OKLAHOMA STATE BUREAU OF INVESTIGATION
FIREARMS & TOOLMARKS UNIT
TRAINING MANUAL

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1.0 Introduction (top ↑)

The Oklahoma State Bureau of Investigation (OSBI) Criminalistics Services Division (CSD) Firearms and Toolmarks (FATM) training program was developed to guide examiner trainees through the various areas of knowledge integral to the field of firearm and toolmark examination. It is paramount that the trainee is cognizant of the primary objective of this training period: to independently and competently examine and compare evidence related to firearm and toolmark examination; to independently and competently render an opinion and reach conclusions relating to examinations and comparisons; and to give expert testimony in court in matters encompassed within the broad discipline of firearm and toolmark examination in a professional, competent and impartial manner. The obligation rests with the trainee to maximize on the effectiveness of their training period and recognize the opportunity to gain as much knowledge as possible in the field. The extent to which the trainee applies themselves during this training and evaluation period will bear directly on the quality of their performance in the laboratory and on the witness stand. The firearm and toolmark examiner's technical ability and testimony may directly impact the outcome of an investigation/case. Therefore, the trainee has a moral and ethical obligation to prepare themselves technically and professionally during training, in order to be able to perform under the most rigorous standards.

The trainee will be expected to familiarize themselves with the Firearm and Toolmark Laboratory's equipment, FATM Quality and Policy Manual, CSD Quality Manual and Quality Procedures and OSBI policies and procedures. Frequent interaction with the trainer (the FATM Technical Manager or designee), a mentor, or other experienced section and system personnel is integral to the success of this training. The trainee should not hesitate to ask questions.

The trainee will be expected to become thoroughly familiar with the basic references and materials which are found as a 'Supplemental Resources' attachment to this manual. However, the trainee should not restrict themselves to these basic references. The trainee should familiarize themselves with the laboratory's reference collection (including files, indices, manufacturer's literature and AFTE Journals).

It is required that the trainee keep a record of their training notes for each topic listed in the training manual for research, discussion, demonstration, study or practical work. The trainee's notebook may include notes, charts, graphs, photographs, limited photocopied material, etc., at their discretion; however, it should address and expand on each of the required topics of study set out in the training manual. Organizing notes in a format that parallels the training manual is suggested which will assist in documenting the trainee's progress and serve as a ready reference in the months and even years following their training.

Coordination of the Program

The Firearms and Toolmarks Unit Technical Manager retains overall responsibility for the Firearms and Toolmarks Training Program. The training coordinator is the Firearms and Toolmarks Unit Technical Manager and/or their designee. The coordinator facilitates the overall training, but may delegate certain duties and blocks of instruction to other qualified individuals.

Training Period

In accordance with QP-19, an assessment should be done to identify a trainee's specific training needs. This assessment may include a review of his/her education, experience, and/or a quiz or other competency evaluation to assess his/her knowledge/skill level. The length of the training period is variable and is at the discretion of the Firearms and Toolmarks Unit Technical Manager or their designee. Certain individuals may require less time than others, depending on experience, education, or learning ability. Generally, the training period is completed within 24 months.

Assessments
Each section has its required assessments at the end of the Section. If the trainee fails any of the assessments, the FATM Technical Manager or their designee will evaluate the need for re-training or re-testing. A summary of these assessments can be found as an attachment to this manual. A one-page list of section sign-offs can be found at the end of this document.

Re-training
This training manual can be modified by the Firearms and Toolmarks Unit Technical Manager for re-training purposes, including a criminalist returning to the firearms and toolmarks unit from another discipline or a criminalist needing re-training in a specific area for remedial reasons. All re-training will be handled according to QP-19.

Depending on the needs of re-training, a specific training plan will be documented for the individual by the Technical Manager, ensuring all objectives are met and adequate training is provided.

Maintenance of Skills and Expertise
Once released for casework, the examiner is encouraged to seek further training, to review each new *AFTE Journal* publication and to work with the Supervisor/Technical Manager to secure regular attendance at regional/national meetings with relevant discipline topics.

This training manual and the trainee's notebook may also be reviewed periodically. Such review is strongly encouraged when the examiner is to perform casework types not typically seen or when preparing for testimony.

NOTE: Hyperlink and attachment maintenance (removal, addition, or correction of hyperlinks and attachments) shall not constitute a new document revision.

2.0 Administrative Matters (top ↑)

OBJECTIVES

- Introduce the trainee to the policies and procedures of the OSBI CSD, and specifically the Firearms & Toolmarks Unit
- Be familiar with the field of forensic science, the role of the forensic scientist in the legal system, the significance of quality assurance and ethical behavior in forensics.

INTRODUCTION

This section of your training manual will address broad concerns related to forensic science in general and laboratory operations in particular. Many of these topics will be covered in much more detail later in your training, and the specifics of how these concerns are addressed in a given laboratory will undoubtedly vary. These issues relate to what are now mandatory aspects of forensic work and fall under a number of major headings. Paramount among these are health and safety concerns, not just in terms of the very obvious requirement for firearms safety, but also in terms of the diverse biological and chemical safety requirements of a multidisciplinary forensic laboratory. This is the environment in which most of us will find ourselves, even if we specialize in firearms-toolmark work. As the number and types of forensic techniques have progressed, so has the need for all types of laboratory safety awareness. Increasingly, most forensic scientists of all stripes have available a large body of safety information in general, as well as in the form of manuals specific to the needs of particular laboratories.

In addition to laboratory safety, there is also the requirement that testing be performed accurately. Therefore, this section of the training manual will also focus on the field of quality assurance procedures designed to make it so. Nearly all forensic laboratories today have instituted a program which tailors generally accepted procedures to the particular circumstances. Overall, these programs address standards for personnel, equipment, facilities, case management practices, training, case documentation, integrity of evidence, peer and supervisory review of work, technical protocols (laboratory procedures), note taking, report writing, monitoring of employee expert testimony, proficiency testing, corrective action for problems which are identified and procedures for introducing new techniques. Some laboratories may consider health and safety procedures a part of quality assurance, but typically health and safety matters are so comprehensive that they become a stand-alone topic as outlined in the previous paragraph.

Training was mentioned above as one aspect of quality assurance, but as in the case of health and safety, it can be also considered as a stand-alone topic. Although this is the training program specific for a firearms and toolmarks examiner, one must be aware that training is a continuous career-long requirement. Initial qualification and individual certification is only the beginning of in-service type training of many types from many sources. This type of training can be obtained from one's own agency, other state laboratory systems, federal sources (ATF and FBI) as well as from academic and private sources. In addition, professional associations and organizations are active in structuring and guiding the content of forensic firearms-toolmarks training, include the Association of Firearm and Tool Mark Examiners (AFTE) and the ANSI National Accreditation Board (ANAB). Training guidelines established by these groups are now wholly consistent with the requirements for individual examiner certification, as well as laboratory accreditation.

Subsuming all of the above are the very real values represented under the general heading of ethics, that is, the set of guidelines which should govern our conduct as forensic examiners. While all of us are generally guided by a reliable moral compass, or conscience, some of the subtleties faced by forensic scientists require as much thought as the actual examinations (Who should know my results? When should they know them? What about conflicts of interest?). Fortunately, the same organizations mentioned previously (AFTE and ANAB) have used the accumulated

experience of thousands of examiners over many decades to codify many of these concerns for the rest of us; these will also be covered in this section.

