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## REVISION HISTORY

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FTM-TM-01-01 OVERVIEW OF THE FIREARMS AND TOOLMARKS TRAINING PROGRAM

1 Introduction

This training program is designed to train Forensic Scientists assigned to the discipline of firearms and toolmarks within the Texas Department of Public Safety Crime Laboratory. Trainees will learn to properly process, preserve, and identify firearms, toolmarks, serial numbers, and distance determinations with the suggested techniques and procedures outlined in this training program.

The Firearms Examiner successfully completing this training program will provide technically proficient examinations of physical evidence, accurately report case examinations and results in written form, and effectively present their findings as an expert witness.

Forensic Scientists employed by the Texas Department of Public Safety in the Firearms and Toolmarks Section must meet specific requirements as outlined in the job description for Forensic Scientist.

An examiner must successfully complete the designated modules in the training manual and must also pass practical examinations, written examinations, competency testing, mock trial, and supervised casework before obtaining authorization to perform independent casework.

Trainees having prior experience in forensic firearms identification procedures may be evaluated by management in such a way that the training time and program may be modified according to their skills and knowledge. Modifications to the training program must be approved by the System Quality Manager.

Those trainees with prior experience will undergo competency testing related to the designated modules before obtaining Director authorization to perform work.

2 Purpose

The Firearms Training Program is designed to provide the trainee with sufficient background, laboratory skills, education, and supervised hands-on experience to adequately perform work with minimal supervision. The training program is approximately 14 to 18 months long. Additional time is required for those also being trained in distance determination and/or toolmark examination.

3 Program Format

Modules of instruction may be studied concurrently with other modules as necessary for optimal student understanding of the materials and methods presented. Each module will be supplemented by required readings, group discussion, independent and directed study, independent research, and practical exercises. Specialized schools in the discipline of firearms and toolmarks should be completed when available. Trainees should observe more experienced examiners during court testimony, when available.

A. General Laboratory Training The trainee will be introduced to general laboratory practices, forensic science, quality assurance, evidence management, legal concepts, pretrial preparation, court testimony, and general laboratory safety.

B. Firearms Unit will introduce the trainee to history and development of firearms and ammunition, history of firearms identification, firearms safety, equipment use, evidence handling, firearms, fired components, comparisons, processing and development procedures, shooting scene reconstruction, laboratory examinations (case evaluation, documentation, and report writing), and legal issues.
C. **Serial Number Restoration Unit** will introduce the trainee to equipment use, evidence handling, processing and development procedures, laboratory examinations (case evaluation, documentation, and report writing), and legal issues.

D. **Distance Determination Unit** will introduce the trainee to equipment use, evidence handling, firearms, fired components, processing and development procedures, specific reagents, laboratory examinations (case evaluation, documentation, and report writing), and legal issues.

E. **Toolmarks Unit** will introduce the trainee to equipment use, evidence handling, tools, toolmarks and related components, comparisons, processing and development procedures, laboratory examinations (case evaluation, documentation, and report writing), and legal issues.

4 **Safety**

There are numerous safety components including, but not limited to, handling evidence, firearms safety, biological and chemical contamination, and mixing reagents. Use appropriate personal protective equipment and laboratory safety precautions as outlined in each module and in the Health and Safety Manual.

5 **Responsibilities**

5.1 **Trainer Responsibilities**

A. The trainer is responsible for providing a training plan and/or outline to the trainee.

B. The trainer will assess, review, evaluate, and sign and date the completion of tasks, modules, practical exercises, and exams (written or oral).

C. The trainer will review and approve items on the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).

D. Documentation of training records, completion of training assignments, and other training records are reviewed and approved by the trainer.

E. Regular meetings between the trainer, trainee, and supervisor, should be held to evaluate the trainee’s progress and identify areas that require additional training.

5.2 **Trainee Responsibilities**

A. The trainee has an obligation to maximize the effectiveness of the training period as an opportunity to learn as much as possible in this field. The extent to which the trainee exerts himself or herself during this training and evaluation period will bear directly on the quality of his/her performance in the laboratory and on the witness stand. The trainee has a moral and ethical obligation to prepare himself or herself technically and professionally during training in order to be able to perform according to the most rigorous standards.

B. The trainee will be required to maintain a training notebook. The training program requires the trainee to keep up with assignments on a self-study basis. The trainee is responsible for informing his/her trainer or Supervisor if problems arise at any time during the training period.

5.3 **Training Notebook**

A. During the training program, the trainee is responsible for keeping detailed records in a training notebook of his/her training and progress. Completion of modules and/or practical exercises will be recorded, dated, and approved by the trainer on the respective training checklist.
B. This notebook will be presented upon request by the trainer or members of lab management. Copies of significant training progress will be provided to the trainer for inclusion into the trainee's notebook.

C. Completion of modules and/or practical exercises will be recorded, dated, and signed off by the trainer on a training record log (checklist).

D. The following is a list of items maintained in the training notebook by the trainee:
   1. Training record (Training Checklist) of training activities and exercises, as well as practical applications
   2. List of literature reading assignments with documented completion dates
   3. List of in-house training videos and lectures attended
   4. Records of all oral and written tests and results will be maintained. This includes written, practical and competency/proficiency tests
   5. Special project assignments with summary reports, as applicable (optional)
   6. Courtroom testimony attended and observations/evaluations
   7. Records will be maintained regarding all site visits (laboratories, schools, museums, factories) related to training
   8. Study notes, including discussion, demonstration or research
   9. Supervised casework assignments
   10. Workshop or lecture certificates (copy)
   11. Mock trial documentation (LAB-313 and LAB-314)

6 Review and Authorization

Firearms, Serial Number Restoration, Distance Determination, and Toolmarks will be undertaken as separate units of training. General Laboratory Training must be completed before beginning this training program.

6.1 Firearms Unit

The Firearms Unit requirements will conclude with examiner approval to conduct supervised work when the following are met:

A. All competency samples are correctly analyzed, which includes a minimum of ten practical exams.

B. The trainee successfully completes written assignments and/or exam(s).

C. Successful completion of at least one mock case, which includes examination of evidence followed by a mock court designed, conducted, and evaluated by the trainer and supervisor. This may be combined with other testing procedures' mock cases/courts.

D. The training notebook and other training records documenting completion of training requirements are reviewed by the trainer.

E. The trainer(s) recommend(s) that the examiner be approved for supervised work.
6.2 **Serial Number Restoration Unit**

Serial/Number Restoration Unit requirements will conclude with examiner approval to conduct supervised work when the following are met:

A. All competency samples are correctly analyzed, which includes a minimum of three practical exams.

B. The trainee successfully completes written assignments and/or exam(s).

C. Successful completion of at least one mock case, which includes examination of evidence followed by a mock court designed, conducted, and evaluated by the trainer and supervisor. This may be combined with other testing procedures' mock cases/courts.

D. The training notebook and other training records documenting completion of training requirements are reviewed by the trainer.

E. The trainer(s) recommend(s) that the examiner be approved for supervised work.

6.3 **Distance Determination Unit**

Distance Determination Unit requirements will conclude with examiner approval to conduct supervised work when the following are met:

A. All competency samples are correctly analyzed which includes a minimum of five practical exams.

B. The trainee successfully completes written assignments and/or exam(s).

C. Successful completion of at least one mock case, which includes examination of evidence followed by a mock court designed, conducted, and evaluated by the trainer and supervisor. This may be combined with other testing procedures' mock cases/courts.

D. The training notebook and other training records documenting completion of training requirements are reviewed by the trainer.

E. The trainer(s) recommend(s) that the examiner be approved for supervised work.

6.4 **Toolmarks Unit**

Toolmarks Unit requirements will conclude with examiner approval to conduct supervised work when the following are met:

A. All competency samples are correctly analyzed, which includes a minimum of ten practical exams.

B. The trainee successfully completes written assignments and/or exam(s).

C. Successful completion of at least one mock case, which includes examination of evidence followed by a mock court designed, conducted, and evaluated by the trainer and supervisor. This may be combined with other testing procedures' mock cases/courts.

D. The training notebook and other training records documenting completion of training requirements are reviewed by the trainer.

E. The trainer(s) recommend(s) that the examiner be approved for supervised work.
6.5 Supervised Work

Supervised work requirements will conclude with authorization for independent work when the following are met:

A. Supervised work consisting of successful completion of at least 20 firearms cases, two toolmark cases (if applicable to the examiner’s assigned lab), five distance determination cases (if applicable to the examiner’s assigned lab), and two serial number restoration cases. Mentor/trainer must initial all relevant pages/results in the examination documentation indicating that they concurred with the examination/results.

B. Trainer or designee is consulted at each step of the analysis procedure prior to trainee proceeding with that step.

C. The trainer(s) recommend(s) that the examiner be approved for independent work to the Quality Manager.

7 Evaluation of Training

The trainee will complete an evaluation of the module/unit content and the trainer the using LAB-304 (Laboratory Training Program Evaluation Form).

8 Retraining

Examiners desiring or requiring retraining prior to resumption of testing activities will consult with the System Firearm Trainer to review any potential knowledge gaps and deficiencies. The System Firearm Trainer will develop an individual training program in consultation with the Comparison Program Coordinator, Quality Manager of the laboratory to which the examiner is assigned, and the affected individual.
FTM-TM-01-02  HISTORY OF AMMUNITION AND EARLY FIREARMS DEVELOPMENT

Duration  Five weeks
Purpose  The trainee will become familiar with the history and development of ammunition and early firearms
Prerequisite  General Laboratory Training Manual

1  Objectives
1.1  Theoretical
The trainee will learn the history and development of ammunition and early firearms and how their developments are intertwined. This forms the foundation of how each component interacts with one another. The trainee will also have an understanding of how modern ammunition is manufactured and how those methods can impact comparisons of fired ammunition components.

1.2  Practical
Following the completion of this module the trainee will have an understanding of:

A. Historical development of firearms and ammunition
B. Current manufacturing methods of ammunition
C. Proper nomenclature
D. Use of available reference materials

2  Training Outline
2.1  Lesson Plan
A. Develop knowledge of the history of propellant development
   1. Components of black powder and their sources
   2. Role of components
   3. Development of smokeless powder
B. Develop knowledge of the history of cartridge case and bullet development
   1. Vocabulary
   2. Materials and shapes
   3. Development of rimfire and centerfire cartridges
C. Develop knowledge of the history of early firearm development and how it is interrelated to propellants, cartridge case and bullet development
   1. Develop knowledge of the various lock systems
   2. Develop knowledge of important inventors
   3. Understand how one mechanism spurred development of future mechanisms
D. Learn about the development and manufacture of modern ammunition, including bullets, cartridge cases (rimfire and centerfire), primers, shotgun shells, and components.
E. The trainer will present PowerPoints for discussion.
F. During the ammunition factory tour, the trainer will assist the trainee with understanding the processes that are being observed.

2.2 Required Readings and Presentations


C. Frost, G. Ammunition Making. NRA Publishing; 1990

D. PowerPoint presentation – Black and Smokeless Powder Development

E. PowerPoint presentation – Ammunition & Early Firearm Development

2.3 Suggested Readings


3 Practice

3.1 Safety

None

3.2 Standards, Controls, Reagent Preparation

None

3.3 Equipment

Ammunition Reference Collection

3.4 Independent Exercises

A. Prepare a detailed chronological report about the origins and development of black powder as an early small arms propellant through the 19th century. Focus on black powder itself as early firearms will be covered later in training. Discuss the following:

1. Early researchers and inventors
2. Countries of origins
3. Components of black powder
4. Ratio of components
5. Early documents
6. Sources of raw materials
7. Production methods
8. Glazing process
9. Grain size
10. Chemistry of combustion
11. Role of each component
12. Mechanical mixture vs. chemical compound
13. End products of combustion
14. Modern improvements

B. Obtain several samples of the various grain sizes of black powder. Preserve them in labeled glass vials for future reference. If the trainee's lab already has these, study the similarities and differences.

C. Sketch the cross-section of Berdan and Boxer primers, showing their relation to the head of the cartridge. Include several paragraphs discussing the origins, advantages and disadvantages of each.

D. Prepare a report discussing the purpose and essential ingredients of priming mixture used in modern cartridges.

E. Prepare a report discussing the evolution of the rimfire cartridge from the mid-19th century to the current generation of modern 22 caliber rimfire cartridge.

F. Prepare a report discussing the evolution of centerfire cartridge development starting with black powder cartridges in the mid-19th century to the current generation of modern centerfire cartridges. Be sure to include
   1. Muzzle loaded paper cartridges,
   2. Colt nitrated paper cartridges,
   3. Sharps linen cartridges,
   4. Maynard brass cases and tape primers,
   5. The Mini ball,
   6. Houiller’s pinfire cartridge,
   7. Flobert’s BB cap,
   8. The Volcanic bullet,
   9. Henry’s 44 rimfire, and
   10. Folded head cartridges

G. Early Firearms – Much of early ammunition development discusses early firearms as well.
   1. Prepare a chronological outline of early firearms development from “cannon lock” through “percussion lock”.
   2. Prepare and submit a chronological report setting out the origins and evolution of muzzle loading firearms through percussion systems. Focus should be on the advantages of each developmental step and how improvements were stimulated by disadvantages of prior system. The report should address and define the following systems:
      a. Hand cannon
b. Matchlock
c. Wheel lock
d. Snaphaunce
e. Miquelet
f. True flintlock
g. Mechanical priming systems (firelocks)
h. Chemical priming systems (percussion)
i. Projectiles used
j. Loading and firing sequences of black powder firearms
k. Inventors (where known)
l. Muzzle-loading firearm safeties
m. Safety mechanisms
n. Repeating arms
o. Countries of origin
p. Use of patches
q. Pre-metallic cartridges
r. Projectile improvements

H. Modern Ammunition – Learn the definitions of the following cartridge vocabulary words and be prepared for an oral exam discussing them:

1. Cartridge
2. Cartridge case
3. Primer
4. Single based powder
5. Double based powder
6. Bottleneck cartridge
7. Rebated-rim cartridge
8. Rimless cartridge
9. Rimmed cartridge
10. Proof cartridge
11. Shoulder
12. Neck
13. Mouth
14. Head
15. Extractor groove
16. Semi-rimmed cartridge
17. Tapered cartridge
18. Head stamp
19. Belted cartridge
20. Bunter

I. Learn the difference between caliber, caliber type and caliber designation. Discuss the following caliber families: 22 caliber, 30 caliber and 38 caliber in regards to cartridge. Explain the differences between the different caliber types specifically in regards to cartridges and bullets in a three page report.

