



Firearms Section
Firearms Examiner Training Manual
Comparative & Analytical Division



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Introduction to Student

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: to be able to independently and competently examine and compare firearms and firearm-related evidence, such as bullets and cartridge cases; to independently and competently render an opinion and reach conclusions relating to your examinations and comparisons; to give expert testimony in court in matters encompassed within the broad definition of firearm identification; and to do this in a professional, 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 a Principal Instructor during your training period. 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.

The Firearms Section (FA) **Manager, Supervisor**, and/or your Principal Instructor interview you in detail after you report to the section. They **are** particularly **concerned with** your past training, experience, education, published articles and other credentials so that they may establish a base line **regarding** your knowledge, skills and abilities regarding the examiner position. 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.

Your training is monitored and assisted by your Principal Instructor, who has primary responsibility



for training matters. The Principal Instructor coordinates all outside schools, tours, lectures and contacts.

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 supervisor or examiner.

Your study includes many printed 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. What is included is at your discretion, but it must address and broaden on each of the required items of study set out in the training program. 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 serve 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 projects as well as certain collateral duties assigned as learning experiences. Discuss your preferences regarding a project or projects and collateral 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.

Written tests require a grade of 80% or greater to pass. The student must receive a passing grade for all written tests to successfully complete the training program.



The student's results on practical exercises/tests must conform to the expected results to successfully complete the training program. Note: An opinion of "inconclusive" is acceptable, if appropriate.



1. Unit 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 Testing

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

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

Date

1.5.3. Firearms Section In-Processing



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

Date

1.6. Required Reading

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

1.7. Terminology

Common Acronyms

HFSC	Houston Forensic Science Center
SOP	Standard Operating Procedures
ANSI-ASQ	American National Standards Institute-American Society for Quality
ANAB	ANSI-ASQ National Accreditation Board

1.8. Estimated Training Time

40 hours



2. Unit 2 – Background/History of Firearm Identification

2.1. Sections

- Introduction to Forensic Firearm Identification
- History
- Scope of Responsibilities and Conclusions
- Association of Firearm and Toolmark Examiners (AFTE)
- National Integrated Ballistics Information Network (NIBIN)/Integrated Ballistic Identification System (IBIS)
- 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 Testing

Written examination

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

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

Date

2.5.3. Scope of Responsibilities and Conclusions

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?
- 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

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

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

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

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

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.

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

2.8. Estimated Training Time

48 hours



3. Unit 3 – Firearm Development

3.1. Sections

- History of Early Firearms
- Long Guns (Single shot to repeating)
- Long Guns (Semiautomatic)
- Submachine Guns & Machine Guns
- Handguns (Revolvers)
- Handguns (Semiautomatic)
- Shotguns
- 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 Testing

- Written/practical examination
- Manual demonstration

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 Early 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

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

Date

3.5.2. **Long Guns (Single shot to repeating)**

3.5.2.1. 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

Date

3.5.2.2. The student function tests, identifies parts, 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

Date

3.5.2.3. The Principal Instructor gives an **oral** practical examination involving at least two of the above listed firearms. 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

Date

3.5.3. Long Guns (Semiautomatic)

3.5.3.1. The student function tests, identifies parts, 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

Date

3.5.3.2. The Principal Instructor gives an **oral** practical examination involving at least two of the above listed firearms. 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

Date

3.5.4. Submachine Guns & Machine Guns

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

- Blowback pistol (i.e. SWD/Cobray M-11)
- 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

Date

3.5.4.2. The Principal Instructor gives an **oral** practical examination involving at least two of the above listed firearms. 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

Date

3.5.4.3. 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

Date

3.5.5. Handguns (Revolvers)

3.5.5.1. 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.

