber in which it is fired. Intercompare the markings imparted to the fired cartridge cases. Microscopically intercompare the markings and document your findings as in Practical Exercise 10.5.5.1.

Principal Instructor Signature and Date

10.5.5.4. Test fire a 22 Long Rifle revolver with each type of cartridge listed below, using every cylinder position. If possible, use the same style and brand of cartridge. Mark each cylinder position of the firearm and each cartridge to note the chamber in which it is fired. Intercompare the markings imparted to the fired cartridge cases. If a 22 Magnum cylinder is available for the revolver, test fire using 22 Magnum cartridges as well. Microscopically intercompare the markings and document your findings as in Practical Exercise 10.5.5.1.

- 22 Long Rifle
- 22 Long
- 22 Short

Principal Instructor Signature and Date

10.5.5.5. Compare tests fired cartridge cases from various firearms before the breech and bore are cleaned and after the breech and bore are cleaned. The bullets created may be used in exercise **Error! Reference source not found.** Microscopically intercompare the markings and document your findings as in Practical Exercise 10.5.5.1.



Principal Instructor Signature and Date

10.5.5.6. Test fire the following shotguns using at least two test shotshell cases from each shotgun and microscopically compare the marks imparted to these shotshell cases. Include in your comparisons the following types of marks: firing pin impression, breechface marks (primer, battery cup, and head), extractor marks, ejector marks, chamber marks, and any other mechanism marks. Discuss the significance of identifying any of these types of marks. **Microscopically intercompare the markings and document your findings as in Practical Exercise 10.5.5.1. Be prepared to discuss these with your Principal Instructor.**

- Bolt action
- Semiautomatic
- Pump action
- Top-break single shot
- Over and under
- Side by side/double barrel

Principal Instructor Signature and Date

10.5.5.7. **Describe what is meant by the term “rotating firing pin”. Discuss the implications of comparing fired cartridge cases from firearms with this type of firing pin. If available, examine test fires from a firearm with a rotating firing pin.**

Principal Instructor Signature and Date

10.5.5.8. **Describe what is meant by the term “reloading”. Discuss the implications of comparing fired cartridge cases from reloaded ammunition. Discuss what indications may be present to indicate a reloaded cartridge.**

Principal Instructor Signature and Date

10.5.5.9. **Define fluting as it relates to firearms. Discuss the purpose(s) with your Principal Instructor. If available, examine test fired cartridge cases from a firearm with a**



fluted chamber. Otherwise, search available resources for images. Discuss the value of these markings with your Principal Instructor.

Principal Instructor Signature and Date

10.5.5.10. Based on what you have learned in this unit, write a summary of reasons why cartridge case identifications or eliminations cannot be made in some cases, and why some firearms and ammunition types may preclude identifications or eliminations. Be prepared to discuss your report with your Principal Instructor.

Principal Instructor Signature and Date

10.5.5.11. Complete 15 mock cases designed by your principal instructor. Each mock case should contain multiple cartridge cases from between 1 and 4 firearms of the same/similar class that mark similarly. At least 5 cases should include a firearm for comparison. The 15 cases should include a variety of calibers/gauges. Each mock case must be worked like real casework, including chain of custody, examination documentation, and generating reports. The cases will be completed in a training LIMS or in a LIMS training case. Complete each case to the satisfaction of your Principal Instructor. These mock cases may be completed together with the mock cases from exercise 9.5.3.15 as long as each case contains cartridge cases and bullets.

Principal Instructor Signature and Date

10.5.6. Competency

10.5.6.1. NIBIN Fired Evidence Cartridge Cases

Competency in evaluating fired evidence cartridge cases for NIBIN entry requires the trainee has completed Units , 2, 3, 4, 5, 6, 8 and the relevant portions of this Unit. The student must complete 5 mock cases. Each mock case should contain multiple cartridges cases from between 1 and 4 firearms of the same/similar class that mark similarly. At least one mock case must be treated as a biohazard.



- 10.5.6.1.1. The trainer will pre-select any items he/she would not choose for NIBIN imaging. The trainer must be able to identify the items that would be inappropriate for imaging without indicating them to the trainee.
 - 10.5.6.1.2. Chain of custody, examination documentation, and NIBIN Notifications must be generated for each mock case. Successful completion means the trainee selects a cartridge case from each firearm represented within the case without missing any firearms represented. The trainee must also not select any items for imaging that the trainer pre-selected as inappropriate (or he/she must be able to provide satisfactory reasoning for their choice (this may be provided in writing or orally). If the trainer is satisfied with the reasoning, the selection is considered satisfactory. If the trainer is not satisfied with the reasoning, or none is given, the selection is considered unsatisfactory. No technical errors with a high or moderate impact (as defined by section guidelines) may be made. A maximum of one technical error with low impact may be made per mock case, and a maximum 2 administrative errors per mock case are allowed.
 - 10.5.6.1.3. If the above criteria are not met, the student must repeat the competency. If the student does not successfully complete a competency on the second attempt, the trainer will evaluate the area(s) of concern and assign appropriate practical exercise for the trainee to complete before he/she attempts the competency again.
- 10.5.6.2. Primary Examiner – Fired Cartridge Cases and Shotshells
- Competency as a primary examiner for fired cartridge cases/shotshells may be done separately from projectiles or at the same time. If done at the same time, they may be combined in any way, as long as the trainee completes 5 mock cases with cartridge cases and 5 mock cases with projectiles. The trainee must have completed Units 1, 2, 3, 4, 5, 6, 8, 13 and this Unit. It is preferable he/she has also completed Unit 7. The student must complete 5 mock cases. Each mock case should contain multiple cartridge cases from between 1 and 3 firearms, including at least two mock cases that contain cartridge cases from different firearms of the same/similar class that mark similarly. The student should be given mock cases with a variety of expected results (i.e., Identification, Elimination, Inconclusive).
- 10.5.6.2.1. The trainer will create an answer key for each case record that includes the expected results of all comparisons for each mock case. The trainer will also create a checklist for any other expected documentation where there may not be a “correct” answer (chain of custody).