J. Learn the definitions of the following bullet vocabulary words and be prepared for an oral exam discussing them:
1. Bullet
2. Cannelure
3. Crimp
4. Ogive
5. Jacketed bullet
6. Round nosed bullet
7. Hollow-point bullet
8. Soft point bullet
9. Spitzer bullet
10. Bullet sizing
11. Wadcutter
12. Semi-wadcutter
13. Truncated nose bullet
14. Brass coated lead bullet
15. Copper coated lead bullet
16. Nylon coated lead bullet
17. “Silvertip” bullet
18. Lubaloy
19. Arsenic
20. Antimony
21. Cast lead bullet
22. Mold marks

K. Learn the definitions of the following shotshell vocabulary words and be prepared for an oral exam discussing them:
1. Shotshell
2. Gauge
3. Battery cup
4. Wadding
5. High brass, low brass
6. “Rule of 17”
7. Shot collar
8. Chilled shot
9. Dram equivalent

### 3.5 Ammunition factory tour

After touring an ammunition factory, in a group oral report discuss the following processes: (Note the differences between rimfire, centerfire, shotgun cartridges)

1. Blanking
2. Cupping
3. Annealing, washing, pickling
4. Drawing
5. Second wash
6. Trimming
7. Heading
8. Relief annealing
9. Priming
10. Trimming
11. Bunting
12. Tapering and necking
13. Head turning
14. Mouth annealing
15. Piercing flash hole
16. Seating/crimping primer
17. Extrusion
18. Slug cutting
20. Knurling
21. Brass and copper coatings
22. Lubricants
23. Formation of bullet cores and jackets
24. Final assembly of jacketed bullets
25. Paper and plastic shotshells
26. Cardboard & felt wadding
27. Plastic wadding components
28. Use of shot tower
29. Use of Bliemeister process
30. Steel & Bismuth shot manufacture
31. Shotshell head construction

3.6 Pattern Recognition Skills

A. The trainer or mentor will assign test fires (known matches) from the local laboratory test fire reference collection. Record the inventory number of the test fire box, the caliber, the cartridge class, and the areas studied on both cartridge cases and bullets.

B. The purpose of this exercise is to start training unskilled eyes to recognize patterns on fired ammunition components. This exercise will be continuous throughout training and build in complexity and level of observations.

4 Assessment

4.1 Competency and Qualifying Examination

Successful performance of the assignments and exercises outlined in this module are considered to be the completion of this module.

4.2 Evaluation of Training

The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
FTM-TM-01-03  MANUFACTURE OF MODERN FIREARMS

Duration  Five to six weeks
Purpose  The trainee will become familiar with the manufacture of modern firearms and firearm operating systems.
Prerequisite  FTM-TM-01-02

1 Objectives
1.1 Theoretical
Building on what was learned in FTM-TM-01-02, the trainee will focus on modern firearm manufacturing and the various operating systems. This knowledge will be applied later to determine sources of various firearm related toolmarks. The trainee will be able to determine make, model, serial number, country of origin, and other marks used to identify firearms.

1.2 Practical
Following the completion of this module, the trainee will have an understanding of:

A. Manufacturing and machining terms and techniques
B. Basic firearm types, firearm parts, and rifling techniques
C. Identifying marks on firearms and proof marks
D. Fundamentals of operation
E. Terminology

2 Training Outline
2.1 Lesson Plan
A. Manufacture of Modern Firearms
   1. Become familiar with different manufacturing/machining terms and techniques
   2. Understand basic firearm types
   3. Understand major firearm parts
   4. Understand the various rifling techniques
   5. Be able to identify firearms
   6. Understand the significance of proof marks
B. Modern Firearms Operation
   1. Understand the fundamentals of operation including
      a. Cycle of fire
      b. Types of operation
      c. Semi-automatic and full automatic fire
   2. Understand manufacturing terminology
   3. Understand trainee’s local laboratory collections
C. Examine reference firearms and identify operating systems
D. Test firing rules
E. Learn the ATF manufacturing requirements and stamp location requirements for identifying firearms
F. Factory tours, as available

2.2 Required Readings and Presentations
A. AFTE Glossary Section 8 (Manufacturing and Machining Terminology)
B. Videos found on YouTube:
   1. John Moses Browning Documentary (57:56)
   2. The Genius of John Moses Browning (14:28)
   3. The Browning Hi-Power (39:38)
   4. S&W Safety Features (3:00)
   5. Colt Factory Tour Part 1 (33:59)
   6. How Henry Rifles are Made (14:35)
   7. America’s Rifle: The M1 Garand (54:46)
   8. AR-15 Components (7:11)
   10. How a Pistol (Colt 1911) Works (5:20)
   11. How a Glock Works (2:54)
   12. How an Arisaka Type 14 works (4:50)
   13. How an AK-47 works (2:21)
   14. How This Rifle Works AK-47 (16:01)
   15. How an AR-15 works (5:10)
   16. How 3 shot burst works (7:28)
   17. How Derringers Work - rimfire (2:02)
   18. How Does a Beretta 92 Operate (1:55)
   19. View PowerPoint – Identifying firearms
   20. View PowerPoint – AOW
   21. View PowerPoint – Machining Techniques

2.3 Suggested Readings
A. Articles

B. Books
11. Schneider, Jr., G. *Cutting Tool Applications*. Farmington Hills, MI: George Schneider, Jr.; 2002 (PDF available)

3 Practice
3.1 Safety
Firearms and Toolmarks SOP: Firearm Safety chapter

3.2 Standards, Controls, Reagent Preparation
None

3.3 Equipment
- Firearms Reference Collection
- Ammunition Reference Collection

3.4 Observed Performance
The trainer will demonstrate proper firearms handling, disassembly, assembly, and function checking to the trainee.
3.5 Supervised Performance

A. Partially disassemble (field strip) and reassemble firearms from the Firearms Reference Collection (FRC) as assigned by the trainer.

B. The trainee will demonstrate the types of operation of various firearms in the Firearms Reference Collection as assigned by the trainer.

3.6 Independent Exercises

A. Numerous techniques are used in the manufacture of modern firearms. Research these processes and discuss in trainee notes:

1. Shaping
2. Planing
3. Drilling
4. Reaming
5. Turning
6. Boring
7. Milling
   a. Face milling
   b. Peripheral (slab) machining
8. Broaching
9. Swaging
10. Abrasive machining
    a. Honing
    b. Lapping
    c. Grinding
    d. Sanding
    e. Ultrasonic methods
11. Sawing
12. Filing
13. Electrical machining
    a. EDM
    b. ECR
14. Investment casting
15. Metal injection molding (MIM)

B. Define the basic nomenclature of handguns, rifles, and shotguns:

1. Revolver (single action, double action)
2. Semiautomatic pistol (single action, double action, simple blowback, recoil operated)
3. Derringer
C. Understand and define the following firearms parts. Understand that not all firearms will have all of the following parts:

1. Breech block & breech bolt (note differences too)
2. Breech face (bolt face)
3. Bolt
4. Extractor
5. Ejector
6. Firing pin
7. Rifling
8. Forcing cone
9. Barrel
10. Bore
11. Lands; grooves
12. Feed ramp & loading ramp (note differences too)
13. Magazine
14. Clip; charger, En Bloc clip, Stripper clip
15. Ejection port
16. Receiver
17. Choke, choke tubes

D. Define the following rifling and bore finishing techniques:

1. Broach
2. Button
3. Hammer forging
4. Hook method
5. Scrape method
6. ECR/EDM
7. Crowning
8. Ball burnishing
9. Bore slugging
10. Lead lapping

E. Research the history and significance of proof marks as they relate to manufacture.
F. Fundamentals of Operations

1. View the video series Fundamentals of Small Arms Weapons, Parts I-III found on YouTube and write a summary of each section.
   a. *Fundamentals of Small Arms Weapons Part I; Cycle of Operation (cycle of fire)*
   b. *Fundamentals of Small Arms Weapons Part II; Types of Operation*
   c. *Fundamentals of Small Arms Weapons Part III; Semi-automatic and Automatic Fire*


G. Explain the differences in the following terms in trainee notes:

1. Single action only (SAO)
2. Double action only (DAO)
3. Double action and single action (DA/SA)
4. Blowback action
5. Delayed blowback action
6. Gas-operated action
7. Short recoil operation
8. Long recoil operation

H. Laboratory Collections

1. Understand the Firearms Reference Collection (FRC) in the trainee’s lab:
   a. *Learn how to locate firearms in the FRC using the FRC database (printed or electronic)*
   b. *Know the correct procedure for checking a firearm out of the FRC*
   c. *In particular note the different types of firearms and actions (operating systems)*

2. Understand the Firearms Section Ammunition Reference Collection in the trainee’s lab

I. Examine reference firearms and identify operating systems

4 Assessment

4.1 Competency and Qualifying Examination

Complete oral exams in the PowerPoint presentations. The successful performance of the assignments and exercises are considered to be the completion of this module.

4.2 Evaluation of Training

The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
02 FIREARMS UNIT

FTM-TM-02-01 HISTORY OF FIREARMS IDENTIFICATION

Duration: One week

Purpose: To familiarize the trainee with the history of firearms identification as a science, including historical background, concepts, and instrumentation development.

Prerequisite: FTM-TM-01-02 and FTM-TM-01-03

1 Objectives

1.1 Theoretical

This body of knowledge is founded squarely on the previous topics already learned – small arms propellants, manufacturing processes, operating systems, and most importantly the cycle of fire. The trainee will learn how class, subclass, and individual characteristics are important for the basis of identification, elimination or inconclusive opinions and principles of examination of firearms, serial number restoration, distance determination, and toolmarks.

1.2 Practical

Following the completion of this module the trainee will have an understanding of:

A. The history of firearms identification
B. Early landmark cases
C. Types of instruments utilized
D. Use of common nomenclature in Firearms Identification
E. The Association of Firearm and Tool Mark Examiners (AFTE) and the Theory of Identification

2 Training Outline

2.1 Lesson Plan

A. Demonstrate knowledge of the history of Firearms Identification, including:
   1. Key people involved in early firearms identification and their contributions.
   2. Early landmark cases
   3. Early instruments used in comparisons

B. Demonstrate knowledge of related terminology, including:
   1. Interior, exterior and terminal ballistics
   2. Types of conclusions
   3. Basis for conclusions
   4. Probability as it relates to Firearms Identification
   5. Class, subclass, and individual characteristics
   6. Parts of firearm that leave class characteristics
   7. What determines individuality in bullets, cartridge cases, and shotgun shells
C. Demonstrate knowledge of AFTE:
   1. Formation of AFTE
   2. History
   3. Membership criteria
   4. Code of Ethics
   5. Glossary and Journals
   6. Criteria for Identification and Theory of Identification

D. Know the importance of laboratory collections
   1. Firearms Reference Collection

E. Ammunition reference collection
   1. Become familiar with the Firearms Reference Collection (FRC):
      a. Learn how to locate firearms in the FRC using the FRC printed or electronic
         inventory listings and obtain up-to-date copies of this inventory for use.
      b. Know the correct procedure for checking a firearm out of the FRC.
      c. In particular, note the different types of firearms, actions, etc.
   2. Become familiar with the Firearm Section Ammunition Reference Collection.

2.2 Required Readings


E. Articles:
   1. Report on the Formation of the Association of Firearm and Tool Marks Examiners
   2. AFTE By-Laws

F. AFTE history, ethics, bylaws, Theory of Identification www.afte.org (under about tab)

G. Read and become familiar with the Association of Firearms and Tool Mark Examiners (AFTE). Include its history, current officers, and criteria for membership, committees, glossary and journals.
   1. History: read the following articles
      b. AFTE History
   2. Criteria for membership, current officers, benefits, committees: read the AFTE Bylaws
3. Code of Ethics
   a. AFTE Code of Ethics
   b. AFTE Procedures for Enforcement of the Code of Ethics;
   c. Ethics will be discussed throughout training and again in-depth near the end of training

4. Glossary

5. Journal

6. AFTE Criteria for Identification and AFTE Theory of Identification

2.3 Suggested Readings
If other references are encountered in this category, the trainee is encouraged to notify the trainer and make notes for future reference.

A. Firearms Safety

B. Chemical Safety
   3. Safety Data Sheets (SDS), as applicable can be obtained in print or on disk from chemical supply houses, and are maintained by all Texas DPS Crime Laboratories.

C. Biohazards
   4. Occupational Safety and Health Administration.

D. Personal Protective Equipment
2. Occupational Safety and Health Administration.

E. Lead Poisoning
   6. Physical Plant Safety

F. Quality Assurance
G. Individual Certification

H. Laboratory Accreditation

I. AFTE History and Development

J. Ethics

3 Practice
3.1 Safety
None

3.2 Standards, Controls, Reagent Preparation
None

3.3 Equipment
None

3.4 Independent Exercises
A. History of Firearms Identification
   1. Research the contributions of the following individuals to the field of firearms identification, citing in particular their most noted publications, inventions, early high profile cases, and business and scientific relationships to each other, if any. Summarize their contributions into 1-3 paragraphs each.
      a. Major Gerald Burrard (Great Britain)
      b. Professor Victor Balthazard (France)
      c. Robert Churchill (Great Britain)
      d. John H. Fisher
      e. Colonel Calvin H. Goddard, U.S. Army
      f. Philip O. Gravelle
**B. Research the following early landmark cases and summarize each in a one page report in terms of firearms identification.**

- **a. The “Affray at Brownsville”**
- **b. The Stielow homicide**
- **c. The Sacco-Vanzetti case**
- **d. The St. Valentine’s Day Massacre**
- **e. The murder of Constable Guttridge (United Kingdom)**

**C. Research the evolution of the following instruments. Discuss who originally invented or adapted it and its original purpose. Emphasis should be on the comparison microscope and its development. Indicate the reasons why some of the instruments that have fallen into disuse.**

- **a. Comparison microscope**
- **b. Stereo microscope**
- **c. Helixometer**
- **d. Comparison camera**
- **e. Rifling meter**
- **f. Striagraph**

**D. Terminology**

1. Define interior, exterior, and terminal ballistics. Also describe the relationship between the term ballistics and firearms identification, how these two fields are related and which areas are the province of the firearms examiner.