Principal Instructor

Date

3.5.5.2. The student function tests, identifies parts, 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

Date

3.5.5.3. The Principal Instructor gives an **oral** practical examination involving at least two of the above listed firearms. 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

Date

3.5.6. Handguns (Semiautomatic)

3.5.6.1. The student function tests, identifies parts, 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)
- Gas operated pistol (i.e. 44 Magnum or 50 AE IMI Desert Eagle)
- Recoil operated double action only pistol (i.e. Glock 17)
- Recoil operated single action/double action pistol (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

Date

3.5.6.2. The Principal Instructor gives an **oral** practical examination involving at least two of the above listed firearms. 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

Date

3.5.6.3. 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
- Short recoil action
- Long recoil action

Principal Instructor

Date

3.5.6.4. 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
- Various single shot rifles
- Percussion revolver
- 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

Date

3.5.7. Shotguns

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

- Single shot shogun
- 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

Date

3.5.7.2. The Principal Instructor gives an **oral** practical examination involving at least two of the above listed firearms. 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

Date

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

Principal Instructor

Date

3.5.7.4. 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

Date

3.5.8. Manufacturing Techniques (May be deferred to Unit 9 – **Bullet Examination and Comparison**)

3.5.8.1. Numerous techniques are used in the manufacture of modern firearms. Study these procedures and discuss them in your notes. Include, but do not restrict your study to, the following machining methods:

- Shaping
- Drilling
- Turning
- Broaching
- Filing
- Electrochemical machining (ECM)
- Electrical discharge machining (EDM)
- Milling (include both face milling and peripheral/slab milling)
- Abrasive machining (include honing, lapping, grinding, sanding, and ultrasonic methods)
- Planing
- Reaming
- Boring
- Sawing
- Swaging
- Investment casting
- **Metal injection molding**

Principal Instructor

Date

3.5.8.2. Research the term “subclass”. Prepare a report describing if and why (or why not) each of the manufacturing techniques studied in Practical Exercise 3.5.8.1 lends itself to subclass carry-over. Include a discussion of why subclass carry-over is a concern to the Firearms Examiner.



Principal Instructor

Date

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

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

- Breechface
- Breechbolt
- Bolt
- Bolt face
- Extractor
- Firing pin
- Rifling
- Receiver
- Barrel
- Lands
- Grooves
- Ramp
- Magazine
- Clip
- Ejection port

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

3.5.8.3.3. 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.

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

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

Principal Instructor

Date

3.5.8.4. Study the following rifling techniques and discuss them in your notes:

- Broach
- Button
- Hammer forging
- Hook method
- Scrape method
- ECM
- EDM
- **Metal injection molding**

Principal Instructor

Date

3.5.8.5. Obtain broaches and buttons for study from the section training materials, if available. Determine the difference between barrels that have been button rifled and those that have been broach rifled.



Principal Instructor

Date

3.5.8.6. Discuss and define the following terms as they relate to firearm manufacture or firearms identification:

- Chambering
- Crowning
- Ballizing
- Bore slugging
- Forcing cone
- Bore
- Choke
- Choke tubes

Principal Instructor

Date

3.5.8.7. 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

Date

3.5.8.7.1. 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
- Company logos
- Serial number
- Factory numbers and markings

Principal Instructor

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.
- 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.
- 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.
- 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).
- 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.
- 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.
- 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.
- 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).
- 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	Saltpeter
Shot	Shotgun	Smooth Bore
Stock		

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		

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	

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)	

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		

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		

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		

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

3.8. Estimated Training Time

520 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** (56 hours, may be deferred to Unit 9)



4. Unit 4 – Ammunition Development and Identification/Cartridge Loading and Ballistics

4.1. Sections

- History of Gunpowder and Cartridge Primers
- Cartridge Manufacture and Identification
- Terminology Used in Cartridge Loading and Ballistics

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 Testing

Written/practical examination

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

Date

4.5.2. Cartridge Manufacture and Identification

4.5.2.1. Trace the evolution of the rimfire cartridge from the mid-nineteenth century to the current generation of modern .22 caliber rimfire cartridges.



Principal Instructor

Date

4.5.2.2. 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

Date

4.5.2.3. Become familiar with the Firearm Section Standard Ammunition File (SAF) and/or its electronic equivalent.

Principal Instructor

Date

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

Principal Instructor

Date

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

Principal Instructor

Date

4.5.2.6. Discuss the purpose and essential ingredients of priming mixtures used in modern cartridges.

Principal Instructor

Date

4.5.2.7. 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.