REQUIRED READINGS

	DATE COMPLETED	TRAINEE INITIALS
In addition to Section 3.0 Laboratory Safety, Security, and Administrative Procedures of New Employee General Training Manual:		
AFTE Technical Procedures Manual, "Safe Firearm Handling," (2015):10-11. AFTE website: https://afte.org/uploads/documents/procedures.pdf		
Dutton, G., "Firearms Safety in the Laboratory," AFTE Journal, 1997; 29(1):37-41.		
National Rifle Association (NRA), "NRA Gun Safety Rules." https://gunsafetyrules.nra.org/		
National Shooting Sports Foundation (NSSF), "Firearm Safety – 10 Rules of Safe Gun Handling." https://nssf.org/safety/rules-firearms-safety/		
Sapp, Rick, "The NRA Step-by-Step Guide to Gun Safety: How to Care For, Use, and Store your Firearms," Skyhorse Publishing, 2016.		
Occupational Safety and Health Administration, "Safety and Health Topics, Lead." https://www.osha.gov/SLTC/lead/		
Occupational Safety and Health Administration, "Protecting Workers from Lead Exposure at Indoor Firing Ranges." https://www.osha.gov/Publications/OSHA3771.pdf		
The National Institute for Occupational Safety and Health (NIOSH), "Preventing Occupational Exposures to Lead and Noise at Indoor Firing Ranges." https://www.cdc.gov/niosh/docs/2009-136/		
In addition to Section 4.0 Overview of Forensic Science of New Employee General Training Manual:		
Mathews, J.H., Firearms Identification, Volume I, University of Wisconsin Press, Madison, WI, 1962, Chapter 1.		
Hatcher, J.S., Jury, F.J., and Weller, J., Firearms Investigation, Identification and Evidence, Ray Rifling Arms Books Co., Philadelphia, PA, 2006, Chapter 1.		
In addition to Section 6.0 Ethics in Forensic Science of New Employee General Training Manual:		
"AFTE Code of Ethics," AFTE website: https://afte.org/about-us/code-of-ethics		
Dutton, G., "Ethics in Forensic Firearms Investigation," AFTE Journal, 2005; 37(2): 79-85.		
Dutton, G., "The Importance of Being Impartial," AFTE Journal, 1998; 30(3): 523-526.		

ADMINISTRATIVE MATTERS ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
2.1 Complete all applicable / required sections of the OSBI CSD New Employee General Training Manual. Familiarize yourself with the ANAB Guiding Principles.			
2.2 Familiarize yourself with evidence storage and accessibility within the Firearms and Toolmarks Unit. Obtain key(s) to your cubicle cabinets and drawers, and mobile cabinet within the lab.			
2.3 Become familiar with the Projectile Recovery Tank, shooting room and long range. Know where to find all applicable PPE, how to operate the tank and ventilation systems and procedure for shooting when alone in the firearms and toolmarks laboratory.			
2.4 Read and familiarize yourself with the Firearms and Toolmarks Quality and Policy Manual. Discuss each section with your trainer. Ensure you review and discuss the following topics: • Basic safety rules and guidelines for handling firearms • Receiving evidence firearms from investigators • Secure storage of firearms after receipt • Shipment and transportation of firearms • General preliminary examination procedures • Safety checks for all firearms • Safety checks for revolvers • Safety checks for non-revolvers • Black powder firearms and propellants • Test firing protocols • Eye and ear protection • Bullet recovery tanks and traps • General range rules			
2.5 Find and document the laboratory policies regarding the following: • Providing preliminary verbal or written results prior to issuance of a final laboratory report • Inquiries from the press and other media • Request for pre-trial meetings or depositions in a criminal case • Request to testify in a civil case • Request to testify in a grand jury proceeding or a preliminary hearing • Providing a laboratory report to other agencies • Policies on working private casework (secondary employment) • The potential for re-examination of evidence • Membership dues and attendance at professional meetings • Training and funding			
2.6 Familiarize yourself with the Firearms and Toolmarks reference collections. Determine, by reviewing laboratory policy, which of these collections can be used for identification, comparison, interpretation or training purposes. Be familiar with how the laboratory files these items for retrieval and understand the correct procedure for using the specimens in casework or training.			
2.7 Familiarize yourself with the Association of Firearm and Toolmark Examiner's website (http://afte.org/). Familiarize yourself with the AFTE Certification Program located on the AFTE website. Through the AFTE			

website and journal, familiarize yourself with the history and development of AFTE.			
2.8 Read the AFTE Code of Ethics. Summarize and submit its contents in a report. Emphasize the following major topic areas: • The scientific method applied to examinations • An adequate basis for opinions and conclusions • The ethics of court presentations • The general practice of firearm and toolmark examinations			

3.0 Administrative Matters (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Final written exam (New Employee General Training Manual)				
Completion of all section activities				

3.0 Evolution of Early Firearms and Ammunition (top ↑)

OBJECTIVES

- Understand where current firearms and ammunition came from and the development of new technologies throughout history affecting their evolution

INTRODUCTION

Black Powder: In this section you will explore the origins and practical aspects of the propulsion of projectiles by chemical means. Originally this conversation of potential chemical energy to the energy represented by the motion of a projectile was only possible through the use of black powder. As you will note in the reference materials set out at the end of this section, black powder did not originate from the work of a chemical engineer, but from the empirical and accidental efforts of many different people who in their own time and place were probably considered among the most educated: alchemists, monks, philosophers, noblemen, and others. These were essentially individuals who during the earlier centuries of the last two millennia lived in societies where the elite who were not concerned with day-to-day survival could afford the time to delve into these "mysteries." As educated people these individuals were also able to leave many records in Chinese, Greek, Latin, Arabic, Old French and Hebrew, reflecting the movement of information along the trade routes of Central Asia and the Mediterranean basin. Many of these records have been lost, but most surviving records have been translated into or summarized in English. While your future caseload will not likely include many firearms using black powder, your depth of knowledge as an examiner will be definitely enhanced by this kind of basic background information.

Evolution of Early Firearms: In this section the goal is for you to gain an appreciation for the origins of muzzle-loading firearms used along with black powder as the projectile propellant. The study of the evolution of these arms is typical of many devices we are familiar with, specifically, that no one individual can claim credit for the most advanced design. At each step someone new appears and takes what went before and adds an innovative idea to the previous concept. In the case of early firearms, the initial small arms design was simply a metal tube mounted on a pole, with ignition accomplished by manually applying fired to a touchhole, which digging the end of the pole into the ground. This was difficult to aim, so the tube was mounted on a wooden stock with a convenient spring-loaded mechanism, a primitive lock, allowing the touchhole to be fired by a burning cord (match) when the trigger was squeezed. This matchlock represented the state of the art for over two hundred years. Obviously the matchlock was a problem in wet weather, and the wheel lock, fired by a piece of iron pyrite brought into contract with a spinning steel disc, became the weapon of choice. The cost, complexity and slowness in use of the wheel lock gave way to the flint and steel lock mechanisms of the snaphaunce, the miquelet lock, and then the true flintlock. The flintlock reigned for at least two hundred years because of its general reliability. At the end of that time the flintlock was commonly rifled with spiraled grooves to stabilize the projectile. Shock-sensitive chemicals capable of generating a spark were discovered, leading to a chemically primed action called the percussion lock. These represented the highest point in the evolution of muzzle-loading firearms and were the immediate precursor to modern metallic cartridge weapons.