- 10.5.6.2.2. Chain of custody, examination documentation (including “log in”), and reports must be generated for each mock case. Successful completion means the trainee reaches the expected results for all comparisons in the case. If the expected result is not reached, the result must be technically sound and properly documented. If the trainer is satisfied with the conclusions, the selection is considered satisfactory. If the trainer is not satisfied with the reasoning, the selection is considered unsatisfactory. No technical errors with a high or moderate impact (as defined by section guidelines) may be made. A maximum of two technical errors with low impact may be made per mock case, and a maximum 5 administrative errors per mock case are allowed.
- 10.5.6.2.3. If the above criteria are not met, the student must repeat the competency. If the student does not successfully complete a competency on the second attempt, the trainer will evaluate the area(s) of concern and assign appropriate practical exercise for the trainee to complete before he/she attempts the competency again.

10.6. Required Reading

- *Firearms Identification, by Mathews*; (Wisconsin: University Wisconsin Press, 1962); Vol. 1, Part. 1, Chapters 3 and 6.
- *Firearms Investigation, Identification and Evidence*, by Hatcher, Jury and Weller; (Pennsylvania: The Stackpole Company, 1957); pp. 285-304 and Chapters 12, 13, and 14.
- *Introduction to Tool Marks, Firearms and the Striagraph*, by Davis; (Illinois: Charles C. Thomas, 1958); Chapter 5.
- *Identification of Firearms and Forensic Ballistics*, by Burrard; (New York: A. S. Barnes and Co., 1962); Chapters 6, 8, and 9.
- *The Identification of Firearms*, by Gunther and Gunther; (New York: John Wiley & Sons, 1935); Chapter 1 pp. 13-102.
- *Hatcher's Notebook*, by Hatcher; (Pennsylvania: The Stackpole Company, 1957); Part 1, Chapter 35, and pp. 431-441.
- *Scientific Evidence in Criminal Cases*, by Moenssens and Inbau; (New York: The Foundation Press, 1978); Chapter 4 pp. 180-182.
- *Forensic Science Handbook Vol. II*, by Saferstein; (New Jersey: Prentice Hall, 1988); Chapter 8 pp. 430-434.



- AFTE Journal Index, by Terry LaVoy; (Tampa: TA LaVoy & Associates, 1999); Cartridge Case Section.
- AFTE Glossary.
- Bunter Marks, What Do They Mean? by Dodson and Masson; AFTE Journal, Vol. 29, No. 1 (Winter 1997) pp. 33-36.
- Ejector Type Marks by Kennington and Galan; AFTE Journal; Vol. 19, No. 4 (October 1987), p. 452.
- NIBIN Training Materials (current editions).
- Breech Face Characteristics of Browning .25 Auto Pistols by T. Nicholson; AFTE Newsletter; Vol. 2, No. NL09-3 (August 1970) p. 39.
- Lorcin L9mm and L380 Pistol Breechface Toolmark Patterns by B. Matty; AFTE Journal; Vol. 31, no. 2 (Spring 1999) pp. 134-137.
- Consecutively Machined Ruger Bolt Faces by L.L. Lopez and S. Grew; AFTE Journal; Vol. 32, No. 1 (Winter 2000) pp. 19-24.
- Anvil Marks of the Ruger MKII Target Pistol – An Example of Subclass Characteristics by R. Nies; AFTE Journal; Vol. 35, No. 1 (Winter 2003) pp. 75-78.
- Firearm and Tool Mark Identification: The Scientific Reliability and Validity of the AFTE Theory of Identification Discussed Within the Framework of a Study of Ten Consecutively Manufactured Extractors by R.G. Nichols; AFTE Journal; Vol. 36, No. 1 (Winter 2004) pp. 67-88.
- Subclass Characteristics in Smith & Wesson SW40VE Sigma Pistols by G. Rivera; AFTE Journal; Vol. 39, No. 3 (Summer 2007) pp. 247-253.
- The Potential for and Persistence of Subclass Characteristics on the Breech Faces of SW40VE Smith & Wesson Sigma Pistols by L. Lightstone; AFTE Journal; Vol. 42, No. 4 (Fall 2010) pp. 308-322.
- Subclass Characteristics on Firing Pins Manufactured by “Metal Injection Molding” by S. Kramer; AFTE Journal; Vol. 44, No. 4 (Fall 2012) pp. 364-366
- Metal Injection Molded Strikers and Extractors in a Smith & Wesson Model M&P Pistol by M. Hunsinger; AFTE Journal; Vol. 45, No. 1 (Winter 2013) pp. 21-29.
- Breech Face Subclass Characteristics of the Jimenez JA Nine Pistol by A.K. Welch; AFTE Journal; Vol. 45, No. 4 (Fall 2013) pp. 336-349.