Principal Instructor

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.

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.

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.



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	Nitrocellulose	Nitrocellulose Powder
Powder	Powder, Ball	Powder Burning Rate
Powder Charge	Powder, Cracked Ball	Powder, Disc
Powder, Flake	Powder, Irregular Flake	Powder Measure
Progressive Burning Powder	Powder, Single Base	Powder, Smokeless
Powder, Tubular	Primer	Priming Mixture
Priming Powder	Propellant	Pyrodex

4.7.2. **Cartridge Manufacture and Identification**

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



4.7.3. Terminology Used in Cartridge Loading and Ballistics

Ammunition Color Code	Ammunition Lot	Ammunition, Ball
Ammunition, Match	Ammunition, Metallic	Ammunition, National Match
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		

4.8. Estimated Training Time

102 hours total

- **History of Gunpowder and Cartridge Primers** (16 hours)
- **Cartridge Manufacture and Identification** (72 hours)
- **Terminology Used in Cartridge Loading and Ballistics** (14 hours)



5. Unit 5 – Handling of Evidence and Safety

5.1. Sections

- Overview of Evidence Receiving and Transfer
- Laboratory Safety

5.2. 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 fill out log in worksheets, and a working knowledge of firearm terminology.

5.3. Method of Testing

Written/practical examinations

5.4. Training Methods

- Self-directed study
- Practical exercises
- Discussion

5.5. Practical Exercises

5.5.1. Overview of Evidence Receiving and Transfer

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

Date

5.5.2. Laboratory Safety

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

Principal Instructor

Date



5.5.2.2. The student reviews all procedures pertaining to the marking of evidence and be given practical exercises in marking bullets, cartridge cases, firearms, and other evidence.

Principal Instructor

Date

5.5.2.3. The student is given practical exercises using the firearms section inventory worksheet. This includes a variety of firearms such as: autoloading shotguns, sawed off shotguns, top break shotguns, semiautomatic pistols, revolvers, and rifles. Safety features are cited, as are precautions in unloading or determining if a firearm is loaded.

Principal Instructor

Date

5.5.2.4. Explore the capabilities in restoring an inoperable evidence firearm to operating condition and know the limitations and reservations that must be considered. Discuss this with your Principal Instructor.

Principal Instructor

Date

5.6. Required Reading

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

5.7. Terminology

None

5.8. Estimated Training Time

64 hours



6. Unit 6 – LIMS and Report Writing

6.1. Sections

- Overview of the Laboratory Information Management System (LIMS)
- 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 Testing

Written/practical examinations

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 case in LIMS and entering items of evidence. The student is shown how to create assignments in LIMS and associate evidence items with the assignments.

Principal Instructor

Date

6.5.1.2. The student is shown how to query the LIMS for the following: pending requests assigned to him/her, pending AR/TR assigned to him/her, common reports, and methods for searching the database for information.

Principal Instructor

Date

6.5.1.3. The student is taken through the procedure for querying LIMS for case/evidence information.



Principal Instructor

Date

6.5.2. 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.

Principal Instructor

Date

6.6. Required Reading

- LIMS Training Manual (Current Edition)
- Firearms Section Standard Operating Procedures

6.7. Terminology

None

6.8. Estimated Training Time

40 hours



7. Unit 7 – Test Firing and Specimen Recovery

7.1. Sections

- Test Firing Rules
- Standard Ammunition File (SAF) and Ammunition Selection
- Test Firing and Bullet Recovery Methods
- Basic Firearm Repair, Malfunctions, and Test Firing Unsafe or Hazardous Firearms

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 Testing

Written/practical examinations

7.4. Training Methods

- Self-directed study
- Discussion

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.

Principal Instructor

Date

7.5.2. Standard Ammunition File (SAF) and Ammunition Selection

7.5.2.1. Familiarize yourself with the ammunition storage areas in the section. Know how to locate test ammunition after correctly selecting test ammunition using the SAF **or other laboratory resources**. Discuss with your Principal Instructor the reasons for using substitute ammunition for test firing.