Evolution of Ammunition: The development of metallic cartridges was the most important landmark event in the evolution of modern firearms. The development of metallic cartridges and the evolution of modern firearms are closely related, and the latter is dependent on the former. Conceptually, pre-packaging powder and propellant in a single container, a paper cartridge, was not new. The problem had always been that these paper cartridges were still loaded from the muzzle of a firearm, and were separately primed by mechanical means (a firelock) or chemical means (a percussion cap). After a few evolutionary steps, the great leap forward came when multi-shot repeating percussion firearms using revolving cylinders, such as the Colt "revolver," were improved on by drilling completely through the cylinder. This allowed use of a pre-assembled metallic cartridge incorporating a case, powder, projectile and shock-sensitive primer, all in one convenient package. This was first successfully accomplished by

the firm of Smith & Wesson, using a rimfire metallic cartridge which carried the shock-sensitive priming material in the rim of the case. When the primer material was struck externally by the release of a spring-loaded firing pin, the shock-sensitive primer compound would release a spark, burning the black powder propellant. The resulting gas pressure would not only serve to propel the projectile out of the cartridge case and the firearm, but importantly, would also expand the typically brass or copper case to seal all the gases forward in the chamber and out of the shooter's face and eyes. This critical design feature virtually insured the application of the concepts to all manner of handguns and long arms, and also made possible the later evolution of all types of modern firearm actions and mechanisms. Due to the fact that rimfire cartridges were somewhat limited as to the pressures and projectile velocities they could safely generate, the centerfire cartridge, with the primer mounted in the center of the base, was developed. Centerfire cartridges with their longer ranges, higher pressures and ease of feeding through complex high-speed actions now predominate, with the familiar .22 rimfire types now nearly the sole survivor of a whole spectrum of that type of cartridge. Centerfire cartridges were then further enhanced by the use of a new propellant in the form of nitrocellulose, or smokeless powder, which was a product of the developing field of organic chemistry in the late nineteenth century. This propellant again enhanced ammunition performance while at the same time eliminating the great clouds of white smoke from the battlefield.

REQUIRED READING

	DATE COMPLETED	**TRAINEE INITIALS**
Smith, W.H.B. Book of Rifles. Pages 3 through 43.		
Smith, W.H.B. Book of Pistols & Revolvers. Pages 6 through 20.		
Hatcher, Jury & Weller. Firearms Investigations, Identification and Evidence Chapter 2.		

EVOLUTION OF EARLY FIREARMS AND AMMUNITION ACTIVITIES

	DATE COMPLETED	**TRAINEE INITIALS**	**TRAINER INITIALS**
3.1 Watch A&E's The Story of the Gun DVDs.			
3.2 Research and discuss the early development of gunpowder.			
3.3 Prepare an outline of early firearms and ammunition development up to the advent of metallic cartridges, with particular emphasis on lock mechanisms, early rifling techniques, percussion systems, priming methods and pre-metallic cartridges. The listing should be in proper chronological order. Discuss how each new system was an improvement over the previous system. Areas of consideration: • What features of these early firearms are still in use today? • What were the advantages of each of these systems? • What were the disadvantages of each of these systems? • Was there a common disadvantage to all these systems? • What was it and how was it overcome? Milestones to include: • Paper cartridges for muzzle • Colt nitrated paper cartridges • Sharps linen cartridges • Maynard brass cases • Maynard tape primers • The Minié ball • Snider coiled brass / paper cases • Burnside brass cases			

• Lefaucheux's cartridge • Houiller's pinfire cartridge • Flobert's BB cap • Smith & Wesson's .22 rimfire • The Volcanic bullet • Henry's .44 rimfire • Folded head cartridges • Berdan primers and cases • Boxer primers and cases • Solid head cartridges • Smokeless powder			
3.4 Visit the J.M. Davis Arms and Historical Museum in Claremore, OK to observe examples of early firearms and ammunition development, paying close attention to firearms that are developmental benchmarks. Note, in particular, commercial and military firearms since the development of metallic cartridges. You will need to prepare a report on your tour. You will need to keep comprehensive notes on what you observe and learn on the tour.			
3.5 Trace the evolution of the rimfire cartridge from the mid-nineteenth century to the current generation of modern 22 caliber rimfire cartridges. Prepare a chronological outline of rimfire ammunition development including firearms types that were developed for this ammunition. It should be in proper historical order and should discuss how each type of development was an improvement over the previous system. Areas of consideration: • What features of these early ammunition/firearms are still in use today? • What were the advantages of each of these systems? • What were the disadvantages of each of these systems? • Was there a common disadvantage to all these systems? • What was it and how was it overcome?			
3.6 Prepare a chronological outline of rimfire ammunition development including firearms types that were develop for this type of ammunition. It should be in proper historical order. Discuss how each type of development was an improvement over the previous system. Areas of consideration: • What features of these early firearms are no longer in use today? • What were the advantages of each of the systems? • What were the disadvantages of each of the systems? • What areas are still open to improvement to any of these systems?			
3.7 Trace the evolution of the centerfire cartridge from the mid-nineteenth century to the present. Pay particular attention to the transition from black powder to smokeless powder. Include any information developed concerning caseless ammunition.			
3.8 Prepare a chronological outline of centerfire ammunition development including firearms types that were develop for this type of ammunition. It should be in proper historical order. Discuss how each type of development was an improvement over the previous system. Areas of consideration:			

• What features of these early firearms are no longer in use today? • What were the advantages of each of the systems? • What were the disadvantages of each of the systems? • What areas are still open to improvement to any of these systems?			
3.9 Study the firearm section standard ammunition file, noting in particular cartridges and shotshells that are representative of commercial and military ammunition development during the past three decades.			
3.10 Conduct an in-depth study of exterior bullet coatings. Prepare a report about how this technology could impact microscopic comparisons.			
3.11 Prepare a report listing trends you see unfolding in cartridge and bullet development and show any historical significance to these findings.			
3.12 Prepare an overview of the current development in handguns and how this information might be of significance to the firearm examiner.			

3.0 Evolution of Early Firearms and Ammunition (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				

4.0 Development, Operating Systems & Manufacture of Modern Firearms

(top ↑)

OBJECTIVES

- Understand how modern firearms are made
- Understand where modern operating systems came from
- Understand modern operating systems, their features and how to identify each

INTRODUCTION

Read this entire section before you begin. Be advised some areas require a general understanding or familiarization, where other areas require specific knowledge. Retain all training documentation. Follow the firearm safety rules and procedures learned from the additional required readings to Section 3.0 of the New Employee General Training Manual.