Student Signature and Date of Reading Completion

10.7. Terminology

None

10.8. Estimated Training Time

480 hours



11. NIBIN Acquisition and Correlation Review

11.1. Sections

- NIBIN Acquisition
- Correlation Review

11.2. Training Objective

To instruct the student in the use of the section's ballistic imaging program.

11.3. Method of Evaluation

- Discussion
- Practical exercises
- Competency

11.4. Training Methods

- Self-directed study
- Discussion
- Observation
- Practical exercises
- ATF approved authorized training

11.5. Practical Exercises

11.5.1. NIBIN Acquisition

11.5.1.1. The student will explain what NIBIN, IBIS, and BrassTrax are and how they are related to the satisfaction of the Principal Instructor.

Principal Instructor Signature and Date

11.5.1.2. Read the ATF Minimum Required Operating Standards for National Integrated Ballistic Information Network (NIBIN) Sites (MROS). Review this document with your Principle Instructor and discuss the implications of the requirements for HFSC and for you as an analyst in the Firearms Section.



Principal Instructor Signature and Date

11.5.2. Correlation Review

11.5.2.1. Review the meaning of class, subclass, and individual characteristics. Discuss their meaning and importance in the context of issuing NIBIN leads with your Principal Instructor.

Principal Instructor Signature and Date

11.5.2.2. Read the ATF policy on issuing NIBIN leads. Discuss with your principal instructor the HFSC definitions of high confidence and low confidence leads. Include, but do not limit your discussion to the implications of each type for law enforcement investigations.

Principal Instructor Signature and Date

11.5.2.3. Discuss the difference between a NIBIN Lead and a NIBIN Hit with your principal instructor. Include in your conversation how the terms are frequently used interchangeably and the confusion surrounding this.

Principal Instructor Signature and Date

11.5.2.4. Your principal instructor will assign you to review at least 25 pre-screened correlations. Within this set of 25, there will be correlations containing known leads of varying ranks/scores and difficulty, as well as correlations that do not have leads. Your instructor will know the "answers" without indicating them to you. Your goal is to successfully identify any leads present while not identifying something as a lead when it is not. Your trainer will provide feedback on any missed leads, as well as any mis-identified leads. Depending on the strength of the lead, you may identify some as low confidence. This should be discussed in-depth with your principal instructor.



Principal Instructor Signature and Date

11.5.3. Competency

11.5.3.1. NIBIN Acquisition

11.5.3.1.1. NIBIN acquisition requires the trainee has completed Unit 1, 8 and the relevant portions of this Unit. The trainee must have also successfully completed an ATF approved NIBIN acquisition training program

11.5.3.1.2. The trainee must complete at least 50 acquisitions and have them reviewed by the Principal Instructor for conformance to training standards. Successful completion means that the student acquires entries with no more than 10% of the entries with a defect that impacts the correlation (caliber, firing pin shape, ring placement, occurrence and collection dates, forensic and agency case numbers and exhibit number). No more than 15% of the entries may have a defect that does not impact the correlation (firearm information, reception date, event type, cartridge make, cartridge composition (if entered), breechface characteristics (if entered)).

11.5.3.1.3. If the trainee does not successfully reach the above defect rate, he/she will continue making acquisitions with feedback from the principal instructor. The trainee will continue to complete acquisitions in batches of 20 until a satisfactory defect rate is obtained (considering all acquisitions made). Once a satisfactory defect rate is obtained, the trainee will repeat the competency as outlined in 11.5.3.1.2, but with 20 acquisitions instead of 50.

11.5.3.2. Correlation Reviews

NIBIN Correlation review requires the trainee has completed this Unit, Units 1, 8, Sections 10.5.1, 10.5.2, and the relevant portions of Unit 6. The trainee must have also successfully completed an ATF approved NIBIN Correlation Review training program.

11.5.3.2.1. The trainee must review at least 50 correlations that are subsequently reviewed by an analyst authorized to perform correlation reviews. Within the correlations reviewed, 5% must have leads (as identified by the reviewing analyst(s)). This rate is consistent with section averages. While this is beyond the trainee's control, the trainee must continue to review correlations until the lead rate reaches at least 5% of the total number of correlations reviewed.