Principal Instructor

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

Date

7.5.3. Test Firing and Bullet Recovery Methods

7.5.3.1. 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, backstop, and cotton box and their limitations. 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

Date

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

Principal Instructor

Date

7.5.4. Basic Firearm Repair, Malfunctions, and Test Firing Unsafe or Hazardous Firearms

Student performs function tests on a:

- | | |
|--|-----------------------|
| • Semiautomatic Pistol | • Revolver |
| • Derringer | • Semiautomatic Rifle |
| • 22 Cal Rifle with a Tubular Magazine | • Shotgun |

Principal Instructor

Date

7.6. 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.

7.7. 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	

7.8. Estimated Training Time

24 hours



8. Unit 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 Testing

Practical examinations

8.4. Training Methods

- Self-directed study
- Demonstration
- Discussion

8.5. Practical Exercises

8.5.1. **Instrumentation and Measuring Devices**

8.5.1.1. Differentiate between the following:

- Compound microscope
- Stereo microscope
- Comparison microscope

Principal Instructor

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

Date



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

Principal Instructor

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

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 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.

Principal Instructor

Date

8.5.1.6. The student is given practical exercises involving powder recognition under the stereo microscope.

Principal Instructor

Date

8.5.2. **Measuring Devices**

8.5.2.1. Become familiar with and demonstrate the use of the following equipment, if available:



- Calipers
- Balance
- Digital (electronic) micrometer
- Digital force gauge (trigger pull gauge)
- NIST traceable steel rules

Principal Instructor

Date

8.5.2.2. Weigh **several fired bullets**, and measure **their** diameter, land, and groove widths utilizing the **calipers and/or micrometers**.

Principal Instructor

Date

8.5.2.3. **Use the digital force gauge to measure the trigger pull values for a variety of firearms listed in Sections 3.5.2 – 3.5.7 of this training manual. Use the section approved worksheet to record the values you obtain.**

Principal Instructor

Date

8.5.2.4. **Use the NIST traceable steel rule to measure the barrel and overall length of a variety of firearms listed in Sections 3.5.2, 3.5.3, and 3.5.7 of this training manual.**

Principal Instructor

Date

8.5.3. **Uncertainty of Measurement**

Discuss uncertainty of measurement with your Principal Instructor, focusing on the measurements in the Firearms Section that have a determined uncertainty. Prepare a simple, written explanation of uncertainty.

Principal Instructor

Date

8.6. Required Reading



- The Stereomicroscope Instrumentation and Techniques, by Schlueter & Gumpertz; American Laboratory, April 1976
- Manufacturer's Procedure and Operation Manuals
- 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.

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

8.8. Estimated Training Time

40 hours



9. Unit 9 – Bullet Examination and Comparison

9.1. 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.

9.2. Method of Testing

Practical exercises

9.3. Training Methods

- Self-directed study
- Practical exercises
- Discussion

9.4. Practical Exercises

9.4.1. General Exercises

9.4.1.1. Review the section(s) of the Standard Operating Procedures covering the examination of bullets. Discuss with your Principal Instructor.

Principal Instructor

Date

9.4.1.2. 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
- Obturation
- Corrosion
- Leading
- Single action firing
- Double action firing
- Knurled and grooved cannellure
- Stab crimp
- Boattail
- Open base
- Closed base



- General rifling characteristics
- Lacquers, sealants, painted tips
- Insufficient individual characteristics
- Recessed base
- Axial engraving

Principal Instructor

Date

9.4.1.3. 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

Date

9.4.1.4. Familiarize yourself with the Standard Ammunition File (SAF) or its electronic equivalent. Know how to search this to determine the manufacturer of fired bullets. Demonstrate your ability to use this file to your Principal Instructor.

Principal Instructor

Date

9.4.1.5. Familiarize yourself with the General Rifling Characteristics (GRC) database. Know how to use this file to compile a list of firearms in a "no-gun case". Demonstrate your ability to use the GRC file to your Principal Instructor.