Modern Firearms Development and Operating Systems: The key to modern firearms development was the evolution of modern self-contained metallic cartridges which could be loaded into a firearm at the breech. As you have seen in the previous section, these ideas actually went back hundreds of years, but until the arrival of the necessary technology they remained in the conceptual stage, or took the form of inadequate, sometimes dangerous, attempts to give the ideas physical form. The major problems were a lack of precision machining techniques which precluded adequate sealing of the high-pressure gases involved, and unreliable priming systems. With the movement from mechanical priming systems (firelocks of all types) to chemical priming (percussion locks) concurrent with the advent of the industrial revolution and precision machining techniques, it was only a matter of time until breech-loaded metallic cartridges designed for particular firearms came into being. The first modern firearms of this type were typically produced in tandem with a custom-designed metallic cartridge. One the concept was proven workable, the way was open for a practically endless series of weapon designs, operating systems, cartridge designs in both rimfire and centerfire, repeating rapid-fire systems and other engineering refinements. Modern ammunition and the firearms it made possible moved into the realm of engineering instead of empirical trial and error design efforts. Weapons could be designed and machined to close tolerances to accommodate precision-made metallic cartridge cases which would expand (obturate) under the high pressure of the hot, expanding gases due to burned gunpowder, thus sealing gases within the breech. These very workable and practical developments during the last half of the nineteenth century allowed the engineers and machinists of the world to produce the modern operating systems we know today. In this present section you will focus on these systems, and you will study the related machining techniques in the succeeding section.

Modern Firearm Manufacturing: The development of modern firearms was dependent on several factors coming together at once. You have already studied the evolution of rimfire and centerfire ammunition. Without these, the development of faster, more efficient firearms mechanisms would not have been possible. Most often, early developments and innovations in ammunition were accompanied by some concurrent development in firearms, often in a kind of chicken and egg relationship. But the critical element was the onset of the industrial revolution which brought with it the precision machine tools and techniques which made possible the manufacture of both ammunition and firearms, and not firearms, but firearms with interchangeable parts, high speed operation and sophisticated mechanisms. In this section you will focus on the machining processes which were critical to the development and manufacture of modern firearms, without which these firearms and much of modern industry would not have been possible.

DEVELOPMENT, OPERATING SYSTEMS & MANUFACTURE OF MODERN FIREARMS ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
4.1 Research and be able to explain the meaning of the terms: • Ballistics • Chemistry • Firearms identification • Mechanical engineering • Metallography • Metallurgy • Physics			
4.2 Research some of the materials used to manufacture firearms. Gain a general understanding of molecular structure by reading about atoms, molecules, compounds and crystals. Define and be familiar with the general composition, qualities and limitations of these materials as they relate to firearms and toolmarks. Include, but do not limit your study to the following: • Alloy • Aluminum • Bar stock • Barrel stock (chromium-molybdenum) • Carbon (as an element) • Ceramic (as used in molds) • Ferrous alloy • Iron (as an element) • Iron crystals • Iron ore • Pig iron • Polymer • Stainless steel • Steel • Tin • Titanium • Tungsten carbide • Zinc (as an element) • Zinc alloy (i.e. ZAMAK)			
4.3 Select firearms from the laboratory firearm reference collection to demonstrate each action listed below. Define each action and be familiar with any additional firearm actions found in the AFTE Glossary: • Automatic • Blowback • Bolt • Break-open • Double • Falling block • Hinged frame • Hybrid • Lever • Martini			

• Pump • Revolver • Rolling block • Semi-automatic • Single • Trap door			
4.4 Define each of the following types of firearms and explain in detail the cycle of fire. The operation of each type of firearm, including the loading of cartridges and the subsequent movement of the cartridge case and/or bullet after firing should be documented. Attempt to use the manufacturers' specific nomenclature for each step. Articulate the firearm information including make, model, caliber, action and serial number for each firearm utilized. • Single and double action revolvers • Single and double action semi-automatic pistols • Single shot pistols (including derringers) • Bolt-action rifle • Gas operated semi-automatic rifle • Pump-action rifle • Single shot rifles • Sub-machine guns (including blowback and delayed blowback) • Muzzle loading firearms • Percussion revolvers • Lever action rifles			
4.5 Explain the difference between manual, semi-automatic and automatic operation of firearms. Give an example of each.			
4.6 Explain the difference between a handgun and long gun.			
4.7 Define the following firearms parts: • Hammer • Trigger • Bolt • Sear • Extractor • Ejector • Barrel • Firing pin • Disconnector • Magazine • Grip • Frame • Butt • Fore-end • Slide			
4.8 Using shotguns from the firearms reference collection, explain and illustrate the differences between a gas-operated and a recoil-operated auto-loading shotgun.			
4.9 Explain and illustrate the differences between the following types of actions: • Blowback • Delayed blowback			

• Gas-delayed blowback • Short recoil • Long recoil • Striker operated • Manual operation • Semi-automatic • Revolver • Bolt • Pump • Lever • Single action • Double action • Hammer operation • Double action only • Single action only • Gas-operated			
4.10 Numerous manufacturing methods are used in the forming of modern firearm parts. Research, identify and briefly define the listed processes using the AFTE Glossary and other reliable references. Be familiar with the toolmark patterns (both striated and impressed) that some of these processes leave on the bearing surfaces of a firearm that are in direct contact with ammunition prior to and after discharge. In addition, you are encouraged to view online videos for these manufacturing process. Review the chip formation phenomenon common to all machine tools and keep it in mind while completing this assignment. • Abrasive machining • Annealing • Boring • Broaching (excluding barrel broaching) • Casting • Chamfering • Computer numeric control (CNC) • Cope and drag (as used in casting) • Drilling (excluding barrel/deep-hole drilling) • Electro chemical machining (ECM) • Electro discharge machining (EDM) • Extrusion • Filing • Fine-forming operations • Grinding • Hammer forging • Honing • Investment and die casting (parts) • Investment die casting (IC) • Lead lapping • Machine hammer forging • Metal injection molding (MIM) • Milling (include both face milling and peripheral or slab milling) • Molding			

• Planning • Powdered metal technology (PMT) • Sacrificial wax and runners (as used in casting) • Sanding • Sawing • Shaping • Stamping • Stoning • Subcontract manufacturing • Swaging • Ballizing • Turning • Ultrasonic methods			
4.11 Research in detail and briefly define the following terms as they pertain to barrel production and rifling methods. Explain how some tools and procedures were used in the past and identify the more common methods currently used. Consider how each method may affect the ammunition component(s) they may be in contact with. • Barrel deep-hole drilling • Barrel straightening • Burnishing • Chambering and throating • Contouring/profiling • Crowning • Cut rifling methods • Damascus barrel • Electro chemical machining (ECM) • Electro discharge machining (EDM) • Honing • Lead lapping • Mandrel • Drawn over mandrel (DOM) • Polygonal • Reaming • Single point tolls (hook/scrape cutters) • Tungsten carbide swaging (microgroove rifling)			
4.12 Research some of the common manufacturing tools (buttons, broaches, mandrels, etc.) used in rifling processes. Select firearms from the laboratory reference collection which were produced using each method (if possible). Examine the rifling of each firearm with a stereoscope to observe the differences in the class characteristics produced by the various rifling methods. Test fire the firearms and examine the effects these rifling methods have on the bearing surface of fired bullets. Mark the test fired bullets with both the firearm and the rifling method.			
4.13 Prepare a short paper discussing the differences in these rifling techniques including the advantages and disadvantages for each as viewed by the industry and the firearms examiner. • Button rifling • ECM rifling • EDM rifling			