- 11.5.3.2.2. Successful completion means that the trainee finds all high confidence leads and does not mis-identify any leads as high confidence. A trainee may not miss more than 2% of low confidence leads (1 per 50), call more than 2% of leads low confidence when they are high confidence, or call more than 2% of leads as low confidence when they are not leads (2% in each category would be considered satisfactory, but over 2% in any category would be considered unsatisfactory). A trainee must provide justification for any low confidence lead to the reviewing analyst. The reviewing analyst will document they received justification.
- 11.5.3.2.3. Successful completion also requires issuing NIBIN Lead Notifications. The trainee will generate NIBIN Lead Notifications in a LIMS training case (or training LIMS) that will correspond to the NIBIN Leads that are generated for all leads identified. This includes any low confidence leads and any lead notifications that require a corresponding reprint. The trainee should not have access to the actual notifications generated. No technical errors with a high or moderate impact (as defined by section guidelines) may be made. A maximum of one technical error with low impact may be made per request, and a maximum 2 administrative errors per request are allowed.
- 11.5.3.2.4. If the trainee does not successfully complete the requirements of 11.5.3.2.2, he/she will repeat the competency. If the student does not successfully complete the competency on the second attempt, the trainer will evaluate the area(s) of concern and assign appropriate practical exercises for the trainee to complete before he/she attempts the competency again.
- 11.5.3.2.5. If the trainee does not successfully complete the requirements of 11.5.3.2.3 but is successful in 11.5.3.2.2, he/she will continue issuing NIBIN Lead Notifications in batches of at least 10 notifications until the requirements are met. (Reprints do not count towards the 10). (These can either be mock leads assigned by the trainer or notifications based on real leads but entered into a training case.) Once the trainee has met the requirements as outlined in 11.5.3.2.3, he/she will issue 5 lead notifications and meet the requirements as a final competency.

11.6. Required Reading

- NIBIN/IBIS training materials issued by Forensic Technology, Inc. (current edition)



- ATF Minimum Required Operating Standards for National Integrated Ballistic Information Network (NIBIN) Sites (current version)
- HFSC Firearms Section Standard Operating Procedures
- ATF Policy on Issuing NIBN Leads

Student Signature and Date of Reading Completion

11.7. Terminology

11.7.1. Common Acronyms

NIBIN	National Integrated Ballistic Information Network
IBIS	Integrated Ballistics Identification System
BATF/BATF/BATFE	Bureau of Alcohol, Tobacco, Firearms, and Explosives

11.7.2. Define the following terms as they apply to NIBIN

Correlation	NIBIN Lead	NIBIN Hit
IBIS	Brasstrax	Matchpoint
Submit	Synchronize	

Principal Instructor Signature and Date

11.8. Estimated Training Time

120 hours



12. Serial Number Restoration

12.1. Sections

- Theory of Restoration, Application of Serial Numbers, and Obliteration Methods
- Serial Number Restoration Methods and Practice

12.2. Training Objectives

To instruct the student in the various methods of how serial numbers are placed on firearms and how they may be restored after having been obliterated by various methods.

12.3. Method of Evaluation

Practical exercises

Competency

12.4. Training Methods

- Self-directed study
- Discussion
- Practical exercises
 - *Completing a Serial Number Restoration Training course offered by the ATF or other reputable organization may be substituted for all practical exercises.

12.5. Practical Exercises

12.5.1. Theory of Restoration, Application of Serial Numbers, and Obliteration Methods

12.5.1.1. Read the "*Handbook of Methods for the Restoration of Obliterated Serial Numbers*", by Treptow. Discuss the theory of number restoration.

Principal Instructor Signature and Date

12.5.1.2. Make a list of the various methods used to mark items by the firearms industry.

This includes but not be restricted to casting, stamping, embossing, debossing, coining, vibratory pencil, pin stamping, laser and electrical discharge machining.

- Discuss with the Principal Instructor the effect each of these marking techniques has on the subsurface of the marked area.



- Discuss with the Principal Instructor how the marking methods used can directly affect the ability of the examiner to restore obliterated markings and why.

Principal Instructor Signature and Date

12.5.1.3. Define the term “plastic deformation” of metal. How does plastic deformation impact the ability to restore a serial number? Discuss this with your Principal Instructor.

Principal Instructor Signature and Date

12.5.1.4. Become knowledgeable of the numbering systems and methods used by various firearm manufacturers including but not limited to Colt, Ruger, Smith & Wesson, US Repeating Arms (Winchester), and Remington. Become familiar with the AFTE Serial Number Search database and the ATF Serial Number Structure Guide. What other sources might be useful in determining the structure of a serial number. Discuss your findings with your Principal Instructor.

Principal Instructor Signature and Date

12.5.1.5. Discuss with your Principal Instructor the effect the following types of alterations have on the subsurface of the marked item and how it impacts results of the examiner.

- Grinding
- Restamping/**Over stamping**
- Pinging
- Gouging
- **Painting**
- **Scratching/filing**
- Combinations of the above techniques
- Heating
- Puddling
- Welding
- Removal
- **Peening**
- **Drilling**



Principal Instructor Signature and Date

12.5.1.6. Determine the telltale signs that can be left by the various alteration methods. Discuss how these signs determine your specific approach to the restoration attempt.

Principal Instructor Signature and Date

12.5.1.7. **Review the Firearms Section SOPs and research relevant peer-reviewed journal articles to determine the various restoration methods available and what type(s) of surfaces they work best for. Prepare a chart or written summary and discuss it with your Principal Instructor.**

12.5.1.8. Determine the chemical reaction that takes place when etching is done and place in your training record the appropriate chemical formulations for the general reactions of acid with steel and aluminum.