Principal Instructor

Date

9.4.1.6. Weigh at least five fired bullets. Measure each bullet using the air gap method.

Principal Instructor

Date

9.4.2. Practical Exercise 1



9.4.2.1. 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. Prepare notes of your findings using appropriate examination documentation.

Principal Instructor

Date

9.4.3. Practical Exercise 2

9.4.3.1. Microscopically compare test bullets from "consecutively-made" barrels. Observe the differences and similarities in the striations and discuss this with your Principal Instructor.

Principal Instructor

Date

9.4.3.2. Cast the barrel of a firearm. Test fire the firearm. Compare the test fired bullets to the cast with your Principal Instructor. Discuss your observations. In your discussion, include the topic of subclass carry-over. Discuss how to avoid areas prone to subclass carry-over when examining fired bullets and what type(s) of rifling techniques may lend themselves to subclass carry-over in firearm barrels. Prepare notes on your discussion.

Principal Instructor

Date

9.4.3.3. 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.

- 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

Date

9.4.4. Practical Exercise 3



9.4.4.1. 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.

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

Principal Instructor

Date

9.4.5. Practical Exercise 4

9.4.5.1. 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. Prepare notes of your findings using appropriate examination documentation. Prepare a report on how exterior bullet coatings/**composition/style** may impact a firearms examiner's conclusions.

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

Principal Instructor

Date

9.4.5.2. Using one 30 caliber rifle, test-fire two each of the following cartridges and compare the tests with each other. Discuss plans and procedures with your Principal Instructor before conducting any tests. Prepare notes of your findings using appropriate examination documentation. Conduct this test with your Principal Instructor.

- 30 caliber Remington jacketed soft-point bullet
- 30 caliber Remington Accelerator cartridges

Principal Instructor

Date



9.4.5.3. 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.

Principal Instructor

Date

9.4.6. Practical Exercise 6

9.4.6.1. Using a 32 S & W 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. Conduct this test with your Principal Instructor.

- 32 S&W Remington lead bullet
- 32 Auto Remington full metal case/jacketed bullet

Principal Instructor

Date

9.4.6.2. Using the provided test bullets fired from polygonal rifled barrels, demonstrate your ability in 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 any have been fired through the same barrel. Prepare notes of your findings using appropriate examination documentation.

Principal Instructor

Date

9.4.6.3. 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.

Principal Instructor

Date

9.4.6.4. Based on what you have learned in this unit, compile a list 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.



Principal Instructor

Date

9.4.7. Practical Exercise 7

9.4.7.1. Obtain different types of mediums to use in test firing. These include aluminum, sheet metal, different types of plastic, and glass (plain and laminated). 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. Also change the angles of the shots to determine if this changes your findings.

Principal Instructor

Date

9.4.8. Practical Exercise 8

9.4.8.1. Compare test fired bullets from various firearms before the breech and bore are cleaned and after the breech and bore are cleaned. The cartridge cases created may be used in exercise 10.5.2.5. Prepare notes of your findings.

Principal Instructor

Date

9.4.8.2. Test fire a firearm three times for each of several different bullet weights and compare them. Ideally, the same cartridge manufacturer is used for all tests. For example, use the same 9mm Luger pistol to test fire Winchester cartridges having bullet weights of 115 gr., 124 gr., and 147 gr. Prepare notes of your findings using appropriate examination documentation.

Principal Instructor

Date

9.5. Reading

9.5.1. 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 Cooney 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.

9.5.2. 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

9.6. Terminology

None

9.7. Estimated Training Time

400 hours



10. Unit 10 – Cartridge Case/Shotshell Examination and Comparison

10.1. Sections

10.1.1. Cartridge/Cartridge Case Examination and Comparison

- Class Characteristics
- Individual Characteristics

10.1.2. Shotshell and Shotshell Component Examination and Comparison

- Class Characteristics
- Individual Characteristics

10.1.3. National Integrated Ballistics Identification Network (NIBIN)

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 Testing

Practical examinations

10.4. Training Methods

- Self-directed study
- Practical exercises
- Discussion

10.5. Practical Exercises

10.5.1. Cartridge/Cartridge Case Examination and Comparison, Class Characteristics

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

Principal Instructor

Date

10.5.1.2. 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 videotape if available regarding the slow motion of firing sequences using semiautomatic firearms.