2. Formulate an answer to the following questions:

- **a. Is the forensic science discipline of Firearms and Toolmarks Identification an art or science?**
- **b. What are the types of conclusions that can be reached in firearm identification comparisons?**
- **c. What is the basis for each of the above conclusions?**
- **d. Is it possible for experts in the forensic science discipline of Firearms and Toolmarks Identification to disagree regarding their conclusions? Why or Why Not?**
- **e. How does "probability" relate to firearm identification?**
3. Define in both general forensic context and specifically within the firearms identification:
   a. Class characteristics
   b. Subclass characteristics
   c. Individual characteristics

4. Describe in writing, the parts of a firearm which can leave gross/general class characteristics on bullets, cartridge cases, and/or shotgun shells, the general appearance and the location of these marks and why they are called ‘class characteristics’.

5. Explain why bullets fired from different firearms with barrels bearing the same class characteristics can usually be distinguished from one another at the microscopic level. Relate this distinction to the manufacturing processes used and the fact that tools do not last indefinitely. Include a discussion for evaluation of the tool working surface for subclass characteristic influence.

6. Do the same as above for cartridge cases and shotgun shells.

4 Assessment

4.1 Competency and Qualifying Examination

There will be a written competency exam over terminology and concepts.

4.2 Evaluation of Training

The trainee and trainer will complete a checklist and sign-off sheet (LAB-FTM-TM-01).
FTM-TM-02-02 EQUIPMENT

Duration  One week
Purpose  The trainee will become familiar with available equipment used in the laboratory in order to choose the appropriate sequence and method, use good laboratory practice, and maintain a safe working environment.

Prerequisite  FTM-TM-02-01, GLT Advanced Topics: Measurement Uncertainty

1 Objectives

1.1 Theoretical

It is important for the trainee to have a strong foundation with the various equipment used in the Firearms and Toolmarks section. In addition to learning how to use the equipment, the trainee will learn the maintenance, calibration, and performance checks routinely performed, as well as proper documentation. The trainee will have an understanding of the principles of microscopy, comparison microscopy, the effects of various lighting, and how to use the equipment. Measurement uncertainty will be covered and, at the end of the module, trainees will participate in the measurement uncertainty budget. New and emerging technologies will also be discussed.

1.2 Practical

Following the completion of this module the trainee will have an understanding of:

A. Use and safe operation of equipment
B. Terminology
C. Performance verification, performance checks, maintenance, and quality control for equipment
D. Use of available reference material
E. 3D Virtual Microscopy

2 Training Outline

2.1 Lesson Plan

A. Microscopy
   1. Compound microscope
   2. Stereo microscope
   3. Comparison microscope
   4. Set up comparison microscope
   5. Light sources

B. Other Equipment
   1. Micrometers and calipers
   2. Inertia bullet puller
   3. Ruler
   4. Balances and scales
   5. Video camera and related software
   6. Trigger pull measuring devices
C. Quality Checks
   1. Performance verification
   2. Performance checks
   3. Calibration

D. Measurement Uncertainty (MU)
   1. Review from GLT
   2. Current firearm MU budgets
   3. Documenting and reporting guidelines
   4. Participate in MU budgets

E. Study of 3D microscopy
   1. AFTE 2019 Conference DVD
   2. Emerging technologies

F. Become knowledgeable on the instruction manuals and the mechanical and optical aspects of the comparison microscope. The purpose of this is to acquaint the trainee with the comparison microscope and is not designed for comparative examinations.

G. Other types of Equipment:
Become familiar with and be able to use the following equipment:
   1. Micrometer
   2. Inertia bullet puller
   3. Ruler/tape measure
   4. Balances and scales
   5. Stage micrometer
   6. Digital (electronic) micrometer
   7. Digital caliper
   8. Video camera or digital camera and related computer software
   9. Trigger pull measuring devices – NRA dead weights, spring gauge, digital force gauge

2.2 Required Readings and Presentations
A. GLT Advanced Topics: Measurement Uncertainty
B. FTM-03-18 – Microscopic Comparison
C. Leeds Forensic Systems, Instructions for the LCF Firearms Comparison System.
2.3 Suggested Readings

A. General


B. Periodicals


C. Basic References


3 Practice

3.1 Safety

Standard laboratory precautions; use universal precautions

3.2 Standards, Controls, Reagent Preparation

The trainee will use appropriate NIST traceable standards, as applicable, in conducting performance verifications/checks as stated in the Standard Operating Procedures.

3.3 Equipment

- Stereo Microscope
- Comparison Microscope
- Micrometer
- Calipers
- Balance
- Scales
3.4 Observed Performance
The trainee will observe the trainer using the equipment prior to assessment.

3.5 Supervised Performance
The trainee will demonstrate knowledge of how to use each piece of equipment to the trainer.

3.6 Independent Exercises
A. Microscopy
   1. Differentiate between the following. Note the differences and similarities in each, both mechanically and optically.
      a. Compound microscope
      b. Stereo microscope
      c. Comparison microscope
   2. Set up a comparison microscope for your vision requirements and focus the “hairline”. Familiarize yourself with each set of objective lenses on your comparison microscope.
   3. Become familiar with the following types of light sources, which are in use on the comparison microscopes.
      a. Fluorescent
      b. Fiber optics (with and without filters)
      c. How to use various light diffusers
   4. Using each type of light source in the field of view on a comparison microscope, note the differences in the quality of each using the following different surfaces:
      a. lead bullets,
      b. jacketed bullets,
      c. various types of cartridge cases, and
      d. various types of surfaces containing impressed and striated toolmarks
      Manipulate the above light source, if possible. Gain an appreciation for the effects of varying the angle and intensity for each light source on each type of surface.
   5. Define and note the differences:
      a. Validation
      b. Performance verification
c. Performance check

d. Calibration

6. Learn how to conduct performance checks on the appropriate equipment.

B. Measurement Uncertainty

1. Review measurement uncertainty from the General Laboratory Training Manual.

2. Discuss current firearm measurement uncertainty budgets, documentation, and reporting guidelines

3. Participate in measurement uncertainty budgets for length and trigger pull.

C. Study of 3D microscopy

1. Read related article(s) and view AFTE 2019 Conference DVD.

2. Write a short summary of the emerging technologies.

4 Assessment

A. The completed assignments and exercises are considered to be the completion of this module.

B. The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
FTM-TM-02-03 EXAMINATION OF FIREARMS

Duration Two weeks

Purpose The trainee will become familiar with the basic operation of firearms, firearms parts, firearms range and safety rules, firearms safety mechanisms, and safety hazards.

Prerequisite FTM-TM-01-02, FTM-TM-01-03, FTM-TM-02-02

1 Objectives

1.1 Theoretical

The trainee will learn how to conduct an examination of a firearm for proper function from the perspective of physical evidence and forensic science. This mandates an approach which always considers safety first, transient forms of trace and associative evidence, and the technical protocols for examining the firearm itself. The trainee will also learn how to properly document the examination by recording the collection of the data and observations. The trainee will become familiar with numerous types of firearms, firearm operating systems, firearm components, proper and safe handling of firearms, how to safely load and unload firearms, and how to collect data using some of the equipment discussed in FTM-TM-02-02.

1.2 Practical

Following the completion of this module the trainee will have an understanding of:

   A. Assembly/disassembly of general types of firearms
   B. Firearms safeties and their function
   C. Different operating systems of firearms
   D. Major component parts of firearms
   E. Range and safety rules
   F. How to safely load and unload firearms
   G. Trigger pull determination
   H. Barrel and overall length determination

2 Training Outline

2.1 Lesson Plan

   A. Firearm Safe Handling
      1. Basic safety rules and guidelines
      2. Secure storage
      3. Preliminary exams
      4. Safety checks
      5. Black powder safety
      6. Test firing safety
      7. The use of PPE
      8. Bullet recovery methods
      9. General range rules
B. Definitions - Types of firearm operation and cycle of fire
  1. Revolvers – single and double action
  2. Pistols – single shot and semi-automatic (single and double action)
  3. Rifles and Shotguns – bolt action, automatic loading, pump action, single shot
  4. Submachine gun
  5. “Assault” rifles

C. Definitions - Auto loading firearms
  1. Gas and Recoil operated rifle and shotgun
  2. Pistols
     a. Blowback
     b. Delayed blowback
     c. Gas operated
     d. Short recoil action
     e. Long recoil action

D. General - Revolvers
  1. Single action, double action, single and double action
  2. Major parts and differences

E. General - Pistols
  1. Walther and Browning
  2. Types of pistols
     a. Toggle cocking
     b. Rear cocking type
     c. Single/Double action recoil operated
     d. Single action gas operated
  3. Hammer fired versus striker fired pistols

F. Become familiar with and handle 25 automatic pistols
  1. Raven Arms
  2. Colt Jr
  3. Beretta
  4. Bauer

G. Become familiar with and handle 22 caliber firearms
  1. Browning automatic loading rifle
  2. Winchester rifle model 62
  3. Remington rifle model 582
  4. Ruger rifle model 10/22
5. Ruger pistol, model Mark II (or III or IV)
6. Colt model Woodsman
7. Raven, Lorcin, Jennings pistols

H. Become familiar with and handle rifles and shotguns
   1. Bolt action
   2. Lever action
   3. Pump action
   4. Automatic loading
   5. Break open

I. Firing range
   1. Firing range construction
   2. Range safety rules
   3. Proper test firing and alternate methods of test firing
   4. Safe handling, making safe, and transporting firearms to/from the range

J. Safety mechanisms
   1. Recognize safeties
   2. How safeties function
   3. Malfunctioning safeties
   4. Types of safeties

K. Measuring trigger pull

L. Measuring barrel and overall length

M. Terminology relating to safe operation of a firearm

N. Misfires, including causes and actions to take

O. Trace collection

P. Fully automatic firearms

Q. Restoring firearms to function

2.2 Required Readings

DPS Firearms and Toolmarks SOP
A. FTM-01-05 – Worksheets
B. FTM-01-06 – Standard Abbreviations and Definitions
C. FTM-01-07 – Item Counting Guidelines
D. FTM-01-08 – Measurement Uncertainty Estimate
E. FTM-02-01 – Physical Evidence Examination
F. FTM-03-01 – Firearm Safety
G. FTM-03-02 – Trigger Pull Examination
H. FTM-03-03 – Barrel and Overall Firearm Length
I. FTM-03-04 – Rusty Firearm Examination
J. FTM-03-05 – Malfunctioning Firearm Examination
K. FTM-03-06 – Bore Chamber Casting
L. FTM-03-08 – Recovery Methods
M. FTM-03-09 – Remote Firing
N. FTM-03-10 – Downloading
O. FTM-03-11 – Primed Cartridge Case/Shotshell
P. FTM-03-19 – Trace Material Examination

2.3 Suggested Readings
M. Manufacturers’ information

3 Practice

3.1 Safety

A. Standard laboratory precautions
B. Range Safety Rules
C. Firearm Safety
3.2 Standards, Controls, Reagent Preparation

None

3.3 Equipment

- Firearms Reference Collection
- Ammunition Reference Collection

3.4 Observed Performance

A. The trainee will observe the handling, disassembly, assembly, and test firing of firearms by the trainer, mentor, and/or Firearms Section personnel.

B. Review the following topics with the trainer:
   1. Basic safety rules and guidelines for handling firearms
   2. Secure storage of firearms
   3. General preliminary examination procedures
   4. Safety checks for all firearms
   5. Black powder firearm safety and propellants
   6. Test firing protocols and safety
   7. Eye and ear protection, use of respirators
   8. Bullet recovery methods
   9. General range rules

C. Explain and illustrate the differences between a gas-operated and a recoil-operated auto loading rifle / shotgun.

D. Explain and illustrate the differences between the following types of auto loading pistols:
   1. Blowback action
   2. Delayed blowback action
   3. Gas-operated action
   4. Short recoil action
   5. Long recoil action
   6. Be able to describe the differences in their mechanisms and identify each part by name.
      a. Toggle cocking type, single action (example Luger P08 Semiautomatic pistol)
      b. Rear cocking type, single action (examples Nambu/Arisaka Type 14 Semiautomatic pistol or Ruger Mark I, II, III, or IV)
      c. Single/Double action, recoil operated (example Smith & Wesson Series 5900 Semiautomatic pistol)
      d. Single action, gas operated (example Desert Eagle Semiautomatic pistol)

E. Discuss the causes of misfires, including faulty ammunition, light strikes, and defects on the bolt or breech face. Discuss and demonstrate the action to be taken should a misfire occur.
F. Discuss the collection and evidentiary potential of foreign deposits or trace material on evidence firearms. Include the following types:

1. Blood
2. Bone
3. Soft tissue
4. Glass
5. Bore residues
6. Cylinder halos
7. Hair
8. Fiber
9. Fingerprints
10. Paint

G. Review various firearm reference files, databases, and print media.

H. Discuss the techniques to determine if a firearm has been altered to fire fully automatic mode.

I. Discuss the normal forensic laboratory capabilities for restoring an inoperable firearm to operating condition. Consider the limited overlap of the role of the firearms examiner with the role of a true gunsmith.

3.5 Supervised Performance

The trainer observes the performance of the trainee for the partial disassemble (field strip) and reassemble of various types of firearms from the Firearms Reference Collection (FRC).

A. Demonstrate how to place firearms in a safe condition
B. Demonstrate how to load and unload each
C. Demonstrate how to handle and carry these firearms in the laboratory
D. Demonstrate how to safely test fire each of these different types of firearms.