Principal Instructor Signature and Date

12.5.1.9. Determine whether the reaction rate for the stressed area is faster or slower than the etching rate of the rest of the surface and why.

Principal Instructor Signature and Date

12.5.2. Serial Number Restoration Methods and Practice

12.5.2.1. Sketch the entire stressed area above and below the indentation of a stamped item and depict what remains when the indented area is removed.

Principal Instructor Signature and Date



12.5.2.2. Discuss with your Principal Instructor the different types of lighting (e.g., incandescent, infrared, UV, and fluorescent) and how they can improve or enhance the restoration results. Explain how the angle of incidence of these lighting techniques might vary the results.

Principal Instructor Signature and Date

12.5.2.3. Determine the specialized equipment that might be used in number restoration and discuss these with your Principal Instructor.

Principal Instructor Signature and Date

12.5.2.4. Discuss the various methods of surface preparation such as sanding and polishing and how they affect the results in the restoration attempt. **Demonstrate your ability to use the rotary tool, including selecting, removing and reattaching accessories.**

Principal Instructor Signature and Date

12.5.2.5. Discuss how/why the magnetic technique of serial number restoration works. **Is this method destructive or non-destructive. Discuss the benefits and limitations of using this method with your Principal Instructor.**

Principal Instructor Signature and Date

12.5.2.6. **Discuss the concept of bar-code serial numbers. Discuss the restoration methods of an obliterated Barcode 39 serial number using chemical processing, manual decryption, and automatic decoding. Your Principal Instructor will give you activities to practice manually decoding Barcode 39 serial numbers.**

Principal Instructor Signature and Date



12.5.2.7. Research the location and format of secondary or “hidden” serial numbers that may be present on various makes and models of firearms. What are the implications of having and sharing this knowledge? Discuss your findings with your Principal Instructor.

Principal Instructor Signature and Date

12.5.2.8. Become familiar with the following chemicals, focusing on their properties and use in serial number restoration:

- CuNH_4Cl_2
- CuCl_2
- NaOH
- HCl
- Fry’s Reagent
- Davis Reagent
- Ferric chloride
- HNO_3
- H_2SO_4
- FeCl_3
- H_3PO_4
- Turner’s Reagent
- Acidic Ferric chloride

Principal Instructor Signature and Date

12.5.2.9. Research the materials (metals) and the best chemicals/techniques to use in number restoration of the following firearms. List all techniques in use at HFSC, identifying any non-destructive methods. Identify any challenges that may be present in restoring serial numbers on these types of firearms. Discuss your findings with your Principal Instructor

- Colt pistol
- Smith & Wesson revolver
- RG Industries revolver
- Winchester rifle
- Scandium and/or Titanium frame
- Smith & Wesson Sigma (bar code)
- Chrome/nickel frame
- Aluminum alloy frame
- Stainless steel frame
- Case hardened steel alloy frame
- Polymer frame with metal insert
- Firearm with hidden serial number



Principal Instructor Signature and Date

12.5.2.10. Discuss with your Principal Instructor why you would or would not try alternating HNO_3 and HCl when attempting to restore serial numbers on chrome or nickel-plated firearms.

Principal Instructor Signature and Date

12.5.2.11. Discuss with your Principal Instructor how the combination of brief application of CuNH_4Cl_2 followed by normal NaOH application may affect the processing time on aluminum.

Principal Instructor Signature and Date

12.5.2.12. Obtain the proper safety equipment (e.g., eyewear, masks, gloves, and lab coats) before attempting any chemical restorations. Review the chemical hygiene policies to ensure proper safety precautions are used. **Review proper use of the safety shower and eyewash station with the Firearms Safety representative.**

Principal Instructor Signature and Date

12.5.2.13. **Review the process of testing chemical etchants for reactivity. Discuss with your Principal Instructor when and how often the reagents are tested.**

Principal Instructor Signature and Date

12.5.2.14. Under the direction and supervision of your Principal Instructor, attempt the restoration of serial numbers on **at least 15** firearms. The obliterations are done with a variety of methods and to a variety of depths. Be sure your restoration attempts expose you to all methods utilized by the Firearms Section. Document your results using the appropriate examination documentation **and practice issuing reports on**



your findings. Discuss with your Principal Instructor the methods used and lessons learned during the restoration process.

Principal Instructor Signature and Date

12.5.3. Competency

Competency as a primary in serial number restoration requires that he/she is already authorized as a primary, second, and reviewer for all other aspects of casework outlined in this training manual. The student must complete 2 mock cases. The mock case serial number restoration will be performed on one magnetic and one non-magnetic item. The items should be either a firearm (frame/receiver is enough) or bar stock with obliterated serial numbers. Once an examiner shows competency in serial number restoration, he/she is authorized to do serial number restoration casework as a primary, second, and reviewer.