Principal Instructor

Date

10.5.1.3. Test fire two of each of the following firearms. Your Principal Instructor may incorporate additional firearms. 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. Discuss how to avoid areas prone to subclass carry-over when examining fired cartridge cases and what type(s) of manufacturing processes may lend themselves to subclass carry-over in firearms (focusing on areas that contact a cartridge case). Do not limit your discussion to only the types of markings seen in the cartridge cases from this exercise. Prepare notes on your discussion.

- Lorcin model L380 or L9mm pistol
- Raven model P-25 or MP-25 pistol
- Ruger model MKII pistol
- Smith & Wesson Sigma Series pistol
- Smith & Wesson revolver
- Beretta Model 92 or 96 pistol

Principal Instructor

Date

10.5.1.4. 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.

- 9mm Luger SWD Inc. Model M11/Nine pistol
- 9mm Luger 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

Principal Instructor

Date



10.5.1.5. 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.

Principal Instructor

Date

10.5.1.6. 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

Date

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

10.5.2.1. Using the test cartridge cases and cartridges from Practical Exercise 10.5.1.3, microscopically intercompare all the markings with each other. Include the following types of markings in your microscopic comparisons: firing pin impression, breechface marks, chamber marks, anvil marks, extractor marks, ejector marks, chambering marks, ramp marks, slide drag marks, ejection port marks, and magazine lip marks. Prepare notes of your findings using appropriate examination documentation.

Principal Instructor

Date

10.5.2.2. Test fire the following firearms using comparable CCI, Remington, Federal, and Winchester ammunition of the appropriate caliber type for each firearm. Select ammunition with both nickel and brass primers. Test fire each firearm at least twice using each brand of ammunition. Microscopically intercompare the markings as in Practical Exercise 10.5.2.1.

- 38 Special Smith & Wesson revolver
- 357 Magnum Smith & Wesson revolver (consider using both 38 Special and 357 Magnum cartridges)
- 9mm Luger Smith & Wesson semiautomatic pistol
- 22 Long Rifle semiautomatic pistol



Principal Instructor

Date

10.5.2.3. Test fire a 22 Long Rifle revolver with each type of cartridge listed below, using every cylinder position. Each cartridge is from the same manufacturer. 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. Prepare notes of your findings using appropriate examination documentation.

- 22 Long Rifle
- 22 Long
- 22 Short

Principal Instructor

Date

10.5.2.4. Test fire a 30 Carbine caliber firearm and compare the test cartridge cases with each other. Compare all the marks imparted to the fired cartridge cases. Load and extract cartridges from this same firearm. Note and compare all the marks imparted to the test cartridges. Prepare notes of your findings using appropriate examination documentation.

Principal Instructor

Date

10.5.2.5. 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 9.4.8.1. Prepare notes of your findings using appropriate examination documentation.

Principal Instructor

Date

10.5.3. Shotshell and Shotshell Component Examination and Comparison, Class Characteristics

10.5.3.1. 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
- Fired card or fiber wads



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

Principal Instructor

Date

10.5.3.2. Familiarize yourself with the use of the SAF (or other laboratory resources) regarding the determination of gauge and manufacturer of fired shotshell components. Know the limitations regarding making such determinations.

Principal Instructor

Date

10.5.3.3. 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.

Principal Instructor

Date

10.5.4. Shotshell and Shotshell Component Examination and Comparison, Individual Characteristics

10.5.4.1. 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. Prepare notes of your findings using appropriate examination documentation.

Principal Instructor

Date

10.5.4.2. 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. Prepare notes of your findings using appropriate examination documentation.



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

Principal Instructor

Date

10.5.4.3. Test fire a 12-gauge shotgun using at least two 12 Gauge 2 3/4" 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.