• Gang broach • Hammer forge • Microgroove • Single point (hook/scrape cutters)			
4.14 Obtain broaches and buttons for study from your trainer. Determine the difference between barrels which have been button rifled and those which have been broach rifled. Write a short synopsis.			
4.15 Define the terms 'class,' 'individual' and 'subclass' characteristics using the AFTE Glossary. Identify and describe how, why or if there is a potential for each rifling method described previously to leave subclass characteristics in the rifling and on fired ammunition.			
4.16 Research AFTE Journal articles using the search key word 'subclass' and 'carry over.' Prepare a brief document summarizing at least five (5) articles. Have your trainer select one (1) of the articles to present to the section.			
4.17 Prepare and continue to update a personal repository/chart of firearms known to produce potential subclass characteristics from research published in the AFTE Journal. Identify the article, the firearm(s) manufacturer, model and caliber. Also identify the location, type and cause of the potential subclass characteristics identified in each article and initial and date each new entry.			
4.18 Identify, associate and explain how manufacturing processes may leave potential subclass characteristics on specific parts of a firearm other than the barrel (firing pin, extractor, ejector, breechface).			
4.19 Research in detail the words 'caliber' and 'gauge' in relation to firearms. Learn how and where a caliber is measured in a rifled barrel. Explain the origin of the word 'gauge' with regard to shotguns and other firearms as well.			
4.20 Research and be familiar with the following part fabrication terms: • Final assembly • Final steps • Hand fitting assembly • Headspace • High-stress load parts • Low-stress load parts • Repeating mechanism components • Small pins, screws and springs			
4.21 Research in detail and explain the meaning of the word 'headspace' and how it is measured in the chambers from all types of firearms. Learn the effects and safety concerns for an improper headspace.			
4.22 Research and explain the significance of the following terms as they related to firearms manufacture, accountability and identification. Note their various general locations on firearms, air-guns and flare-guns. Select ten firearms from the firearms reference collection and note the marks and location for each. Record the firearm(s) used and the location where this information was found: • Caliber • Firearm importer/exporter names • Hidden serial number(s) • Manufacturers' number			

• Manufacturers' name • Model • Part-stamped numbers (as on German Luger pistols) • Proof marks • Serial number • Work-stamp numbers (as on S&W revolvers)			
4.23 Research the history and current significance of proof marks as they relate to the manufacture of firearms. Be familiar with the following and prepare a brief synopsis of each: • Birmingham Gun Barrel Proof House • Firearm Owners' Protection Act 1986 • National Firearms Act 1934 • Private Proof House • Sporting Arms and Ammunition Manufacturers' Institute, Inc. (SAAMI) • The American National Standards Institute (ANSI) • Title II of the Gun Control Act (GCA) of 1968			
4.24 Research and document how and why the following manufacturing processes or methods are used in the finishing process of firearms: • Anodizing • Barrel straightening • Bluing • Case hardening • Chrome plating • Cosmetic finish • Electroplating • Honing • Lead lapping • Microstamping • Nickel plating • Parkerizing • Patina • Polishing • Powdered metal technology			
4.25 Obtain the following firearms from the firearms reference collection: • Rifle (bolt action; semi-automatic, lever) • Semi-automatic pistol (blowback; recoil) • Revolver (single action; double action) Take photographs and label the following parts of the seven firearms above, as applicable: • Breechface • Breech bolt • Bolt • Bolt face • Extractor • Ejector • Firing pin • Rifling • Barrel			

• Lands • Grooves • Ramp • Magazine • Clip • Ejection port • Receiver			
4.26 Demonstrate knowledge of the basic nomenclature of handguns, rifles and shotguns by defining the words and terms in the list below. Discuss the manufacturing methods that may have been used to fabricate and finish each part. Note the type of machining marks and/or marks produced from wear and abuse and each area that may leave impressions, striations or both on ammunition. Include but do not restrict your study to the following: • Actions • Anvil • Barrel • Bolt • Bore • Breech bolt • Breechface • Butt • Chamber • Choke • Choke tubes • Clip • Comb • Crown • Cylinder • Ejection port • Ejector • En bloc clip • Extractor • Feed ramps • Firing pin • Firing pin aperture • Forcing cone • Frames • Grooves • Hammer • Hammer spur • Heel • Lands • Magazine • Muzzle • Percussion nipple • Ramp • Receiver • Rifling type • Safeties			

• Sear • Slides • Stock pistol grip • Stock types • Stock wrist, heal and toe • Striker • Throat/leade • Trigger • Trigger bar • Trigger guard			
4.27 Research and explain the various types of firing mechanisms, specifically hammer and striker mechanisms found in open and closed bolt designs. Learn the internal safety mechanisms associated with these assemblies and how they function. Learn the manufacturer's nomenclature for these parts, when available, using the AFTE Glossary as needed.			
4.28 Research the evolution, purposes and processes associated with the application of serial numbers on firearms. Prepare a brief history of the methods used to apply serial numbers to frames.			
4.29 Identify the role of Small Arms and Ammunition Manufacturers Institute, Inc. (SAAMI) and the European Commission Internationale Permanente (CIP) on the firearm industries in the United States and Europe.			
4.30 Be familiar with the concepts, practice and reliability of 'microstamping' and evaluate the pros and cons these markings may have on the discipline of firearms identification.			
4.31 Select a firearm and identify how the following parts of that gun may have been made. Identify high stress and low stress parts paying close attention to those areas that are in direct contract with ammunition components during cycling and firing. Define the following: • Barrel • Barrel extension • Breechface • Chamber(s) • Brown • Ejection port • Ejector • Extractor • Feed ramp • Firing pin • Rifling • Throat/leade			
4.32 Research and explain the difference between an ammunition magazine and an ammunition clip.			
4.33 Research relevant state and penal laws and, at minimum, the legal definitions for the following words/terms. Define the following by state law and using the AFTE Glossary if needed: • Antique firearm • Assault weapon • Disguised gun • Firearm			

• Gun (discuss the meaning and use of the word in laboratory reports) • Imitation firearm • Replica firearm • Machine gun • Magazine/high capacity • Pistol • Revolver • Rifle • Semi-automatic • Shotgun • Silencer Oklahoma State Statutes can be found here: OKLAHOMA STATUTES (oklegislature.gov)			
4.34 Learn the meaning of the terms 'field strip,' detail strip' and 'disassembly.' While in training, it is recommended that reach firearm examined be field stripped.			
4.35 Research and define the following as they relate to firearm accessories and attachments: • Bayonet lug • Bipod • Butt plate • Flash suppressor • Half-moon clip • Moon clip • Muzzle brake • Pistol grip • Rail systems (Picantinny, Weaver, etc.) • Scope ring • Sling • Sling swivel • Sound suppressor • Stripper clip • Threaded barrel			
4.36 Identify the various types of internal and external safety mechanisms found in pistols, revolvers, rifles and shotguns. Learn the manufacturer's nomenclature for each safety mechanism. The AFTE Glossary may be used when needed. Classify each safety as active (manual) or passive. Include the following: • Cross bolt • Firing pin block • Grip • Half cock • Lever • Magazine • Sliding button • Tang • Thumb • Transfer bar • Trigger			

• Trigger lock • Wing			
4.37 Research and be able to comprehensively explain to a layman the manufacturing methods of common firearm parts that are in direct contact with ammunition during cycling and firing (barrel, breechface, chamber, extractor and ejector).			
4.38 If possible, tour the manufacturing facilities of at least six toolmakers, firearms and/or barrel manufacturers such as Wilson Barrels, Colt, Ruger, Smith & Wesson, Mossberg, Marlin, US Repeating Arms, etc. Document your experience and produce a written report of each visit. Emphasis should be placed on manufacturing and rifling techniques used by each manufacturer. Note the methods that may leave individual manufacturing toolmarks on firearm parts, which, in turn, produce individual microscopic marks on bullets and cartridge cases. Coordinate tours with your trainer.			
4.39 Explore some of the futuristic ideas and prototypes of new firearms. While these firearms may not be available for examination, attempt to evaluate any new manufacturing methods. Include in this research the use of 3-D printers to manufacture firearms. Document your findings.			