- 12.5.3.1.1. The trainer will create an answer key for each case record that includes the expected results of restoration for each mock case. The trainer will also create a checklist for any other expected documentation where there may not be a "correct" answer (chain of custody, chemical testing).
- 12.5.3.1.2. Chain of custody, examination documentation (including "log in"), and reports must be generated for each mock case. Successful completion means the trainee restores all expected characters. It is permissible for the trainee to report out one character per firearm as an "*" that represents no more than two possible characters. No technical errors with a high or moderate impact (as defined by section guidelines) may be made. A maximum of two technical errors with low impact may be made per mock case, and a maximum 5 administrative errors per mock case are allowed.
- 12.5.3.1.3. If the above criteria are not met, the student must repeat the competency. If the student does not successfully complete a competency on the second attempt, the trainer will evaluate the area(s) of concern and assign appropriate practical exercise for the trainee to complete before he/she attempts the competency again.

12.6. Required Reading

- Firearms Identification by Mathews; Part I, Chapter 5.



- Firearms Investigation, Identification and Evidence by Hatcher, Jury, and Weller; pp. 182-185.
- Handbook of Methods for the Restoration of Obliterated Serial Numbers by Treptow
- Serial Number Restoration, ATF Laboratory

Student Signature and Date of Reading Completion

12.7. Terminology

Be familiar with the following terms:

Plastic deformation

Cold rolled steel

Cast iron metal

Fry's Reagent

Davis' Reagent

Turner's Reagent

Principal Instructor Signature and Date

12.8. Estimated Training Time

60 hours



13. Testimony Training

13.1. Sections

- General Aspects of Forensic Science
- Courtroom Procedure, Brady, and Michael Morton
- Expert Testimony/Mock Trials

13.2. Training Objectives

This unit prepares the student for appearance in court as an expert witness. It introduces the student to the proper protocol, demeanor, and interaction between all parties connected with the court system.

13.3. Method of Evaluation

Mock trials

13.4. Training Methods

- Self-directed study
- Discussion

13.5. Practical Exercises

13.5.1. Courtroom Procedure, Brady, and Michael Morton

13.5.1.1. Discuss the meaning and/or definition of the following terms or phrases, as they apply to testimony in the field of firearm identification, with your Principal Instructor.

- | | |
|---|-------------------------------|
| • Expert witness | • Voir dire |
| • Hearsay | • Cognitive bias |
| • “Reasonable degree of scientific certainty” | • Opinion |
| • “To the exclusion of all others” | • “Practical certainty” |
| • Absolute certainty | • Objection |
| • Hearsay | • “Normal course of business” |



Principal Instructor Signature and Date

13.5.1.2. Prepare a list of "qualification questions" which can be used in court to qualify you as an expert witness. Include in these questions those that can be used as a guide for the introduction of examined evidence in court. **Formulate responses to questions pertaining to accreditation, certification, proficiency testing, training, verification/second examiner, blind quality control program, blind verification, review, procedures etc.** Discuss this with your Principal Instructor.

Principal Instructor Signature and Date

13.5.1.3. Research the following laws and publications, focusing on their impact in forensic firearms identification. Discuss these with your Principal Instructor. Chose a court case (any state in the US) that involves at least one of the publications/laws. Prepare a written essay about the case/topic to the satisfaction of your Principal Instructor. Include, but do not limit your discussion to ethical behavior, the analyst's role and responsibilities in the justice system, and consistency and clarity in reporting/testifying.

- Brady doctrine/pre-trial discovery
- The Michael Morton Act: Texas Senate Bill 1611
- Strengthening Forensic Science in the United States: A Path Forward, National Academy of Sciences (commonly referred to as the NAS report)
- Ballistic Imaging: Feasibility, Accuracy, and the Technical Capability of a National Ballistics Database, National Academy of Sciences
- Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods, President's Council of Advisors on Science and Technology (commonly referred to as the PCAST report)

Principal Instructor Signature and Date

13.5.2. Expert Testimony/Mock Trials

13.5.2.1. Undergo a series of moot court proceedings. Discuss your performance with the participants. Mock trials must cover all competencies the student is demonstrating; however, not all competencies must be covered in each trial.



Principal Instructor Signature and Date

13.5.2.2. Observe at least two Firearm examiners testifying as an expert witness. **Complete an HFSC Testimony Evaluation form, then discuss** the testimonies with each examiner. Coordinate this with your Principal Instructor.

Principal Instructor Signature and Date

13.5.2.3. **Review court transcripts of at least two firearms examiners providing expert witness testimony. Ask your Section Manager to provide transcripts as well as the HFSC committee review of the testimony. If they are willing, discuss the testimony with the examiner. Discuss the importance of a clear transcript of testimony with your Principal Instructor.**

Principal Instructor Signature and Date

13.5.2.4. **Prepare a list of metaphors/analogies or simple explanations to assist in communicating the following technical concepts to a jury. Other examiners in the field may be consulted for this exercise. Discuss these metaphors/analogies with your Principal Instructor.**

- **Comparison microscope**
- **Subclass characteristics**
- **Cycle of fire**
- **Semiautomatic/full auto/revolver**
- **Uncertainty of Measurement**
- **Class characteristics**
- **Individual characteristics**
- **Single/double action**
- **Trigger pull**

Principal Instructor Signature and Date

13.5.2.5. Confer with other examiners regarding personal hints and recommendations regarding courtroom testimony. Discuss these with your Principal Instructor.