- Remington, Magnum, 00 Buck
- Federal, Magnum, 00 Buck
- Activ, Field load, #7 1/2 shot
- Winchester, Xpert, #6 shot
- Remington, Shur-Shot, #8 shot
- Federal, Field load, #9 shot
- Activ, Magnum, BB shot
- Winchester, Super-X, #7 1/2 shot

Principal Instructor

Date

10.5.5. National Integrated Ballistics Identification Network (NIBIN)

10.5.5.1. Complete training on the IBIS/NIBIN system and become an authorized NIBIN user.

Principal Instructor

Date

10.5.5.2. Upon successful completion of an ATF-approved NIBIN training program, the student records at least 20 acquisitions and has them reviewed by the Principal Instructor for conformance to training standards.

Principal Instructor

Date

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.

10.7. Terminology

None

10.8. Estimated Training Time

320 hours



11. Unit 11 – Serial Number Restoration*

11.1. Sections

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

11.2. 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.

11.3. Method of Testing

Practical examinations

11.4. Training Methods

- Self-directed study
- Discussion
- Practical examinations and assignments

11.5. Practical Exercises

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

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

Principal Instructor

Date

11.5.1.2. 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, 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

Date

11.5.1.3. 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.

Principal Instructor

Date

11.5.1.4. 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
- Pinging
- Gouging
- Combinations of the above techniques
- Heating
- Puddling
- Welding
- Removal

Principal Instructor

Date

11.5.1.5. 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

Date

11.5.1.6. 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

Date

11.5.1.7. 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

Date

11.5.2. **Serial Number Restoration Methods and Practice**

11.5.2.1. 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

Date

11.5.2.2. 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

Date

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

Principal Instructor

Date

11.5.2.4. Discuss the various methods of surface preparation such as sanding and polishing and how they affect the results in the restoration attempt.

Principal Instructor

Date

11.5.2.5. Discuss how/why the magnetic technique of serial number restoration works.

Principal Instructor

Date

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

- | | |
|------------------------------|---------------------------|
| • CuNH_4Cl_2 | • HNO_3 |
| • CuCl_2 | • H_2SO_4 |
| • NaOH | • FeCl_3 |
| • HCl | |



Principal Instructor

Date

11.5.2.7. Research the materials (metals) and the best chemicals/techniques to use in number restoration of the following firearms:

- Colt pistol
- Smith & Wesson revolver
- RG Industries revolver
- Winchester rifle
- Scandium and/or Titanium frame
- Chrome/nickel frame
- Aluminum alloy frame
- Stainless steel frame
- Case hardened steel alloy frame

Principal Instructor

Date

11.5.2.8. 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

Date

11.5.2.9. 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

Date

11.5.2.10. 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.

Principal Instructor

Date

11.5.2.11. Under the direction and supervision of your Principal Instructor, attempt the restoration of serial numbers on a variety of 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. Discuss with your Principal Instructor the methods used and lessons learned during the restoration process.

Principal Instructor

Date

11.6. 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

11.7. Terminology

Be familiar with the following terms:

Plastic deformation

Cold rolled steel

Cast iron metal

Fry's Reagent

Davis' Reagent

Turner's Reagent

11.8. Estimated Training Time

40 hours

*This training may be satisfied by completing an ATF-approved serial number restoration training course.



12. Unit 12 – Moot Court

12.1. Sections

- Legal Aspects of Evidence
- Mock Trials

12.2. 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.

12.3. Method of Testing

Mock trials

12.4. Training Methods

- Self-directed study
- Discussion

12.5. Practical Exercises

12.5.1. Legal Aspects of Evidence

12.5.1.1. 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
- Hearsay
- “Reasonable degree of scientific certainty”
- “To the exclusion of all others”
- Voir dire
- Cognitive bias
- Opinion

Principal Instructor

Date

12.5.1.2. 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. Discuss this with your Principal Instructor.

Principal Instructor

Date

12.5.1.3. Research the following laws and publications, focusing on their impact in forensic firearms identification. Be prepared to 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.

- **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)**

12.5.2. Mock Trials

12.5.2.1. Undergo a series of moot court proceedings. Discuss your performance with the participants.

Principal Instructor

Date

12.5.2.2. Observe at least two Firearm examiners testifying as an expert witness. Discuss the testimonies with each examiner. Coordinate this with your Principal Instructor.