4.0 Development, Operating Systems & Manufacture of Modern Firearms

(top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Written exam				

5.0 Modern Ammunition (top ↑)

OBJECTIVES

- Understand the general manufacturing techniques used to make modern ammunition
- Be able to describe features of ammunition components (i.e., projectiles, cartridge cases, primers and gunpowder)
- Understand and be able to explain caliber / caliber-families

INTRODUCTION

Modern ammunition has not changed greatly after the invent of the self-contained metallic cartridge in the late 1800s. Manufacturing processes and a greater understanding of chemistry have helped 'fine-tune' the modern cartridge/shotshell; however, it can be difficult for an ammunition manufacturer to stand out in the crowd. This fact can aid, as well as limit, the examiner in their analysis.

In this section, you will learn the many types, features and manufacturing processes of modern ammunition, in addition to the current naming practices for ammunition. These can be used in the description and analysis of both unfired and fired ammunition components. The vast range of ammunition can seem overwhelming, as it is a topic with many years of history in addition to a continually expanding library of possibilities. Use this training section to collect resources and summarize large volumes of information, making yourself a resource to reference during further training sections, mock and real casework.

MANUFACTURE OF MODERN AMMUNITION ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
5.1 Identify and define the following words and terms with regard to cartridge case nomenclature/manufacturing. Locate an example of each from the lab stock ammunition or ammunition reference collection and photograph. Label the photograph appropriately. (Note: some photographs may be able to contain more than one of these words/terms): • Cartridge case • Head • Headstamp • Bunter • Mouth • Web • Extractor groove • Shoulder • Neck • Primer pocket • Flash hole • Primer (types and sizes) • Cannelure			
5.2 Metallic cartridges are primarily constructed of brass and lead. Brass is an alloy of copper and zinc. Research and identify the percentage of each, copper and zinc, typically used to manufacture the following: • Bullet jacket • Cartridge case • Primer			

5.3 Identify some common steel ammunition (cartridge cases, bullet jackets and bullet cores) and their marketers. Record your findings by producing a list with headstamps and their associated marketers.			
5.4 Military ammunitions often use color codes to identify bullet purpose and effect. Locate and examine three military ammunition color code charts and see how they may differ in this regard. Report some potential hazards when dealing with military ammunition in a laboratory.			
5.5 Identify, define and assemble a collection of representative photographs that best display these cartridge types. Document the significance of each. (Note: some photographs may be able to contain more than one of these words/terms): • Belted • Bottleneck • Rebated-rim • Rimless • Rimmed • Semi-rimmed • Centerfire • Rimfire			
5.6 Identify the locations on each of the cartridges above where headspace is measured. Prepare a report, in your own words, to describe the measurable locations on each.			
5.7 Identify and define these words and terms. Identify those areas on applicable bullets. Locate an example of each from the lab stock ammunition or ammunition reference collection and photograph. Label the photograph appropriately. (Note: some photographs may be able to contain more than one of these words/terms): • Meplat • Mold line/mold marks • Cannelure (types and purposes) • Ogive • Bearing surface • Diameter • Crimp • Core • Shank			
5.8 Identify, define and assemble a collection of representative bullets and/or photographs that best displays each of the following bullet types. Discuss the purpose and effect of each bullet design. • Full metal jacketed • Total metal jacketed • Jacketed round nose (ball) • Semi-jacketed soft point • Hollow point • Jacketed hollow point • Wadcutter • Semi-wadcutter • Copper-coated lead • Brass-coated lead • Frangible • Truncated-nosed			

• Soft point • Nylon-coated lead • Nickel plated • Heel • Concave base • Lead round nose • Bottail • Spritzer			
5.9 Research commercial names and manufacturers for cartridges with unique bullet designs including but not limited to the following. Document the problems involved with describing a fired by the commercial name versus the bullet design. • Black Talon • Silvertip • Nyclad • Gold Dot • SXT • Golden Saber • Hydra-Shok • Lubaloy • RIP • Guard Dog			
5.10 Research and list at least twenty (20) cartridge commercial names and discuss why the designer/manufacturer may have chosen those names. For example: 30.06, 30-30, 308 Win, 40 S&W, 38 Special, 9mm Luger, 357 Magnum, 7.62x39, 22 Long Rifle, etc. Reference the NRA Fact Book – Small Arms Ammunition – General Reference section.			
5.11 Research and prepare a brief report describing the difference in composition between single base, double base and triple base smokeless powders.			
5.12 Research and identify the purpose for various gunpowder grain shapes and coatings. Identify and list from slow burning to fast burning for each shape.			
5.13 Identify and document the difference between the measured caliber of a fired bullet and its inclusive caliber class of cartridges as listed in Table 8 of the AFTE Glossary.			
5.14 Using a bullet puller and micrometer, measure and discuss the difference between the actual bullet caliber and casing length measured to its commercial cartridge name applicable to those measurements. Research why some cartridges are tapered. Prepare a list of at least five tapered cartridges by name, caliber and case length.			
5.15 Using magnification, examine each bullet pulled in the above assignment for any striated marks. Note the direction and depth of any striae and attempt to determine the cause. Document what, if any, effect on firearm identification these striations may have when fired.			
5.16 Watch a variety of available ammunition manufacturing videos and document the videos watched.			
5.17 Based on previous tours/manufacturing videos outline the main steps in the modern manufacturing of each of the following: • Rimfire cartridges • Centerfire cartridges			

• Jacketed bullets • Lead bullets • Shotshells Steps to consider: • Blanking • Cupping • Annealing, pickling and washing • Drawing • Trimming • Bunting • Heading • Tapering and necking • Head turning • Relief annealing • Piercing flash hole • Priming / seating primer • Extrusion			
5.18 From those ammunition manufacturing videos, assess the typical manufacturing procedures used to construct a cartridge. Identify those areas on new cartridges that may have manufacturing marks. Search AFTE Journal articles for the key word 'subclass' in relation to manufacturing marks on ammunition. Prepare a list of articles that specifically identify an area on cartridges where repeated manufacturing marks may be found.			
5.19 Research and identify what is meant by the term 'proof cartridge.' Why is it different than a commercial cartridge? What is it used for? What authority governs the characteristics of a proof cartridge?			
5.20 Identify the following words and terms with regard to the manufacture of lead bullets: • Swaging • Casting • Casting seam • Sprue • Cutter quill • Bullet sizing			
5.21 Research the typical terminology used when discussing shotgun ammunition. Use the AFTE Glossary to define and be able to identify shotshell nomenclature. Do not limit your research to only this list. • Shotshell • Battery cup • High brass • Low brass • Overpowder wad • Undershot wad • Overshot wad • Filler wad • Cup wad • Power Piston wad • Shot collar • Crimp			