Principal Instructor Signature and Date

13.6. Reading

13.6.1. Required Reading (General Aspects of Forensic Science)

- Houck, M., Siegel, J., *Fundamentals of Forensic Science*, 2nd edition or newer. Section I, Chapters 1 (Introduction), 2 (Crime Scene Investigation), and 3 (The Nature of Evidence).
- Saferstein, R. *Criminalistics: An Introduction to Forensic Science*, 8th edition or newer. Chapters 1 (Introduction), 2 (The Crime Scene), and 3 (Physical Evidence).
- All reading listed by TFSC as required for the Root Cause Analysis Domain of the Forensic Analyst License Exam.
- All reading listed by TFSC as required for the Human Factors Domain of the Forensic Technician License Exam.
- All reading listed by TFSC as required for the Statistics Domain of the Forensic Analyst License Exam.

Student Signature and Date of Reading Completion

13.6.2. Required Reading (Courtroom Procedure, Brady, and Michael Morton)

- Houck, M., Siegel, J., *Fundamentals of Forensic Science*, 2nd edition (or more recent), Chapter 23 (Legal Aspects of Forensic Science).
- All reading listed by the Texas Forensic Science Commission (TFSC) as required for the Brady and Michael Morton Act Domain of the Forensic Technician License Exam.
- All reading listed by TFSC as required for the Human Factors Domain of the Forensic Technician License Exam.
- *Scientific Evidence in Criminal Cases: "A Texas Lawyer's Guide"* by Moenssens, Moses and Inbau, Chapter 1.
- Courtroom Demeanor Information by E. Hodge and B. Blackburn, AFTE Journal, (Vol. 16, No. 4) Oct.1984, pp. 35-45.



Student Signature and Date of Reading Completion

13.6.3. Required Reading (Expert Testimony/Mock Trials)

- All reading listed by TFSC as required for the Expert Testimony Domain of the Forensic Analyst License Exam.
- National Research Council. 2009. Strengthening Forensic Science in the United States: A Path Forward. Washington, DC: The National Academies Press
- National Research Council. 2008. Ballistic Imaging. Washington, DC: The National Academies Press.
- President's Council of Advisors on Science and Technology. 2016. Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods.

Student Signature and Date of Reading Completion

13.7. Terminology

Appropriate legal terms

Any previously listed terminology

13.8. Estimated Training Time

120 hours



14. Role as Second Examiner and Reviewer

14.1. Training Objectives

This unit will not be completed all at once. An examiner must be authorized to do independent case work as a primary for some period of time before demonstrating competency as a second examiner.

In the HFSC firearms section, the second examiner typically also does the first round of review (both administrative and technical). The second round of review (both administrative and technical) is completed by a third authorized examiner.

While the second examiner is trained in review, he/she is typically not authorized to do the second round of review until after a period of doing casework as a primary and a second examiner. The amount of time will depend on the examiner's level of previous experience as well as his/her own confidence in performing those roles.

14.2. Method of Evaluation

Discussion
Written exercises
Practice reviews
Competency

14.3. Training Methods

Mock cases
Practice reviews

14.4. Practical Exercises

14.4.1. General Review

14.4.1.1. Review the Quality Manual sections on technical records, technical reviews, and administrative review. Review the Firearms Section SOPs regarding technical and administrative reviews. Review any guidelines developed by the section regarding conducting reviews. Prepare a detailed outline including what you think needs to be reviewed in a typical firearms comparison case. Discuss this outline with your Principal Instructor.



Principal Instructor Signature and Date

14.4.1.2. **Your Principal Instructor will demonstrate how to complete review DUIs in Justice Trax and review the guidelines for the defect type, location, and category of the defect. Demonstrate your ability to properly complete these fields by filling in review DUIs with information as provided by your Principal Instructor.**

Principal Instructor Signature and Date

14.4.2. Second Examiner

14.4.2.1. **Prepare a written summary on the role of the second examiner in the firearms section of HFSC. Include what conclusions must have a second examiner and which conclusions can be but are not required to be seconded. Discuss your summary with your Principal Instructor.**

Principal Instructor Signature and Date

14.4.2.2. **Review the section policies on consultation and conflict resolution. Discuss why documentation of consultations and conflicts is required with your Principal Instructor.**

Principal Instructor Signature and Date

14.4.2.3. **Prepare a written summary on the impact of confirmation bias as it relates to a second examiner. What is/can be done to minimize confirmation bias in a second examiner? Discuss this with your Principal Instructor.**

Principal Instructor Signature and Date



14.4.2.4. Practice reviewing real casework by completing at least 15 review DUIs as “training” in Justice Trax. The cases you review should have been seconded, but the second should not have provided feedback to the primary yet. Once you have completed your practice review, discuss any defects you failed to identify or improperly identified with the second examiner. The case should then be provided back to the primary. Continue practice reviewing the case until the primary and second are ready to pass the case along to final review.