3.6 Independent Exercises

A. Define each of the following types of firearms and explain in detail the operation of each type to include the loading of cartridges and the subsequent movement of the cartridge case and/or bullet after firing. Be able to understand and explain the cycle of fire for each general type of firearm listed below.

1. Revolver, single and double action
2. Auto loading pistol, single and double action
3. Derringer and single shot pistols
4. Bolt-action rifle and shotgun
5. Auto loading rifle and shotgun
6. Pump-action rifle and shotgun
7. Various single shot rifles and shotguns
B. Identify the major parts and make appropriate notes for six different revolvers - single-action only (2), double-action only (2) and single/double action (2).
   1. Obtain a copy of an exploded drawing of each of the revolvers.
   2. Ensure that the drawing identifies all of the parts of the firearm.
   3. Be able to describe the differences in their mechanisms and identify each part by name.

C. Identify the major parts and make appropriate notes for the four different Browning and Walther pistols.
   1. Obtain a copy of an exploded drawing of each of the pistols.
   2. Ensure that the drawing identifies all of the parts of the firearm.
   3. Learn the names of the major components and how they interact.
   4. Be able to describe the differences in their mechanisms and identify each part by name.
   5. Understand the evolution of firearm development between the Browning and Walther designed firearms.

D. Identify the major parts and make appropriate notes for the following types of pistols.
   1. Obtain a copy of an exploded drawing of each of the pistols (other pistols may be substituted based upon availability and the trainer's discretion).
   2. Ensure that the drawing identifies all of the parts of the firearm.

E. Identify the major parts and make appropriate notes for the following pistols (other pistols may be substituted based upon availability and the trainer's discretion).
   1. Obtain a copy of an exploded drawing of each of the pistols listed below.
   2. Ensure that the drawing identifies all of the parts of the firearm.
   3. Be able to describe the differences in their mechanisms and identify each part by name.
      a. *Glock, Model 17 or 19 Semiautomatic pistol*
      b. *SIG-Sauer, Model P226, Semiautomatic pistol*

F. Identify the major parts and make appropriate notes for the following 25 Auto firearms (other pistols may be substituted based upon availability and the trainer's discretion).
   1. Obtain a copy of an exploded drawing of each of the pistols listed below.
   2. Ensure that the drawing identifies all of the parts of the firearm.
   3. Be able to describe the differences in their mechanisms and identify each part by name.
      a. *25 Auto caliber Raven Arms pistol*
      b. *25 Auto caliber Colt Jr. pistol*
      c. *25 Auto caliber Beretta pistol*
      d. *25 Auto caliber Bauer pistol*
G. Identify the major parts and make appropriate notes for the following 22 caliber firearms (other firearms may be substituted based upon availability and the trainer’s discretion). Identify the major parts and make appropriate notes.
   1. Obtain a copy of an exploded drawing of each of the firearms listed below.
   2. Ensure that the drawing identifies all of the parts of the firearm.
   3. Be able to describe the differences in their mechanisms and identify each part by name.
      a. 22 caliber Browning auto loading rifle
      b. 22 caliber Winchester rifle, Model 62
      c. 22 caliber Remington rifle, Model 582
      d. 22 caliber Ruger rifle, Model 10/22
      e. 22 caliber Ruger pistol, Mk II
      f. 22 caliber Colt pistol, Woodsman
      g. 22 caliber Raven, Lorcin, Jennings pistols

H. Identify the major parts and make appropriate notes for the rifles below.
   1. Bolt action rifle (example Remington model 700)
   2. Lever action rifle (example Winchester model 94)
   3. Pump action rifle (example Remington model 572)
   4. Autoloading rifle (examples Ruger 10/22, Colt AR-15, Garand M-1)
   5. Break open rifle (examples H&R Handi-Rifle, CVA firearms)

I. Identify the major parts and make appropriate notes for the following shotguns.
   1. Bolt action shotgun (examples Mossberg 185-K, Savage 220 Slug Gun)
   2. Lever action shotgun (examples Century Arms PW87, Chiappa 1887)
   3. Pump action shotgun (examples Remington 870, Mossberg 550)
   4. Autoloading shotgun (examples Remington 1100, Benelli M4, Browning A5)
   5. Break open shotgun (examples H&R Topper, Browning Citori 725)

J. Firing Range
   1. Become familiar with the firearms range including its physical dimensions, construction of walls and backstop, and bullet velocity limitations.
   2. Become familiar with the range safety rules regarding firearms.
   3. Understand how to test fire firearms thought to be possibly unsafe (remote firing device).
   4. Become familiar with the use of all the equipment on the range.
   5. Understand the range rules and emergency medical treatment procedures.
   6. Demonstrate how to place firearms in a safe condition, how to load and unload each, how to handle and carry these firearms in the laboratory, and how to safely test fire each of these different types of firearms.
K. Understand the various safety mechanisms employed in each common design of each type of firearm.

1. Understand how to recognize which safeties are present on a given firearm.

2. Understand how the firing mechanisms are blocked, interrupted, or otherwise stopped from operating by these safeties.

3. Understand how to recognize when one of these safeties is malfunctioning and whether or not that malfunction may cause an accidental discharge.

4. Example safety mechanisms are listed below:

   a. Manual Safeties – These safeties have an “on” and “off” position that is set by the individual handling the firearm. These include cross bolt, lever safety, tang safety, sliding button safety, thumb safety, wing safety, slide lock safety, etc. These safeties work in a variety of ways and may function in a similar method to the other safeties listed below. It may be necessary to determine how a particular manual safety operates in order to properly determine any malfunctions. Examples include:

      i. Some block or disconnect trigger when engaged

      ii. Some function as a de-cocker which de-cocks the hammer and blocks it from striking the firing pin assembly or moves the firing pin assembly away from the reach of the hammer

      iii. Some lock the slide closed and block the trigger

      iv. Some block the movement of the sear

   b. Push-Off (Full Cock) – This is a safety test which involves pushing on the hammer to determine if it is possible to cause the sear to disengage from the notch in the hammer which holds it in a cocked position, thereby allowing the hammer to fall forward. It is important to note that other safety mechanisms present on the firearm may prevent accidental discharge in this manner despite a push-off incident. If a firearm is suspected of being capable of discharging due to push-off, confirmation should be sought using primed cartridge cases.

   c. Jar-Off (Full Cock) – This is a safety test which involves striking the backstrap or back of a firearm with a rubber mallet to determine if it is possible to cause the sear to disengage from the notch in the hammer which holds it in a cocked position, thereby allowing the hammer to fall forward. It is important to note that other safety mechanisms present on the firearm may prevent accidental discharge in this manner despite a jar-off incident. If a firearm is suspected of being capable of discharging due to jar-off, confirmation should be sought using primed cartridge cases.

   d. Half and/or Quarter Cock – These hold a hammer nose from primer or a hammer from firing pin assembly. They may function to catch the hammer and prohibit the firearm from firing if the trigger is not held rearward during the firing process. Also consider Jar-Off and Push-Off (as above for Full Cock) at each of these positions.

   e. Disconnector – This prohibits a firearm from firing when slide is out of battery or in a fully automatic mode.

   f. Magazine Safety – This prohibits the firearm from firing when the magazine is not inserted into the magazine well to a certain point. The trainee may wish to
determine at what that point is and document it: full insertion, half insertion, and partial insertion.

g. **Transfer Bar** – This prohibits the firearm from firing unless the trigger is held rearward during the firing process. This is accomplished by interposing a physical object between the hammer and the striker or firing pin assembly to allow transfer of kinetic energy from the former to the latter. Alternatively, it can be considered as not allowing the hammer to transfer its energy to the striker or firing pin assembly unless the trigger is held rearward during the firing process.

h. **Hammer Block** – This prohibits the firearm from firing unless the trigger is held rearward during the firing process by blocking a hammer nose from striking the primer or the hammer from striking the firing pin assembly. This is accomplished by means of interposing a physical object to impede the forward motion of the hammer unless the trigger is held rearward during the firing process.

i. **Rebound Safety** – This causes the trigger to return to its normal position and rebounds the hammer away from firing pin assembly or hammer nose from primer.

j. **Firing Pin Block** – This prohibits the forward movement of the firing pin through the firing pin aperture unless the trigger is held rearward during the firing process.

k. **Grip Safety** – This prohibits firearm from firing unless the safety mechanism (typically located on the backstrap of the firearm) is depressed. It may also block rearward movement of the trigger.

l. **Trigger Safety** – this prohibits the rearward movement of the trigger unless a lever on the forward part of the trigger is depressed or unless the lower portion of a hinged trigger is in alignment with the upper portion of the trigger in order to pivot the trigger blocking mechanism away from the frame of the pistol.

m. **Automatic Safety** – This type of safety returns the firearm to “Safe” when the action of the firearm is opened.

n. **Key-Operated / Keyed Safety** – This is a manual safety that requires a separate key and prohibits some internal mechanism from operating (such as blocking the sear, blocking the trigger, locking the hammer, etc.) when used to lock the firearm in the safe configuration.

o. **Loaded Chamber Indicator** - While not technically a safety, this mechanism is a visible or physical projection that indicates whether or not there is a cartridge or cartridge case in the chamber of the barrel.

p. **Cocking Indicator** – While not technically a safety, this mechanism is a visible or physical projection that indicates whether or not the striker or firing pin assembly is cocked.

q. Other proprietary safeties may also be encountered; this list is for example purposes only and should be considered neither mandatory nor comprehensive.

L. Determine the trigger pull on at least one firearm from each type of firearm.

M. Determine the barrel and overall length on at least one firearm from each type of firearm.

N. Identify the implications of the following terms as they relate to safety in the operation of a firearm.

1. Excessive headspace

2. Bore obstruction
3. Barrel bulge
4. Broken extractor
5. Push off
6. Trigger shoe
7. False half cock
8. Slam fire
9. Inadequate/improper sear engagement
10. Defective safety
11. High primer
12. Improper/defective ammunition
13. Overloads
14. Hang fire/delayed firing
15. Broken/defective sear tip and sear notch
16. Rail splitting
17. Hairline cracks
18. Improper timing
19. Excessive pressure
20. Dented barrel
21. Jar off

4 Assessment

4.1 Competency and Qualifying Examination

A. The trainee will demonstrate competency for each type of firearm provided by the trainer. The trainee will:
   1. Give a basic description of each firearm
   2. Name the basic parts of each firearm
   3. Check the loaded condition of each firearm
   4. List and check the safeties of each firearm
   5. Load and unload each firearm using snap caps or ‘dummy rounds’

B. A written competency exam will be given to assess terminology and concepts.

4.2 Evaluation of Training

The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
FTM-TM-02-04  EXAMINATION OF CARTRIDGE CASES

Duration  One month

Purpose  Familiarize the trainee with basic cartridge case examination

Prerequisite  FTM-TM-01-02; FTM-TM-02-02, FTM-02-03

1  Objectives

1.1  Theoretical

The trainee will learn the principles of cartridge case identification. There will be a focus on learning class characteristics, identifying individual characteristic patterns, as well as understanding how to evaluate specimens for subclass characteristics. The trainee will be able to differentiate between markings imparted by firearms on cartridge cases and learn how to apply the principles of the AFTE Theory of Identification to arrive at opinions using the range of conclusions.

1.2  Practical

Following the completion of this module the trainee will have an understanding of:

A. Determination of manufacture and caliber
B. Reloading of ammunition
C. Determination of class, subclass, and individual characteristics
D. Nomenclature
E. Firing and recovery of tests
F. Selection of test ammunition, downloading, and shooting primed cases
G. Cartridge case comparison
H. Use of available reference material

2  Training Outline

2.1  Lesson Plan

A. Demonstrate knowledge of terminology specific to cartridge case examinations
B. Demonstrate knowledge of cartridge case comparisons:
   1. Use of Cartridge Case Worksheet (LAB-FTM-03)
   2. Ammunition storage areas
C. Gain experience comparing cartridge cases for marks imparted by firearms
   1. Cycle marks versus fired marks
   2. Different primer and case body metals
   3. Differences between 22 Shot, 22 Long and 22 Long Rifle cartridge cases
   4. Reloading marks
   5. Class characteristics of similar firearms
   6. Fluted chambers
   7. Gas-operated military style rifles
8. Cartridge case manufacturing marks
9. Cartridge cases fired in dirty firearms versus clean firearms

D. Demonstrate knowledge of subclass characteristics through attendance of a Subclass Characteristics workshop

2.2 Required Readings

A. DPS Firearms and Toolmarks SOP
   1. FTM-01-04 – Reporting Guidelines
   2. FTM-03-17 – Physical Examination and Classification of Fired Evidence


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

2.3 Suggested Readings

A. General

B. Firing Pin Impressions


C. Anvil Marks


D. Manufacturing Marks


E. Breech Face Marks


F. Chamber Marks


G. Bunter Marks


H. Reloading Marks


3 Practice

3.1 Safety

A. Firearms Safety
B. Range Safety Rules
C. Standard Laboratory Precautions

3.2 Standards, Controls, Reagent Preparation

None

3.3 Equipment

- Ammunition Reference Collection
- Comparison Microscope
- Cotton/Kevlar Box
- Firearms Reference Collection
- Water Tank
3.4 **Observed Performance**

A. The trainee will observe the trainer conduct microscopic cartridge case examinations.

B. Discuss with the trainer the feasibility of comparing and identifying manufacturing marks on a fired cartridge case from a scene to cartridges associated to a suspect. Identify various types of manufacturing toolmarks, including bunter marks, which may be present on cartridges or cartridge cases and which may constitute subclass characteristics.

C. Discuss the possibility of comparing and identifying reloading-type marks on cartridges/cartridge cases. Identify the various types of marks that may be indicative of reloaded ammunition. Become familiar with the reloading equipment in the section or attend reloading training if reloading equipment is not available in the section. Become familiar with the procedures used in reloading cartridges. Reload several cartridges and compare reloading-type marks on these cartridges with each other.

3.5 **Supervised Performance**

The trainer will observe the trainee performing microscopic cartridge case comparisons to include the identification of various toolmarks present on cartridge cases and associate them with the tool surface that created them.