Principal Instructor

Date

12.5.2.3. Confer with other examiners regarding personal hints and recommendations regarding courtroom testimony.



Principal Instructor

Date

12.6. Required Reading

- 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.
- SWGGUN ARK.
- **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.**

12.7. Terminology

Appropriate legal terms

Any previously listed terminology

12.8. Estimated Training Time

80 hours



13. Unit 13 – Oral Board

13.1. Training Objectives

To instruct the student on the format of the final examination of Phase I of Firearm training and to provide time and guidance for the student to study for this test. Additionally, the student acquires various insights from feedback received after the exam from the different members on the board.

13.2. Method of Testing

- Oral examination by one or more of the student’s trainers, Technical Leader and/or the Section Manager to consist of not less than one hour and not more than 2 hours of questioning to include any material covered in the training program. Generally, more technical material are emphasized; however, legal and procedural subjects may be covered.
- Immediate feedback to the student’s response may be given, or held until the end of the exam.
- Evaluation is done by a pass/fail only basis.

13.3. Training Methods

- Self-directed study
- Discussion

13.4. Practical Exercise

Complete an oral board constituting questions from Units 1-10, and 12. To the satisfaction of your Principal Instructor. Unit 11 may or may not be covered (depending on the needs of the Firearms Section).

Principal Instructor

Date

13.5. Reading

Any reference previously listed

13.6. Terminology

Any term previously listed



13.7. Estimated Training Time

40 hours



14. Unit 14 – Supervised Casework

14.1. Training Objectives

At the conclusion of this unit, the student has experience and confidence in working independently on all phases of casework in Forensic Firearm examination.

14.2. Method of Testing

Direct observation/discussion

14.3. Training Methods

- The student conducts normal casework (mock casework may be substituted for actual casework during this phase) under the direct supervision of the Principal Instructor. These cases are basic in nature at the start and gradually increase in complexity. This gives the student an opportunity to work with the Principal Instructor and other examiners and learn under their direction, all phases of independent casework. Supervised casework is conducted in conjunction with the remainder of the units set forth in this manual and is interrupted as necessary based on the needs of the section.
- Supervised casework (primary examination, second examination, AR, & TR) continues until the Principal Instructor and the Quality Division approve the student for independent casework. The student may be signed off in stages rather than all at once.

14.4. Practical Exercises

14.4.1. The Principal Instructor assigns cases that are reflective of typical casework involving microscopic comparison of fired evidence. Due to the destructive nature of serial number restoration, no such supervised casework is administered. Instead, the student works with another trained examiner on at least two serial number restoration cases.

Principal Instructor

Date

14.4.2. In addition to conducting supervised examinations, the student also undergoes a period of supervised Administrative and Technical Review (AR/TR) training. During this phase, the student is trained on how to conduct ARs and TRs. The student then conducts ARs and TRs on cases and have his/her work reviewed by other trained analysts, who provide constructive feedback on the work performed by the student.



Principal Instructor

Date

14.5. Required Reading

- Guarding Against Error by Evan E. Hodge, AFTE Journal, Volume 20, No. 3, July 1988.
- That which may be necessary to accomplish certain tasks involved in conducting actual casework. Some research and/or refreshing of past readings may be necessary and may be required, as the Principal Instructor deems appropriate.

14.6. Terminology

None

14.7. Estimated Training Time

400 hours



15. Unit 15 – Armorer’s Schools

15.1. 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.**

15.2. Method of Testing

Provided by the instructors in schools attended.

15.3. Training Methods

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

15.4. Practical Exercises

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

Principal Instructor

Date

15.5. Reading

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

15.6. Terminology

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

15.7. Estimated Training Time

80 hours



16. Unit 16 – Firearm and Ammunition Plant Visitation

16.1. 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.**

16.2. Method of Testing

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.

16.3. Training Methods

- On-site demonstrations
- Tours
- Discussion

16.4. Practical Exercises

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

Principal Instructor

Date

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

Principal Instructor

Date

16.5. Reading

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



16.6. Terminology

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

16.7. Estimated Training Time

80 hours