Principal Instructor Signature and Date

14.4.3. Reviewer

As needed, refresh your understanding of general aspects of review from Section 14.4.1. Practice reviewing real casework by completing at least 15 review DUIs as “training” in Justice Trax. The cases you review should have been seconded (and reviewed by the second examiner). Once you have completed your practice review, discuss any defects you failed to identify or improperly identified with the examiner that will complete the second round of review. The case should then be provided back to the primary. Continue practice reviewing the case until the primary, second, you, and the final reviewer are ready to release the report.

Principal Instructor Signature and Date

14.4.4. Competency

14.4.4.1. Second Examiner

Competency as a second examiner requires that the trainee is currently authorized to conduct independent casework for fired cartridge cases, shotshells, and projectiles. The student must complete 5 mock cases as a second examiner. Each mock case should contain multiple items from between 1 and 3 firearms, including at least two mock cases that contain cartridge cases and bullets from different firearms of the same/similar class that mark similarly. At least one mock case must include a firearm for comparison. The student should be given mock cases with a variety of expected results (i.e., Identification, Elimination, Inconclusive, Insufficient, and Unsuitable).



- 14.4.4.1.1. The trainer will create the mock cases where an authorized examiner acted as the primary. The trainer will create answer key for each case record that includes the expected results of all comparisons for each mock case. The trainer will also create a checklist for any documentation that must be completed and any defects that must be identified.
- 14.4.4.1.2. Chain of custody and examination documentation must be completed for each mock case. Successful completion means the trainee reaches the expected results for all comparisons in the case. If the expected result is not reached, the result must be technically sound and properly documented. If the trainee differs from the primary examiner, the proper consultation/conflict resolution procedures must be followed. If the trainer is satisfied with the conclusions, the results are considered satisfactory. If the trainer is not satisfied with the reasoning, the result is considered unsatisfactory. No technical errors with a high or moderate impact (as defined by section guidelines) may be missed as the reviewer. A maximum of one technical error with low impact may be missed per mock case, and a maximum 2 administrative errors missed per mock case are allowed.
- 14.4.4.1.3. If the above criteria are not met, the student must repeat the competency. If the student does not successfully complete a competency on the second attempt, the trainer will evaluate the area(s) of concern and assign appropriate practical exercise for the trainee to complete before he/she attempts the competency again.
- 14.4.4.2. Reviewer
- Competency as a reviewer requires that the trainee is currently authorized to conduct independent casework as a primary and second for fired cartridge cases, shotshells, and projectiles. The student must complete 5 mock cases as a reviewer. The mock cases should represent a range of complexities. At least one mock case must include a firearm (with functionality).
- 14.4.4.2.1. The trainer will create the mock cases where authorized examiners acted as the primary and second. The trainer will create answer key for each case record that includes the defects expected to be identified by the reviewer.
- 14.4.4.2.2. Successful completion means the trainee does not miss any technical errors with a high or moderate impact (as defined by section guidelines). A maximum of one technical error with low impact may be missed per mock case, and a maximum 2 administrative errors missed per mock case are allowed.



14.4.4.2.3. If the above criteria are not met, the student must repeat the competency. If the student does not successfully complete a competency on the second attempt, the trainer will evaluate the area(s) of concern and assign appropriate practical exercise for the trainee to complete before he/she attempts the competency again.

14.5. Estimated Training Time
120 hours



14.6. Training Objectives

Attendance and participation in various Armorer's Schools provides the student with hands-on exposure to the workings of many types of firearms. These schools are scheduled as appropriate by the Principal Instructor and cover as many types of firearms as possible during the training period. A Firearms Examiner does not have to participate in these visitations to perform casework.

14.7. Method of Evaluation

Provided by the instructors in schools attended.

14.8. Training Methods

- Self-directed study
- Practical exercises
- Classroom instruction
- Discussion

14.9. Practical Exercises

Attend at least one armorer's school, or provide documentation of attendance prior to hire with HFSC.

Principal Instructor Signature and Date

14.10. Reading

None except that which may benefit the above-mentioned courses.

14.11. Terminology

None except that which may benefit the above-mentioned courses.

14.12. Estimated Training Time

80 hours



14.13. Training Objectives

This unit requires the student to visit at least one firearm factory and one ammunition factory. Other machining factories may also be visited. The goal is for the student to understand the procedures and processes that are involved in the manufacturing of these items from start to finish. These visits are conducted in conjunction with other activities and based on funding and scheduling. A Firearms Examiner does not have to participate in these visitations to perform casework.

14.14. Method of Evaluation

The student prepares a summarized accounting of all tours outlining the various manufacturing techniques involved in each area. These summaries are discussed in depth with the Principal Instructor.

14.15. Training Methods

- On-site demonstrations
- Tours
- Discussion

14.16. Practical Exercises

- 14.16.1. Attend at least one firearm manufacturing facility, or provide documentation of attendance prior to hire with HFSC.

Principal Instructor Signature and Date

- 14.16.2. Attend at least one ammunition manufacturing facility, or provide documentation of attendance prior to hire with HFSC.

Principal Instructor Signature and Date

14.17. Reading

None except that which may benefit the above-mentioned visits.



14.18. Terminology

None except that which may benefit the above-mentioned visits.

14.19. Estimated Training Time

80 hours