3.6 **Independent Exercises**

A. **Cartridge Case Terminology**

   1. Define the following terms in relation to a cartridge/cartridge case. Differentiate between loading, cycling, and firing marks:
      
      a. Class characteristics
      b. Caliber
      c. Breechface marks
      d. Chamber marks
      e. Firing pin impression
      f. Extractor marks
      g. Ejector marks
      h. Ejection port marks
      i. Feed ramp marks
      j. Magazine lip marks

B. Compare the known cartridge cases in the assignments below using the following guidelines.

   1. The Cartridge Case Worksheet form should be filled out completely.
   2. List the identifying number of each set of known tests
   3. For the FPI, indicate the class characteristics and location of individual pattern marks observed
   4. For the primer, list in each category as per the assignment sheet.
   5. For each area examined, indicate whether there is enough data to use for identification (based on that area).
C. Access the FTM SOP and become familiar with FTM-03-17 regarding the examination of cartridges and cartridge cases.

D. Assignments

1. Test fire each of the following firearms at least three times (other firearms may be substituted based upon availability and the trainer's discretion). 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.
   a. 9mm SWD, M11/Nine pistol
   b. 9mm Glock pistol
   c. 45 Auto, Colt pistol, Model 1911 pistol
   d. 22 LR, Ruger, MKII, pistol
   e. 22 LR, Ruger, 10/22, rifle

2. Using the above firearms, load and extract at least three cartridges and visually compare the fired cartridge cases to the cycled cartridges. Microscopically examine all of the markings with each other.

3. Using the test fired cartridge cases and cycled cartridges from above, microscopically compare all of the markings with each other. Include the following types of markings:
   a. Firing pin impression
   b. Breechface marks
   c. Chamber marks
   d. Anvil marks
   e. Extractor marks
   f. Ramp marks
   g. Slide drag marks
   h. Slide scuff marks
   i. Ejection port scuff marks
   j. Magazine lip marks

4. 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 three times using each brand of ammunition (other firearms and ammunition may be substituted based upon availability and the trainer's discretion). Microscopically examine all of the markings with each other, including the types of marks outlined above. Using the Cartridge Case Worksheet, record observations, take photos, and indicate the criteria used for making conclusions (identification, elimination, inconclusive) and if any subclass characteristics were present.
   a. 38 Special, Smith & Wesson, Model 10, revolver
   b. 357 Magnum, Smith & Wesson, Model 19, revolver
   c. 9mm Luger, Smith & Wesson, Model 669, pistol
   d. 22 Long Rifle, Colt, Woodsman, pistol
5. Test fire a 22 Long Rifle caliber Smith and Wesson revolver. Fire six 22 Long Rifle cartridges, six 22 Long caliber cartridges, and six 22 Short caliber cartridges of the same manufacturer (other firearms and ammunition may be substituted based upon availability and the trainer’s discretion). Mark each cartridge to note the chamber in which it is fired. Examine the markings imparted to the fired cartridge cases, including firing pin impression, breechface marks, chamber marks, and anvil marks. Using the Cartridge Case Worksheet, record observations, take photos, and indicate the criteria used for making conclusions (identification, elimination, inconclusive) and if any subclass characteristics were present.

6. Using test fired cartridge cases from 9 mm Luger Glock, Smith & Wesson Sigma series, and Springfield model XDS pistols, visually relate the markings to the component on the firearm producing them. Inter-compare all of the marks on the respective pairs to determine if they can be identified with each other. Pay particular attention to the firing pin impressions and surrounding areas, observing their size, shape, and the flat primer sheared area adjacent to it. Using the Cartridge Case Worksheet, record observations, take photos, and indicate the criteria used for making conclusions (identification, elimination, inconclusive) and if any subclass characteristics were present.

7. Complete the same assignment above comparing Glock Gen 5 pistols and Smith & Wesson M&P series pistols (if firearms are available).

8. Examine test fired cartridge cases that were fired in fluted chambers. Examples of firearms include H&K rifles, models MP5, 53, 91, 93 and 94 and some CETME rifles. Note the value of fluted chambers on the form of class, subclass and individual characteristics. Inter-compare them to objectively determine if they can be identified to each other. Using the Cartridge Case Worksheet, record observations, take photos, and indicate the criteria used for making conclusions (identification, elimination, inconclusive) and if any subclass characteristics were present.

9. Examine test fired cartridge cases from an AK-47, an SKS and an M16A1. Inter-compare them to objectively determine if they can be identified to each other. Be especially aware of the possibility of identifiable marks from the ejection port of the AK-47. Using the Cartridge Case Worksheet, record observations, take photos, and indicate the criteria used for making conclusions (identification, elimination, inconclusive) and if any subclass characteristics were present.

10. Obtain test firings from the following types of firearms and then thoroughly clean the breech and bore areas of each firearm. Test fire these firearms again and compare the cartridge cases.

   a. Semiautomatic centerfire pistol
   b. Semiautomatic rimfire pistol
   c. Centerfire revolver
   d. Rimfire revolver

   E. If possible, attend a subclass determination workshop.
4 Assessment

4.1 Competency and Qualifying Examination

A. The trainee will demonstrate competency by successful completion of at least 5 cartridge case comparisons. Previously analyzed proficiency tests can be used for this purpose. The competency examination will include documentation that simulates casework (worksheets, report, etc.).

B. Successful completion of a written competency exam over terminology and concepts is required.

4.2 Evaluation of Training

The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
FTM-TM-02-05  EXAMINATION OF SHOTSHELLS

Duration  One week
Purpose  Familiarize the trainee with the basic understanding of shotshell examination
Prerequisite  FTM-TM-01-02, FTM-TM-02-02, FTM-02-03, FTM-02-04

1  Objectives
1.1  Theoretical

This module is a continuation of the Examination of Cartridge Cases module (FTM-TM-02-04), with an emphasis on the examination of the shotshell cartridge case. The trainee will learn how to determine the source of marks on the shotshell and how to apply the principles of the AFTE Theory of Identification to arrive at opinions using the range of conclusions.

Following the completion of this module the trainee will have an understanding of the different components of shotshell ammunition and fired versus unfired shotshell components.

1.2  Practical

Following the completion of this module the trainee will have an understanding of:

A. Shotguns and shotgun ammunition
B. Shotshell components
C. Terminology
D. Shotshell comparison
E. Determination of shot size and bore sizes

2  Training Outline
2.1  Lesson Plan

A. Demonstrate knowledge of terminology specific to shotshell examinations
B. Demonstrate knowledge of shotshell comparisons:
   1. Use of the Projectile Worksheet (LAB-FTM-02) and Cartridge Case Worksheet (LAB-FTM-03)
   2. Ammunition storage areas
C. Gain experience comparing shotshells for marks imparted by firearms
   1. Cycle marks versus fired marks
   2. Different primer and case body metals
   3. Differences between the various shotshell gauges
   4. Reloading marks
   5. Class characteristics of similar firearms
   6. Shotshell manufacturing marks
D. Become familiar with the use of the Ammunition Reference Collection in regards to the determination of gauge and manufacturer of fired shotshell components. Know the limitations in regards to making such determinations.
E. Learn the significance of the Rule of 17 as it applies to shot size.
2.2 Required Readings


B. DPS Firearms and Toolmarks SOP
1. FTM-03-15 – Wadding Determination
2. FTM-03-16 – Shot Determination
3. FTM-03-17 – Physical Examination and Classification of Fired Evidence.

2.3 Suggested Readings

A. Basic References
2. Davis, J. E. *An Introduction to Tool Marks, Firearms and the Striagraph*. Charles C. Thomas; 1958

B. Shotshells


C. General


D. Headstamps


E. Shot Buffer Material


F. Shot Pellets


G. Shotshell Slugs


H. Shotshell Wadding

I. Firing Pin Impressions


J. Manufacturing Marks


K. Breech Face Marks


L. Chamber Marks


M. Bunter Marks


3 Practice

3.1 Safety

A. Standard Laboratory Precautions

B. Firearm Safety

C. Range Safety Rules

3.2 Standards, Controls, Reagent Preparation

None

3.3 Equipment

- Ammunition Reference Collection
- Comparison Microscope
- Electronic Scale
- Firearms Reference Collection
- Firearms Range
- Micrometer/Caliper

3.4 Observed Performance

A. The trainee will observe the trainer conduct microscopic shotshell examinations.

B. Discuss in detail the procedures used in reloading shotshells and become familiar with the shotshell reloading equipment in the Firearm Section.

1. Understand how to recognize reloaded shotshells from an examination of the shotshell casing and/or its components.

2. Reload shotshells using the shotshell reloading equipment in the section or attend reloading training if reloading equipment is not available in the section.

3. Become familiar with and examine the reloaded shotshells for reloading-type marks.
3.5 Supervised Performance

The trainer will observe the trainee performing microscopic comparisons to include the identification of various marks imparted by shotguns and associate them with the tool (part) surface that created them.

3.6 Independent Exercises

A. Determine what type of examinations may be conducted and what conclusions can be reached from an examination of the following components. Prepare a written report of observed findings and obtain examples of each.

1. Shot, deformed and un-deformed
2. Fired card or fiber wads
3. Fired plastic wads
4. Fired shotshells (fired cases)
5. Unfired shotshells (shotshell cartridges)
6. Shot buffer material
7. Shot collar and shot cup

B. Research the current U.S. shot sizes and weights and obtain a chart reflecting the data. Become familiar with the variations in shot size and composition. Be aware of the differences in US sizes versus worldwide.

C. Test fire a shotgun with a sawed-off barrel from the Firearms Reference Collection (or obtain a shotgun and saw off a portion of the barrel) using a Remington shotshell with a power piston wad (other ammunition may be substituted based upon availability and the trainer’s discretion). Recover the test shotshell wads and make microscopic comparisons of marks imparted to the test wads.

D. Test fire the shotgun types listed below using at least three test shotshells from each shotgun and microscopically compare the marks imparted to these shotshell cases (other shotguns may be substituted based upon availability and the trainer’s discretion). Include in the 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. Photograph these marks and discuss the significance of identifying any of these types of marks.

1. Bolt action shotgun (example Marlin, Model 55)
2. Semiautomatic shotgun (example Remington, Model 1100)
3. Pump action shotgun (example Mossberg, Model 500)
4. Single shot, top break shotgun (example J.C. Higgins, Model 1011)
5. Double barrel, over and under shotgun (example Beretta, Silver Snipe)
6. Double barrel, side by side shotgun (example Stevens, Model 311)

E. Using a 12 gauge shotgun (example - Remington, Model 1100, shotgun, or other similar shotgun from the Firearms Reference Collection), obtain at least three test shotshell cases with various types of ammunition (suggested types are listed below or other ammunition may be substituted based upon availability and the trainer’s discretion). Recover a representative number of the fired pellets and fired wadding from each test firing, if possible. Compare markings on these test shotshell cases with each other. Examine the...
fired components that are recovered and compare them to unfired components of the same type. In a report, discuss the significance of the findings. Suggested types of ammunition:

1. Remington, Magnum, 00 Buck
2. Remington, Shur-Shot, 8 shot
3. Federal, Magnum, 00 Buck
4. Federal, Field Load, 9 shot
5. Activ, Field Load, 7 shot
6. Activ, Magnum, BB shot
7. Winchester, Xpert, 6 shot
8. Winchester, Super-X, 7 shot

F. Examine eight sets of shot pellets using case worksheets. Determine the possible pellet sizes for each set. If possible, also determine the shot shell load (gauge).

G. Examine a set of ten shot wads. Determine the type, gauge and, if possible, the manufacturer, brand and/or shot load of each wad.

4 Assessment

4.1 Competency and Qualifying Examination

A. Competency

1. The trainee will demonstrate competency by successfully completing at least two shotshell comparison exams supplied by the trainer. These competency exams will include documentation that simulates casework (worksheets, report, etc.).

2. The trainee will demonstrate competency by examining four sets of shot pellets to determine pellet sizes and possible loads. These competency exams will include documentation that simulates casework (worksheets, report, etc.).

B. Written Examination

At the completion of the module, a written exam will be given to test terminology and concepts used in the examination of shotshell components.

4.2 Evaluation of Training

The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
FTM-TM-02-06  EXAMINATION OF BULLETS

Duration          One month
Purpose           Familiarize the trainee with basic projectile/bullet examination
Prerequisite      FTM-TM-01-02, FTM-TM-02-02, FTM-TM-02-03

1 Objectives

1.1 Theoretical

The trainee will learn the principles of bullet/projectile identification. There will be a focus on learning class characteristics, identifying individual characteristic patterns, as well as understanding how to evaluate specimens for subclass characteristics. The trainee will be able to differentiate between markings imparted by firearms on bullets and learn how to apply the principles of the AFTE Theory of Identification to arrive at opinions using the range of conclusions.

1.2 Practical

Following the completion of this module the trainee will have an understanding of:

A. Terminology
B. Determination of manufacture and caliber
C. Determination of class, subclass, and individual characteristics
D. Use of General Rifling Characteristics
E. Firing and recovery of tests
F. Selection of test ammunition
G. Bullet comparison
H. Use of available reference material

2 Training Outline

2.1 Lesson Plan

A. Demonstrate knowledge of bullet terminology
B. Understand how various physical characteristics relate to the examination of bullets
C. Understand how to use various characteristic databases
D. Demonstrate knowledge of how to determine caliber, firearm type, and potential firearm list using databases
E. Demonstrate general knowledge of bullet comparisons:
   1. Use of Projectile Worksheet (LAB-FTM-02)
   2. Determining the difference between lead bullets and lead bullet cores
   3. Polygonally rifled firearms
   4. Bullet recovery from various bullet capture devices
   5. Ammunition storage

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F. Demonstrate specific knowledge of bullet comparisons as they relate to various construction materials:
   1. Diameter differences between fired and unfired bullets
   2. 22 caliber bullets
   3. 38 caliber bullets
   4. 9mm Luger bullets
   5. 30 caliber rifle bullets
   6. 32 S&W versus 32 Auto
   7. Bullet hole in metal

G. Gain experience comparing “known match” to “known non-match” bullets.

H. Gain experience comparing bullets fired from consecutively manufactured barrels

I. Gain experience comparing mutilated bullets to pristine fired bullets from the same firearm

J. Bullet Comparison Resources/Databases
   1. Become familiar with the Ammunition Reference File (Standard Ammunition File). Understand how to search this file in order to determine the manufacturer of fired bullets. Discuss any problems encountered when using this file.
   2. Become familiar with the Test Reference File
   3. Become familiar with various General Rifling Characteristics (GRC) files/databases. Understand how to use this file to compile a list of firearms in a no-gun case.