• Shot size • Slug • Buckshot • Birdshot			
5.22 Research modern shot compositions, manufacturing methods and preferred uses. Define and explain the following words and terms. • Bliemeister method • Antimony • Arsenic, as related to shot • Chilled shot • "Rule of 17" • Dram equivalent • Bismuth shot • Tungsten shot			
5.23 Prepare a list of common cartridge case headstamps and identify their marketers. Research and group those marketers to further identify their past and present corporate owners. Discuss why a cartridge headstamp may only represent the cartridge marketer and not necessarily the cartridge manufacturer.			
5.24 Define and explain the components of and differences between Berdan and Boxer primers. Research the differences in cartridge cases used with each and learn which can typically be related and why.			
5.25 Research and report the purpose and essential ingredients of priming mixtures used in modern cartridges. Include those that no longer use lead styphnate. Identify some ammunition manufacturers that employ lead free primers and compile a list of how they can be identified visually.			
5.26 Define and discuss the difference between caliber and caliber family. Illustrate this difference by relating these terms to a discussion of the 22 caliber, 30 caliber and 38 caliber families of cartridges.			
5.27 Compile a list of resources concerning ammunition and ammunition components. This can include books, articles and websites. Keep this list available, as it may prove useful in future mock and actual casework.			

5.0 Modern Ammunition (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Written exam				

6.0 Background/History of Firearm and Toolmark Examination and Current Trends (top ↑)

OBJECTIVES

- Understand the history and development of the field of firearm and toolmark examination
- Understand the basis for firearm and toolmark examination
- Become aware of current trends in the field

INTRODUCTION

In this section you will study the historical background, concepts and hardware advances in the field of firearms identification as we know it today. This body of knowledge is founded squarely on the previous topics covered in your training manual: small arms propellants, manufacturing processes, operating systems and very importantly, the cycle of fire of firearms. Propellants are essential to the accomplishment of the cycle of fire by any type of firearm operating system. In turn, the cycle of fire may cause the unique microscopic details left in the steel operating surfaces of firearms during factor machining process to be transferred to the surfaces of the softer metals of bullets and cartridge cases. These unique marks are often reproducible from shot to shot, and can be viewed and compared through an appropriate optical system, specifically the comparison microscope. If sufficient detail is present within these marks, fired ammunition components can often be identified as having been fired by a specific firearm, or by the same firearm as another similar component. This capability is at the core of what we call firearms identification today. Even in the absence of sufficient microscopic marks of value for identification purposes, certain grosser macroscopic markings can be used to at least categorize or classify fired ammunition components as to possible brands and models of firearms by which they could have been fired. For example, the relatively gross macroscopic impressions of the lands and grooves of a barrel left in fired bullets may yield data indicating the number of lands and grooves in that barrel, as well as the direction of the twist of these spiraled lands and grooves, and their dimensions. All of this data, while not unique to a particular firearm, are representative of a certain group of brands and models of firearms, and in this sense have value in limiting the field of possible firearms that could have fired a given evidence bullet. The potential value of even this limited kind of information is of great significance for investigators in managing and pursuing their cases.

At this point it is important to note that this section of your manual will also concentrate on the pioneers, history, personalities and hardware of firearms identification. The legitimate question as to the concept of what criteria constitute sufficient microscopic characteristics for identification of a fired bullet, cartridge case or shotshell casing with a particular firearm, as well as standards to be met for admissibility in court, will be held in abeyance until a subsequent section of your manual regarding these topics. The reason for this is that firearms identification, its pioneers and equipment, were originally focused on high profile crimes of violence using techniques based on empirical observations, good judgement, experience and training. All of this told them that each fired ammunition component bore unique markings, and that like fingerprints in humans, no two firearms bore the same individual characteristics. That sufficed for a period of years, until it was generally recognized that firearms identification was and is actually a very specialized subset of the umbrella discipline of general toolmarks identification. A convenient way to think about this is that since toolmarks in general are class, subclass and individual marks left by a harder object (a tool) acting on a softer object, that they steel parts of a firearm actually constitute a set of specialized steel tools that often leave unique microscopic marks on the softer metals of ammunition components. The problem arises when you consider that the discipline of firearms identification came to prominence historically before the conceptual basis and criteria for general toolmarks identifications (including firearms identification) had been articulated, defined and codified. That is an ongoing process, and would be confusing to incorporate in this section's historical orientation. Therefore, for clarity's sake, we will address this now rapidly accelerating

movement towards defining criteria for identification of any toolmark (including those caused by firearms) in a subsequent section.

BACKGROUND/HISTORY OF FIREARM AND TOOLMARK EXAMINATION AND CURRENT TRENDS ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
6.1 Define the following terms: • Firearm and toolmark examination • Ballistics • Interior ballistics • Exterior ballistics • Terminal ballistics			
6.2 Using applicable sections from the basic references and other relevant sources, prepare a report on the history, principles, evolution and scope of Firearm Identification in its broadest sense. Support your report by creating a timeline of key advancements in the field of Firearm and Toolmark Examination.			
6.3 Research the contributions of key individuals to the field of Firearm and Toolmark Examination. Summarize their contributions in a paper, devoting a paragraph to each individual.			
6.4 Prepare a short report on the history and development of laboratory instrumentation in the field of Firearm and Toolmark Examination, with emphasis on the comparison microscope.			
6.5 Discuss with system operators the status of the ongoing initiatives to link shootings using computer imagery such as the National Integrated Ballistics Information Network (NIBIN). Prepare a report on the legacy, existing, and emerging technologies.			
6.6 Research and discuss the emerging trends, pitfalls and identification possibilities of 3D-printed firearms, firearm parts and firearm accessories.			
6.7 Research and discuss 3D technologies as applied to firearm identification, including, but not limited to virtual comparison microscopy, measurement types (e.g., confocal, stereomicroscopy), etc.			
6.8 Visit and tour any laboratories that provide firearm and toolmark examination and comparison within your region. Coordinate these visits with your trainer.	Oklahoma City PD Tulsa PD		
6.9 Become knowledgeable about proficiency testing programs administered by outside independent testing services, with emphasis on proficiency testing programs conducted within the field of Firearm and Toolmark Examination.			
6.10 Discuss the proficiency testing program with your trainer, including an introduction to the CTS Portal (or other proficiency test provider portal).			