K. General Bullet Comparison
   1. Become knowledgeable about the facilities in the section for the recovery of fired test bullets. Understand when and how to use the horizontal recovery tank, Kevlar boxes, and cotton boxes, and their limitations. Understand and observe all safety rules.

L. Understand the feasibility of determining caliber and/or the rifling characteristics of a fired bullet from an examination of a bullet hole in metal.

2.2 Required readings


2.3 Suggested Readings

A. General

2. Davis, J. E. *An Introduction to Tool Marks, Firearms and the Striagraph*. Charles C. Thomas; 1958

B. General Rifling Characteristics


C. Comparison Techniques


D. Automated Systems


E. Manufacturing Marks


### 3 Practice

#### 3.1 Safety

A. Standard laboratory precautions  

B. Firearm Safety  

C. Range Safety Rules  

#### 3.2 Standards, Controls, Reagent Preparation

None
3.3 **Equipment**
- Ammunition Reference Collection
- Caliper/Micrometer
- Comparison Microscope
- Cotton/Kevlar Box
- Scale and/or balance
- Firearms Reference Collection
- Water Tank

3.4 **Observed Performance**
A. The trainee will observe the trainer conduct microscopic bullet examinations.
B. As they relate to the examination and comparison of fired bullets or bullet fragments, discuss with the trainer the importance and limitations of, determining the following:
   1. Weight
   2. Caliber
   3. Caliber type
   4. Manufacturer
   5. General rifling characteristics
   6. Pitch of rifling
   7. Depth of rifling
   8. Jacket construction/composition
   9. The use of a magnet
C. Discuss the differences of diameters between fired and unfired bullets and measure the land and groove impressions to determine caliber of the fired bullets
D. Discuss knowledge that can be obtained from a bullet hole in sheet metal

3.5 **Supervised Performance**
The trainer will observe the trainee perform microscopic comparisons including the identification of various bullets. The trainee will also make an association with the firearm from which they were fired.

3.6 **Independent Exercises**
A. Bullet terminology
   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.
   1. Slippage
   2. Shaving
   3. Obturation
   4. Leading and trailing edge
   5. Melting and gas erosion
   6. Flow-by and blow-by
7. Striation
8. Individual microscopic marks
9. Ogive
10. Bearing surface
11. Class characteristics
12. Subclass characteristics
13. General rifling characteristics
14. Corrosion
15. Leading
16. Insufficient individual microscopic marks
17. Limited individual microscopic marks
18. Single-action firing
19. Double-action firing
20. Knurled & grooved cannelure
21. Stab crimp
22. Boat tail
23. Open base
24. Closed base
25. Recessed base
26. Hollow point
27. Trace evidence aspects (lacquers, sealants, etc.)

B. Caliber and Possible Firearms Determination

1. The general rifling characteristics (GRC) left by firearms on the surfaces of fired bullets are a type of class characteristic. Review and discuss the following with the trainer:
   a) Caliber
   b) Number of land and groove impressions
   c) Land and groove dimensions
   d) Direction of twist

2. Learn how to measure land and groove impressions.

3. Using test bullets and other fired bullets and bullet fragments provided, analyze the GRC and compile a list of firearms which could have fired the bullets using an available GRC database.

C. General Bullet comparisons

1. The Projectile Comparison Worksheet Form should be filled out completely. List the identifying number of each set of known match tests (KM). For each projectile examined, indicate whether there is enough data to use for identification (based on that area).
2. Determine the methods and techniques used to differentiate between lead bullets and bullet cores.

3. Using test bullets fired from polygonally rifled barrels, demonstrate proficiency 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 file and/or the AFTE Listing of Polygonally Rifled Firearms.

4. Access the FTM SOP and become familiar with the examination of fired bullets.

D. Additional assignments

1. Using several pairs of fired and unfired bullets from the same box of ammunition, measure their diameters before and after firing. Measure the land and groove impressions of the fired bullets and compute the calibers based on these measurements. Account for these differences and discuss with the trainer.

2. Using a single 22 caliber firearm, test fire three of each of the following cartridges (other ammunition may be substituted based upon availability and the trainer’s discretion) and attempt to identify the test bullets with each other. Use the Projectile Worksheet (LAB-FTM-02) to document observations with appropriate wording and photographs. Use standard report wording.
   a) 22 Long Rifle, Remington, lead bullets
   b) 22 Long Rifle, Winchester, lead bullets
   c) 22 Long Rifle, Remington, brass-coated lead bullets
   d) 22 Long Rifle, Winchester, copper-coated lead bullets
   e) 22 Long, Remington, lead bullets

3. Using the same 357 Magnum caliber revolver, test fire three of each of the following cartridges (other ammunition may be substituted based upon availability and the trainer’s discretion) and attempt to identify the test bullets with each other. Use the Projectile Worksheet (LAB-FTM-02) to document observations with appropriate wording and photographs. Use standard report wording.
   a) 38 Special, Remington, lead round-nosed bullet
   b) 38 Special, Remington, jacketed bullet
   c) 357 Magnum, Remington, jacketed bullet
   d) 357 Magnum, Winchester Silvertip bullet
   e) 357 Magnum, Remington, lead round-nosed bullet

4. Using a single 9mm Luger pistol, test fire three of each of the following cartridges (other ammunition may be substituted based upon availability and the trainer’s discretion) and attempt to identify the test bullets with each other. Use the Projectile Worksheet (LAB-FTM-02) to document observations with appropriate wording and photographs. Use standard report wording.
   a) 9mm Luger, Federal Hydra-Shok
   b) 9mm Luger, PMC Starfire
   c) 9mm Luger, Remington full metal jacket
   d) 9mm Luger, Winchester Silvertip
e) 9mm Luger, CCI total metal jacket  
f) 9mm Luger, Black Talon/Ranger SXT  
g) 9mm Luger, military ball, 124 grain, FMJ  
h) 9mm Luger, Federal Nyclad  

5. Using a single 30 caliber rifle, test fire three of each of the following cartridges (other ammunition may be substituted based upon availability and the trainer’s discretion) and compare the tests with each other. Use the Projectile Worksheet (LAB-FTM-02) to document observations with appropriate wording and photographs. Use standard report wording.  
a) 30 caliber, Remington, jacketed soft-point bullet  
b) 30 caliber, Remington Accelerator cartridges  
c) Test fire and inter-compare steel jacketed bullets vs. copper jacketed bullets from the same barrel  

6. Using a single 32 Smith & Wesson caliber Harrington & Richardson revolver (another revolver may be substituted based upon availability and the trainer’s discretion), test fire three of each of the following cartridges and compare the test bullets with each other. Use the Projectile Worksheet (LAB-FTM-02) to document observations with appropriate wording and photographs. Use standard report wording.  
a) 32 Smith & Wesson, Remington, lead bullet  
b) 32 Auto, Remington, full metal case jacketed bullet (discharge remotely)  

7. Compile a list of reasons why bullet identifications cannot be made in some cases and why some barrels and bullets can preclude or tend to preclude identifications. This list should include, but not be limited to, the results of the above testing.  

8. Compare test fired bullets from different firearms. Look for the best match between these tests. The “best known non-match” should be reviewed and discussed with the trainer. Use consecutively manufactured barrels if possible.  

9. Compare mutilated and deformed bullets with undamaged bullets from the same firearm. Place corresponding areas adjacent to each other in the field of view on the microscope. Discuss with the trainer why an identification is possible, even if the class characteristics are not aligned.  

4  Assessment  

4.1 Competency and Qualifying Examination  
A. The trainee will demonstrate competency by the completion of at least 5 bullet comparison competency examinations. Previously analyzed proficiency tests can be used for this purpose. The competency examinations will include documentation that simulates casework (worksheets, report, etc.).  
B. There will be a written competency examination over terminology and concepts.  

4.3 Evaluation of Training  
The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
FTM-TM-02-07  SHOOTING SCENE RECONSTRUCTION

Duration  One week

Purpose  The trainee will become familiar with the theoretical applications of evidence encountered at shooting scenes such as physical and chemical analysis of various types of bullet defects, ejection pattern testing, and the order of shots in glass.

Prerequisite  FTM-TM-01-02, FTM-TM-01-03, FTM-TM-02-02, FTM-TM-02-03

1  Objectives

1.1  Theoretical

The trainee will learn how to conduct an examination of a bullet's trajectory, bullet defects in a variety of materials, a firearm's ejection pattern, and the order of shots in glass. The trainee will learn considerations for documentation, the use of appropriate controls, limitations of these testing techniques. The trainee will also learn how to properly document the examination by recording the collection of all original observations as well as analyze and report this data. This program of instruction may be substituted by an externally produced course that covers similar topics.

1.2  Practical

Following the completion of this module the trainee will have an understanding of:

A. Factors that affect bullet trajectory
B. The physical and chemical properties of bullet defects
C. The factors that affect a given firearm's ejection pattern
D. Limitations to all testing related to bullet defects and ejection patterns
E. Setting up an appropriate test for the evidence provided
F. Measurement and documentation of the evidence and tests
G. Analyzing the results

2  Training Outline

2.1  Lesson Plan

A. Trajectory

1. Demonstrate knowledge of the factors governing trajectory.
2. Demonstrate understanding of using trajectory measuring equipment, their potential, and limitations.

B. Directionality of Shots

1. Demonstrate knowledge of bullet defect characteristics in various materials.
2. Demonstrate knowledge of ricochet characteristics and circumstances.
3. Demonstrate knowledge the limitations of determining entry and exit defects.
C. Order of Shots in Glass
   1. Demonstrate knowledge of different types of glass and forensic aspects.
   2. Demonstrate knowledge of characteristics in glass, including:
      a. Concentric and radial fractures
      b. Penetrating and non-penetrating defects
      c. Relative location of radial cracks for sequencing shots

D. Chemical Testing of Bullet Defects
   1. Demonstrate knowledge of the various chemicals used for detecting bullet strike defects
   2. Demonstrate knowledge of factors that affect chemical residues on an object
   3. Ejection pattern
   4. Demonstrate knowledge of ejection pattern and factor affecting a firearm’s ejection pattern
   5. Demonstrate knowledge of proper protocols for designing an ejection pattern test relative to the case
   6. Demonstrate knowledge of measuring and analyzing ejection pattern data

E. Become familiar with the steps in the SOP for ejection pattern testing:
   1. Obtain the approximate height at which the firearm was fired
   2. Obtain sufficient ammunition to generate a representative ejection pattern and ensure that this ammunition is the same or similar to that used in the shooting offense
   3. Attempt to limit variables that could impact the testing such as weather conditions, plotting initial versus the final location of the fired cartridge cases
   4. Set up a stand or other reference to ensure that each test shot is fired from a consistent location and height.
   5. Set up two tape measures as an x and y axis with the firearm itself as the origin.
   6. Using an observer, have the initial location of each cartridge case marked.

F. Become familiar with the aspects of measuring and analyzing ejection pattern data:
   1. If performing a quantitative determination, measure both the axial and lateral distance of each cartridge case and record the data.
   2. If performing a qualitative determination, assess the overall axial (front/back) and lateral (left/right) direction of the ejection pattern relative to the shooter.
   3. Consider using a scatterplot or other data to record and/or display the results. Ensure that distances are input as positive or negative depending on their relative direction to the shooter.
   4. Report the results listing the general (qualitative) or range of direction and distances (quantitative). Refer to FTM-01-04 for examples of suggested report wording.
5. Examples (all distances are in inches):
   a. *Ruger 40 S&W caliber pistol shot both prone and standing*

   ![Graph of example a]

   b. *Item 05-01 was a Glock 9mm Luger caliber pistol and Item 06-01 was a Colt 223 Remington caliber rifle*

   ![Graph of example b]

   c. *Ejection Pattern of Norinco SKS rifle*

   ![Graph of example c]
2.2 Required Readings
   A. DPS Firearms and Toolmarks SOP:
      1. FTM-05-01 – Dowel and String/Laser Trajectory
      2. FTM-05-02 – Direction of Travel
      3. FTM-05-03 – Ejection Pattern Testing
      4. FTM-05-04 – Determination of Order of Shots in Glass
      5. FTM-05-05 – Chemical Testing of Suspected Projectile Defects

2.3 Suggested Readings

3 Practice
3.1 Safety
   A. Range Safety Rules
   B. Firearm Safety
   C. Personal Protective Equipment for chemical testing

3.2 Standards, Controls, Reagent Preparation
   A. Dithiooxamide test reagents
   B. Sodium Rhodizonate test reagents

3.3 Equipment
   • Firearms Reference Collection
   • Ammunition Reference Collection
   • Protractor
   • Tape Measure/Ruler
   • Dowels/string and/or lasers
   • Ejection Pattern Measurement Uncertainty Study

3.4 Observed Performance
   A. The trainee will observe the trainer performing qualitative trajectory measurements.
B. The trainee will observe the preparation and testing of reagents DTO and Sodium Rhodizonate.

C. The trainee will observe the trainer analyze the order of shots in glass and bullet impacts in various materials.

D. Trajectory

1. Discuss the following factors governing the trajectory of a fired projectile and how they affect the determination of the trajectory of a bullet defect
   a. Bullet design
   b. Target hardness
   c. Ricochet effects
   d. Target thickness
   e. Angle of impact
   f. Intermediate targets
   g. Movement of the firearm, target, and/or shooter
   h. Damage to the target after projectile impact
   i. Potential trace evidence on or near the defect

2. Discuss the characteristics of the following measuring equipment and their potential use and limitations in trajectory analysis. Describe how each should be used to document bullet defects.
   a. Protractor
   b. Dowel Rods
   c. Laser Trajectory Kit
   d. Centering cones
   e. String
   f. Tape Measure/Ruler
   g. Camera

3. Discuss the limitations of a qualitative trajectory analysis.

E. Directionality of Shots

1. Discuss the characteristics of entrance and exit defects in each of the following materials:
   a. Plywood and other laminated woods
   b. Sheet metal
   c. Tempered glass
   d. Laminated glass
   e. Upholstered furniture
   f. Rubber (tires)
   g. Drywall
2. Describe the following types of ricochet marks and the circumstances that may produce them:
   a. *V-shaped marks*
   b. *Fracture lines in a painted surface*
   c. *The “Chisum Trail”*
   d. *The “Pear Effect”*
   e. *Ricochets off of glass*
   f. *Ricochet marks on frangible surfaces*
   g. *Coning*
   h. *Cratering*

3. Discuss the limitations of determination of the entrance/exit of a bullet defect.

**F. Order of Shots in Glass**

1. Describe the differences between plate glass, tempered glass, and laminated glass. List their common applications and the forensically significant aspects of each as they relate to shooting incident reconstruction.
2. Compare and contrast with the marks present in glass with concentric and radial fractures.
3. Discuss the characteristics present on penetrating and non-penetrating defects in glass.
4. Describe how the relative location of radial cracks can allow an examiner to sequence the order that defects in glass were produced.

**G. Chemical Testing of Bullet Defects**

1. Describe the chemical reaction of the Dithiooxamide Test.
2. Describe the chemical reaction of the Sodium Rhodizonate Test.
3. Describe how the positive and negative controls for each chemical test should be created when testing potential bullet defects.
4. Describe the factors that could reduce or remove chemical residues on an object.

**H. Ejection Pattern**

1. Define ejection pattern and explain how each of the following factors affects a firearm’s ejection pattern:
   a. *Extractor/Ejector Orientation*
   b. *Location and shape of ejection port*
   c. *Presence of a deflector device such as are present on AR-15’s*
   d. *Shooting height*
   e. *Ammunition differences*
   f. *Meteorological conditions (high wind, precipitation, etc)*
   g. *Ground surface*
h. Presence of intervening objects (walls, furniture, vehicles, etc.)

2. Discuss the factors that could preclude an accurate ejection pattern test, specifically addressing the topics below:
   a. Inability to interpret a pattern due to movement of cartridge cases after initial impact
   b. Significant change in angle/height of the firearm
   c. Disturbance of the ejection pattern due to the presence of first responders, wildlife, or weather conditions

3.5 Supervised Performance

A. The trainer observes the performance of the trainee in measuring and recording data for participation in the Ejection Pattern Measurement Uncertainty Study
   1. Demonstrate how to measure both lateral and axial distances
   2. Demonstrate how to report both the qualitative and quantitative ejection pattern

B. The trainer observes the preparation and testing of both DTO and Sodium Rhodizonate reagents by the trainee

C. The trainer observes the trainee documenting and interpreting the order of shots in glass and bullet impacts in various materials.

D. The trainer will observe the trainee documenting and interpreting bullet impacts in various materials.

4 Assessment

4.1 Competency and Qualifying Examination

A. The examiner is required to successfully complete a written exam over terminology and concepts.

B. The examiner will complete a competency exam requiring the analysis of a series of at least 5 defects made by bullets and at least 5 defects not made by bullets in materials similar to those encountered in casework. The trainee will document, analyze, and report on their conclusions regarding each defect. The competency examination will include documentation that simulates casework (worksheets, report, etc.)

4.2 Evaluation of Training

The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
03 SERIAL NUMBER RESTORATION UNIT

FTM-TM-03-01 SERIAL NUMBER RESTORATION

Duration One week

Purpose The trainee will become familiar with the basic serial number restoration techniques used.

Prerequisite FTM-TM-02-03

1 Objectives

1.1 Theoretical

The trainee will become familiar with the methods of serial number removal, the types of metals used, and various means of restoration including magnetic particle inspection, chemical etching, and electrochemical methods. Deciphering alternative codes and hidden serial numbers will also be discussed. This program of instruction may be substituted by an externally produced course that covers similar topics.

1.2 Practical

Following the completion of this module the trainee will have an understanding of:

A. Principles used to impart serial numbers to items
B. General locations of numbers
C. Determination of type of surface
D. Reagent preparation and quality control
E. Alternative decryption methods
F. Methods of documentation, enhancement, and preservation of recovered information

2 Training Outline

2.1 Lesson Plan

A. Demonstrate knowledge of various types of marking methods used in the firearms industry
B. Understand how to determine the type of material used in the area of serial numbers
C. Demonstrate knowledge of the effect of the various methods and materials can have on the substrate areas
D. Demonstrate knowledge of structures used by various major manufacturers.
E. Demonstrate knowledge of how to reference the ATF Serial Number Structure Guide
F. Understand terminology related to serial number restoration
G. Establish understanding of various obliteration methods and their impacts on restoration
H. Establish understanding of surface preparation, non-destructive, and chemical restoration processes.
I. Demonstrate knowledge of making serial number restoration chemicals/reagents
J. Gain experience restoring serial numbers from various firearms and materials.
K. 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.

L. Become familiar with the following chemicals/reagents:
   1. Fry’s Reagent
   2. Arais Reagent
   3. Hydrofluoric acid
   4. Turner’s Reagent
   5. Davis’ Reagent
   6. CuNi₄Cl₂
   7. CuCl₂
   8. NaOH
   9. HNO₃
   10. KCN
   11. Aqua Regia
   12. H₂SO₄
   13. HCl
   14. K₂SO₄
   15. FeCl₃

2.2 Required Readings
   A. DPS Firearms and Toolmarks SOP
      1. FTM-07-01 – Serial Number Polishing
      2. FTM-07-02 – Serial Number Chemical Restoration
      3. FTM-07-03 – Serial Number Electrochemical Restoration
      4. FTM-07-04 – Serial Number Magnetic Restoration
      5. FTM-07-05 – Serial Number Heat Treatment

2.3 Suggested Readings
   A. General
      1. ATF Serial Number Structure Guide
      2. The Reproduction of Obliterated Data by Fred Rymer
      3. Instant Recovery of Obliterated Serial Numbers by Mike Knowles


B. Professional Journals


C. AFTE Journal


3 Practice

3.1 Safety
   A. Eye protection
   B. Preparation and documentation of reagents
   C. Gloves
   D. Lab coats
   E. Vent hood
   F. Standard laboratory precautions
   G. Firearm safety
   H. Pinch points

3.2 Standards, Controls, Reagent Preparation
   A. Reagents will be quality tested with known standards prior to each use.
   B. Reagents will be prepared according to FTM SOP.

3.3 Equipment
   - Camera
   - Firearms Reference Library
   - MagnaFlux magnet
   - Tools

3.4 Observed Performance
   A. The trainee will observe the trainer in the following:
      1. Preparation of reagents for ferrous and non-ferrous material
      2. Use of the MagnaFlux
      3. Surface preparation
      4. Application of the reagents to the obliterated area(s).
   B. Explain the difference between cold rolled steel and cast iron metal.
   C. Describe the effect that the following types of alterations, or combination of alterations, will have on the subsurface of the marked item and how it will impact on the results of the examiner.
      1. Grinding
      2. Over stamping
      3. Peening
      4. Gouging
      5. Heating
      6. Puddling
7. Welding
8. Removal

D. Discuss any surface preparation, specialized equipment, photography techniques or procedures, lighting effects or magnifying techniques that may be used to aid in determining any data that is produced. Discuss different types of lighting (e.g. incandescent, infrared, UV, and fluorescent) and how they can improve or enhance the restoration results. Be prepared to explain how the angle of incidence of these lighting techniques might vary the results.

E. Discuss nondestructive, magnetic techniques of serial number restoration.

F. Discuss how chemicals can be used to restore obliterated data (metal types, etc.)
   1. If the reaction rate for a stressed area is faster or slower than the etching rate of the rest of the surface and why.
   2. Specialized equipment that might be used in number restoration.

G. Discuss the electrochemical technique of enhancing chemical serial number restoration. Consider the benefits and drawbacks of utilizing this technique.

3.5 Supervised Performance

The trainer will observe the trainee performing:

A. Preparation of reagents for ferrous and non-ferrous material
B. Use of the MagnaFlux
C. Surface preparation
D. Application of reagents to obliterated serial number areas.

3.6 Independent Exercises

A. Research and make a list of the various methods used to mark items by private industry. This list can include, but not be restricted to:
   1. Casting
   2. Stamping
   3. Embossing
   4. Debossing
   5. Coining
   6. Vibratory pencil
   7. Laser
   8. Electrical discharge machining
   9. Code 39 barcode

B. Determination of Metal Type (use magnet or reference material)
   1. Steel (magnetic) (Take care due to possibility of false determination due to magazine, slide, or barrel)
   2. Aluminum
   3. Other such as Zinc
C. Prepare a written report which covers the following areas:
   1. The effect each of the above methods of marking techniques has on the subsurface of the marked area.
   2. How and why each of the above marking methods will affect the ability of the examiner to restore any obliterated markings.

D. Review Serial Number Structure Guide, Reference Collection, and other references for serial number structures. Keep in mind no single reference is complete.

E. Define “plastic deformation” of metal

F. Obtain several items with obliterated serial numbers, and attempt to restore them. Be prepared to discuss and demonstrate the methods. (Firearms below may be substituted with other suitable items by the trainer based on availability and discretion)
   1. Colt pistol
   2. Smith & Wesson revolver
   3. RG Industries revolver
   4. Ruger stainless steel revolver
   5. Chrome/nickel 25 caliber autoloading pistol
   6. Shotgun alloy receiver
   7. Shotgun casehardened receiver
   8. Winchester rifle
   9. Smith & Wesson Sigma Series Code 39 (photographs may be used)

4 Assessment

4.1 Competency and Qualifying Examination
   A. The trainee will demonstrate competency for serial number restoration by restoring a minimum of two obliterated serial number samples in steel and aluminum metals.
   B. There will be a written exam over terminology and concepts.

4.2 Evaluation of Training
   The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
04 DISTANCE DETERMINATION UNIT

FTM-TM-04-01 DISTANCE DETERMINATION

Duration One month

Purpose The trainee will become familiar with the practices for gunshot residue explanation and distance determination

Prerequisite None

1 Objectives

1.1 Theoretical

Following the completion of this module the trainee will have an understanding of:

A. Application and interpretation of tests for gunshot residue compounds
B. Common pitfalls to distance determination
C. Nomenclature

1.2 Practical

Following the completion of this module the trainee will have an understanding of:

A. Clothing examinations
B. Reagent preparation and quality control
C. Preparation of test
D. Selection of test ammunition
E. Use of available reference material

2 Training Outline

2.1 Lesson Plan

A. Demonstrate proficiency in preparing the chemicals and test papers used in the Modified Griess test, Dithiooxamide, and the Sodium Rhodizonate test including the test media and photographic paper.

B. Describe, in detail, the chemical reactions that take place in the burning of smokeless powder, the Modified Griess test, and the Sodium Rhodizonate test.

C. Demonstrate proficiency in conducting the following techniques, using the Firearms Section SOP:
   1. Modified Griess test – Direct Application Technique (DAT)
   2. Modified Griess test – Reverse Application Technique (RAT)
   3. Sodium Rhodizonate test – Direct Application Technique (DAT)
   4. Sodium Rhodizonate test – Bashinsky Transfer Technique (BTT)
   5. Sodium Rhodizonate test – Standard Transfer Technique (STT)
   6. Dithiooxamide

D. Using specimens provided by the trainer, demonstrate proficiency in conducting "muzzle-to-garment" distance tests in cases involving the deposition of gunshot residues. The
examination should include note taking, microscopic and chemical examinations, test firing to produce test patterns and accurately determining "muzzle-to-garment" distance.

E. Using specimens provided by the trainer, demonstrate proficiency in conducting "muzzle-to-garment" distance tests in cases involving gunshot residue patterns. The examination should include the following:

1. Note taking
2. Microscopic and chemical examinations
3. Test firing of shot patterns; gunshot residue patterns
4. Accurately determining "muzzle-to-garment" distance
5. Orientation of the firearm
6. Sources and patterns of gunshot residues (e.g. muzzle orthogonal vs. Muzzle oblique)
7. GSR patterns from flash suppressors
8. Effect on patterns by sound suppressors
9. Revolver cylinder gap
10. Geometric aspects of powder and GSR patterns

2.2 Required Readings


B. Review relevant chemical SDS

2.3 Suggested Readings

A. General


7. Kirk, *Crime Investigation*

B. Gunshot Residues


C. Shot Patternning


D. Wound Effects


E. Shooting Reconstruction


52. “Ball Powder” (with four page flow chart), Chemical Engineering, Dec. 1946, pp. 136-139.


68. Ballou, S. “Reconstruction of Trajectory Paths Through the Use of Basic Trigonometric Functions”. paper presented at the FBI Laboratory Crime Scene Processing and Reconstruction Seminar, September 4-6, 1996, Quantico, VA.


71. Ernest, R. “A Study of Shooting Scene Dynamics”. paper presented at the FBI Laboratory Crime Scene Processing and Reconstruction Seminar, September 4-6, 1996, Quantico, VA.

72. Taormina, S. “Reconstructive Placement of a Victim Within the Kill Site of a Homicidal Shotgun Discharge”. paper presented at the FBI Laboratory Crime Scene Processing and Reconstruction Seminar, September 4-6, 1996, Quantico, VA.

F. Copper and Lead Testing of Possible Bullet or Projectile Strikes


3 Practice

3.1 Safety

A. Hearing and eye protection, gloves, lab coats

B. Preparation and documentation of reagents

C. Vent hood

D. Blood borne pathogens

E. Standard laboratory precautions

F. Firearm Safety

3.2 Standards, Controls, Reagent Preparation

- Modified Griess test reagents
- Sodium Rhodizonate test reagents
3.3 **Equipment**
- Firearms Reference Collection
- Ammunition Reference Collection
- Hot/stir plate
- Spray bottles
- Electronic scale

3.4 **Observed Performance**
The trainee will observe the preparation of reagents, test materials, and evidence garments by other examiners.

3.5 **Supervised Performance**
The trainer will observe the trainee prepare reagents and test materials, as well as apply them properly.

3.6 **Independent Exercises**
The trainee will demonstrate knowledge and completion for completion of training assignment: Distance 1.

4 **Assessment**

4.1 **Competency and Qualifying Examination**
   A. The trainee will demonstrate competency by successfully identifying five (5) unknowns using chemical tests and one (1) shotgun distance. This competency exam will include documentation that simulates casework (worksheets, report, etc.).
   B. Successful completion of the FBI “Gunpowder and Primer Residues” course or equivalent and competency samples may qualify the examiner for completion of this module.

4.2 **Evaluation of Training**
The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).

4.3 **Requirements for Use in Casework**
   A. Successful completion of this module is required.
   B. Supplemental training in the form of trajectory courses, shooting reconstruction courses, and/or advanced homicide crime scene processing courses is to be completed prior to the use of copper and lead testing of possible projectile strikes in casework or reporting of possible conclusions.
05 TOOLMARKS UNIT

FTM-TM-05-01 EXAMINATION OF TOOLMARKS

Duration One month

Purpose The trainee will become familiar with basic toolmarks examination.

Prerequisite None

1 Objectives

1.1 Theoretical

Following the completion of this module the trainee will have an understanding of:

A. Class characteristics of various tools
B. Definition of a toolmark in broadest sense

1.2 Practical

Following the completion of this module the trainee will have an understanding of:

A. Determination of class characteristics
B. Preparation of tests
C. Selection of test materials
D. Variation of toolmarks due to differences in angle and force

2 Training Outline

2.1 Lesson Plan

2.2 Suggested Readings

A. General


2. Association of Firearm and Tool Mark Examiners, “Theory of Identification,” AFTE Glossary, Revision Section, Toolmarks Section, Appendix E (Knives), and Appendix H (Machining Terms).


B. The Daubert Decision and Toolmarks/Firearms Identification


C. Ammunition Manufacturing Processes


D. Automotive Ignitions


E. Beverage Tabs/Tops


F. Boltcutters


G. Bone and Cartilage


H. Burglary Tools


I. Cable and Wire


J. Casting Materials and Techniques


K. Dies


L. Drills/Lathes


M. Firearms Components


N. General Toolmark References


O. Impressions


P. Knives


Q. Lighting Techniques


R. Locks and Keys


S. Miscellaneous Examination Subtopics


T. Photographic Techniques


U. Physical/Fracture Matches


V. Plastic Bags and Sheet Materials


W. Pliers


X. Reloading


Y. Safes


W. Pliers


X. Reloading


Y. Safes


Z. Saws


AA. Screwdrivers


BB. Staplers/Staples

CC. Test/Known Toolmark Production Techniques

DD. Tires

EE. Tool Orientation Effects

FF. Trace Evidence Concerns

GG. Vehicles


HH. Wood


3 Practice

3.1 Safety

Standard laboratory precautions

3.2 Standards, Controls, Reagent Preparation

None

3.3 Equipment

- Comparison scope
- Various hand tools

3.4 Observed Performance

The trainee will observe the trainer performing microscopic comparisons of various toolmarks and associate them with the tools that made them.
3.5 Supervised Performance

The trainer will observe the trainee performing microscopic comparisons to include the identification of various Toolmarks and associate them with the tool surface that created them.

3.6 Independent Exercises

A. Trainee will review their notes in reference to the section entitled “Manufacture of Modern Firearms.” The machining methods covered are also the basis for toolmark identification. However, it should be noted that in the broad definition of toolmarks identification, certain other related types of examinations are also performed. The trainee will discuss their review with the trainer.

B. Define the word “tool” and “toolmarks identification” in the narrow sense of the expression. Also define “toolmark identification” in its broadest sense and determine the types of conclusions that may be reached in toolmark identification.

C. Discuss the significance of examining submitted tools first for trace evidence and itemize several types of such deposits.

D. For cases involving a toolmark examination wherein no tool is submitted, understand and determine the types of conclusions which can be reached. Consider the type of tool, size of the tool, action employed by the tool, value of toolmark for comparison purposes, and any unusual tool features.

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

   1. Shearing
   2. Pinching
   3. Fracture
   4. Scrape mark
   5. Impression
   6. Slicing

F. Define the term “class characteristics” as it applies to toolmark identification. Using the tools or methods selected as examples in #5, describe their respective class characteristics in detail.

G. Select at least two tools representative of each category listed in #5. Produce toolmarks with each tool and observe the class characteristics of the toolmark. Vary the angle and force with which each tool is used.

H. Using soft copper wire of approximately ¼” diameter, make cuts through it with the tools that employ a shearing, pinching and slicing action. Make test cuts in lead using the same tools. Attempt to identify the cuts in the copper wire as having been made by the same tool as that which cut the test lead. Photographs can be used to support your results if desired. Note any lighting considerations made necessary by the color difference between copper and lead.

I. Select a flat-bladed tool such as a screwdriver and a pry bar and make marks in a piece of copper or brass sheeting. Make the same type of marks in lead with both tools. Microscopically compare those in the brass or copper sheeting with the test marks in the lead. Attempt to identify the appropriate marks with the appropriate tool. Comment on the difference in the quality of marks made by each tool.
J. Research and report findings regarding whether saws, files and abrasive tools are identifiable or not with the marks they make. Cite any exceptions to this rule.

K. Obtain a used tire and make cuts and stabs into the sidewall with a fixed blade knife. Attempt to make comparisons of the toolmarks produced by the knife. Support the results with photographs if desired. Discuss how the results of the examinations might be altered if the knife had been sharpened after making the questioned cuts, or if the knife had been used for an extended period of time after making the initial questioned cut.

L. Become familiar with the toolmark definitions in the AFTE Glossary.

M. Become familiar with the knife terminology in the AFTE Glossary.

N. The trainee will demonstrate knowledge and completion of training assignments: TM 1-7.

4 Assessment

4.1 Competency and Qualifying Examination

The trainee will demonstrate competency by successfully completing a minimum of two toolmark examinations (previous proficiency tests can be used for this purpose). The competencies will include documentation that simulates casework (worksheets, report, etc.).

4.2 Evaluation of Training

The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
06 CASEWORK AND COURTROOM TESTIMONY UNIT

FTM-TM-06-01 CASE REVIEW

Duration Approximately one week

Purpose The trainee will become familiar with the verification and technical review process of case reviews.


1 Objectives

1.1 Theoretical

The trainee will learn the process for conducting verifications and technical reviews of FTM related casework and the documentation requirements associated with these review processes.

1.2 Practical

Following the completion of this module the trainee will have an understanding of:

A. Items that require verification
B. The verification process and documenting verification in the case record
C. The verification resolution process
D. Items checked during technical review
E. Documenting the technical review in the case record

2 Training Outline

2.1 Lesson Plan

Demonstrate knowledge of:

A. The difference between verification and technical review.
B. What types of cases and components are required to be verified.
C. The techniques for verification and process for resolution.
D. Elements of technical review.
E. Circumstances that require rejection of technical review.
F. The requirements to sustain competency in technical review.
G. Documenting reviews in LIMS
H. Procedures for testimony technical review.

2.2 Required Readings

A. DPS Firearms and Toolmarks SOP: FTM-01-03 – Case Review Process
B. CLS Manual
   1. Monitoring the Validity of Results
   2. Court Testimony and Monitoring
   3. Review of Laboratory Records
3 Practice

3.1 Safety

None

3.2 Standards, Controls, Reagent Preparation

None

3.3 Equipment

None

3.4 Observed Performance

A. The trainee will observe the trainer perform verifications and technical reviews on at least two different cases which include firearms examination and comparison of bullet and cartridge cases.

B. Verification

1. Discuss items that are required to be verified for the following types of cases:
   a. Microscopic Comparisons
   b. Critical Measurements
   c. Other items at the discretion of the verifier or analyst

2. List techniques for verification.
   a. Using alternate tests
   b. Using alternate pattern areas
   c. Trying different orientations

3. Discuss with the trainer the process for resolving differences between the analyst and verifier.

C. Technical Review

1. Discuss the elements required to be checked during technical review
   a. Worksheets/Notes
      i. Is the evidence properly described?
      ii. Are all layers of packaging properly described, and is there an indication of sealed condition of the evidence when received in the section?
      iii. Do the case number, examiner’s initials, date, and/or page number appear on all required pages?
      iv. Are the notes organized, neat and understandable?
      v. Are the sheets properly organized?
      vi. Is the Chain of Custody (including internal transfer) current as of this date?
      vii. Are necessary photographs, diagrams, sketches, etc. included as appropriate?
      viii. Are all photographs, diagrams, sketches, etc. properly labeled?
ix. Have all mathematical calculations been checked and are correct?

x. If work expands more than one day, is the work performed on each day properly annotated?

xi. Is the correct measurement uncertainty value present within the case record?

b. Opinions/Conclusions
   i. Have all requested examinations been addressed?
   ii. Were the proper number of tests obtained / performed for valid results?
   iii. Were unknowns properly evaluated and/or documented prior to comparison to knowns?
   iv. Were the conclusions drawn supported by the data?
   v. Are the data and conclusions properly and accurately documented?

c. Report
   i. Is case information (case #, offense, victim, suspect, etc.) correct?
   ii. Have all requested examinations been addressed?
   iii. Is evidence properly / accurately described?
   iv. Are the results clearly communicated to the reader?
   v. Is the significance of the identification properly explained?
   vi. Are inconclusive results explained?
   vii. If requested, have additional copies been provided?
   viii. Is the disposition of the evidence included in the report?

d. LIMS
   i. Are the item counts entered under the Requested Analysis DUI and are they accurate?
   ii. Are the number and type of each conclusion entered under the Requested Analysis DUI and are they accurate?
   iii. Have all case activities, if applicable, been documented?
   iv. Are dates of analysis accurately recorded?
   v. Are methods used accurately recorded?
   vi. Have the case images been reviewed and does the electronic and hard copy information agree?

2. Discuss the optional use of LAB-FTM-14 (Case Documentation Review)

3. Discuss what circumstances require rejection of technical review in LIMS.

4. Discuss the requirements to sustain competence in technical review.

5. Discuss how technical review is documented in LIMS.

6. Discuss considerations and procedures for the technical review of testimony.
3.5 Supervised Performance

The trainer will observe the trainee conduct verifications and technical reviews on 2 different cases which include firearms examination and comparison of bullet and cartridge cases.

4 Assessment

The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
FTM-TM-06-02  COURTROOM TESTIMONY

Duration  Two weeks

Purpose  Provide additional courtroom testimony training for the trainee to be prepared for firearm and toolmark specific testimony, as well as challenges to the admissibility of firearm and toolmark related testimony.

Prerequisite  General Laboratory Training: Legal Unit

1  Objectives

1.1  Theoretical

Firearm and toolmark related testimony constantly faces new challenges for admissibility. This section will provide the tools for any examiner to properly prepare for those challenges as well as prepare new examiners specifically for firearms and toolmark testimony.

1.2  Practical

Following the completion of this module, the trainee will be able to present firearm/toolmark specific testimony with professionalism and confidence and be able to locate resources to withstand scrutiny for testimony admissibility hearings.

2  Training Outline

2.1  Lesson Plan

The trainee will demonstrate:

A. The ability to speak in front of an audience.
B. The ability to orally describe aspects of firearm operation to those not familiar with guns.
C. The ability to successfully present an opinion to an audience.
D. The ability to present an impromptu speech.
E. Knowledge of individual courtroom positions and their locations.
F. Knowledge of advantages of pre-trial conferences.
G. Knowledge of arguments for and against the admissibility of firearms and toolmarks testimony and of the SWGGUN Admissibility Resource Kit.

2.2  Required Readings

A. Unfavorable to firearm/toolmark testimony
   1. United States v. Davis (2019)

B. In favor of firearm/toolmark testimony
2.3 Suggested Readings

SWGGUN ARK found at https://afte.org/resources/swgun-ark

3 Practice

3.1 Safety

None

3.2 Standards, Controls, Reagent Preparation

None

3.3 Equipment

None

3.4 Observed Performance

A. Oral speeches to be given in front of other laboratory personnel
   1. Present a 3-5 minute speech on any topic of interest without the use of aids.
   2. Present a 3-5 minute speech on a how-to (choose one)
      a. Describe how to field strip a pistol
      b. Describe the cycle of fire of a particular firearm
      c. Describe how the safeties function in a particular firearm
   3. Present a 3 minute speech to successfully convince audience of your opinion of a topic assigned by the trainer.
   4. Present an impromptu 3-5 speech about the trainer's choice of topic. You will be given 5 minutes to prepare.

   Note: The above speeches can be substituted with proof of attendance of a Toastmaster's meeting in which the trainee gives related speeches to the audience.

B. Tour a courtroom and learn the relative positions of the judge, the jury, the prosecution, and the defense.

C. Discuss with the trainer the purposes and advantages of a pre-trial meeting with both prosecution and defense.

D. Discuss recent court decisions regarding the admissibility of firearms related testimony. Prepare a response to one of the recent court decisions.

E. Discuss where to find SWGGUN Admissibility Resource Kit (ARK) and how to create your own ARK.

F. Write a reply to the standard voir dire question “Please state your name and qualifications for the court.”

4 Assessment

4.1 Competency and Qualifying Examination

A. Completion of a mock trial and the associated LAB-313 and LAB-314. Acceptable performance and documentation is outlined in the Crime Laboratory Service Manual.

B. The trainee must complete all assignments. Successful completion of this module is determined by the trainer.
C. The trainer may opt for the trainee to complete a written exam in addition to the mock trial.

4.2 Evaluation of Training

The trainee and trainer will complete the Firearms and Toolmarks Training Checklist (LAB-FTM-TM-01).
### 07 FORMS

#### TRAINING FORMS

<table>
<thead>
<tr>
<th>Document Name</th>
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<tbody>
<tr>
<td>1 Firearms and Toolmarks Training Checklist</td>
<td>LAB-FTM-TM-01</td>
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