6.0 Background/History of Firearm and Toolmark Examination and Current Trends (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Written exam				

7.0 Instrumentation (top ↑)

OBJECTIVES

- Be familiar with the types, capabilities and limitations of the equipment used by the firearm and toolmark examiner
- Understand the requirements for each type of equipment found in the firearms and toolmarks unit
- Know how to use all instrumentation available and utilized in the FATM Unit

INTRODUCTION

One key aspect in the development of the discipline of firearms identification has always been the evolution of appropriate instrumentation. In this section you will study the evolution of the comparison microscope, the individuals involved, and the early ancillary equipment developed for or adapted to the firearms examiner's analysis of microscopic and macroscopic characteristics of value on fired ammunition components. All of these optical and mechanical tools have been developed because they have increased the examiner's ability to make observations and collect data at both the microscopic and macroscopic level, and to generate conclusions in terms of identifications or exclusions. Developments initiated during the last decade include computer-based imaging and pattern analysis systems such as the Integrated Ballistics Identification System (IBIS). These systems are additional tools which take advantage of the strength of computers: the ability to rapidly scan, store and make preliminary comparisons of extremely large numbers of images of microscopic marks from ammunition components and indicate high probability identifications. At the same time the human ability to make the final determination regarding identifications or unique matches is brought into play as has historically been the case. These systems increase the capabilities of firearms examiners, and paradoxically, the workload, in that the systems now make practical the comparison of today's evidence with all past submitted evidence, increasing the volume of work required of the human examiner.

INSTRUMENTATION ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
7.1 Describe and differentiate between the following: • Compound microscope • Stereo microscope • Comparison microscope			
7.2 Familiarize yourself with the instruction manuals and the mechanical and optical aspects of the various makes/models of comparison microscopes in the firearm section. Note the differences and similarities of each, both mechanically and optically. Determine how to insert a reticle and conduct measurements.			
7.3 Familiarize yourself with the following types of light sources that are used with comparison microscopes. • Fluorescent • Fiber optics (with and without filters) • Light emitting diode (LED)			
7.4 Use each of the light sources listed above with a comparison microscope. Observe the differences in the quality of each light source by examining specimens with various compositions to include: lead bullets, jacketed bullets and cartridge cases. In addition, various types of substrates displaying impressed and striated toolmarks, painted surfaces, fabric, paper, etc. should be evaluated. Vary the direction and, if possible, the intensity of the light sources. Discuss this with your trainer.			

7.5 Familiarize yourself with a comparison microscope in the firearm and toolmark unit and adjust the eyepieces and lighting. Become familiar with each of the objectives and the methods used to generate photomicrographs. Using each of the objective lenses, take photographs of the same object while varying the intensity and angle of the light sources.			
7.6 Become familiar with the use of the following equipment. • Steel rule • Reticle in ocular lens of binocular microscope • Scales located in the firearm section • Stage micrometer • Digital calibers			
7.7 Become familiar with and demonstrate use of the following equipment/software on the comparison microscope. • Digital camera • Digital photography software (SPOT)			
7.8 Weigh bullets of varying calibers using a scale. Report results in both grams and grains.			
7.9 Become familiar with and demonstrate use of the following bullet recovery systems (if available): • Water tank • Cotton box • Bullet trap • Long range			
7.10 Become familiar with and demonstrate use of an inertial bullet puller.			
7.11 Become familiar with the preventative maintenance, performance and/or calibration checks required in your laboratory for the following: • Comparison microscope • Micrometer • Calipers • Water tank • Long range • Scale • Steel rule • Gage blocks			

7.0 Instrumentation (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Observation-based exam				

8.0 Examination and Test Firing of Firearms (top ↑)

OBJECTIVES

- Be familiar with, able to describe, and able to mechanically manipulate all types of firearms
- Be able to safely examine a firearm, including but not limited to its overall functionality and obtaining known specimens (test firing)
- Be familiar with the various ways a firearm can malfunction, and ways to react or combat such malfunctions
- Image test fired specimens into the NIBIN databases via BrassTRAX

INTRODUCTION

This section of your training will rely heavily on your comprehension of certain previous building blocks: Section 4.0 Development, Operating Systems and Manufacture of Modern Ammunition and Section 5.0 Modern Ammunition. Taken together with this current section, these previous sections will allow you to conduct an examination of a firearm for proper function from the perspective of physical evidence and forensic science, as well as obtain known specimens of firearm ammunition components. This mandates an approach which as always considers safety first, transient forms of trace and associative evidence secondarily, and lastly, the actual technical protocol or procedure for examining the firearm itself. Because all that we do must be considered as ultimately open to review and scrutiny by our peers, supervisors, investigators, prosecutors, the courts and defense attorneys, and because we all want to do the best work possible, it is essential that we competently and accurately document what we do, how we do it and what our results are. This means conforming to standard protocols, gathering the necessary raw data and generating formal reports based on that data. These concepts will be adapted to the functional examination of firearms and obtaining known specimens.

It is the hope that after completion of this Section of the training manual, you will be authorized to perform firearm functionality testing, which will allow you to begin working casework that contains firearms for NIBIN entry.

EXAMINATION AND TEST FIRING OF FIREARMS ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
8.1 Using each type of firearm listed below, demonstrate how to render each in a safe condition, load and unload each using dummy ammunition, and safely handle each in a forensic environment. • Single shot firearm • Single action revolver • Double action revolver • Single action pistol • Double action pistol • Hybrid action pistol • Manually operated rifle • Semi-automatic rifle • Automatic rifle • Submachine gun • Machine gun			
8.2 Review the Firearms Chemical Inventory List (CIL), including the Safety Data Sheets (SDS) for the common chemical reagents used during the examination of firearms. Be familiar with the potential health hazards identified for each.			

8.3 Examine the following types of magazines and identify their parts. Pay close attention to those areas that come into direct contact with ammunition. Determine the comparative value of marks left on cartridges by these magazines in firearms identification. Read related AFTE Journal articles. • Detachable box • Drum • Internal box • Internal rotary • Single stack • Staggered column • Tubular			
8.4 Partially disassemble and reassemble the following revolvers (if available). Photograph and note the differences in their mechanisms. Identify the major parts by name and make appropriate notes. • Smith & Wesson double-action • Colt double-action • Ruger double-action • "Old style" Ruger single-action • "New style" Ruger single-action • Colt single-action			
8.5 Field strip and reassemble the following pistols (if available). Photograph and note differences in their mechanisms. Identify the major parts by name and make appropriate notes. • Browning Hi-Power • U.S. Pistol Model 1911A1 • Steyr, GB • Glock Model 17 • Beretta Model 92F • Sig Sauer Model 226 • Smith & Wesson Model 669 • H&K P7 • Desert Eagle • Walther P.38 • Walther PPK • Ruger MK II • Luger P08 • Hi-Point Model C9 • Smith & Wesson Sigma			
8.6 Field strip and reassemble the following submachine guns (if available). Photograph and note the differences in their mechanisms. Identify the major parts by name and make appropriate notes. • RPB Industries, M10 (open & closed bolt) • SWD Inc. M11/Nine • Uzi • M&K MP5 • US M3 • Intratec TEC 9 • Thompson • IMI Desert Eagle			

8.7 Become familiar with the operation for each of the following firearms (if available). Photograph and note the differences in their mechanisms. Identify the major parts by name and make appropriate notes. • U.S. Rifle Model M1 • U.S. Rifle Model M14 • U.S. Rifle Model M16 • Savage Model 99 • Winchester Model 94 • AK 47/74 and SKS • U.S. Rifle Model 1903			
8.8 Become familiar with the operation of each of the following shotguns (if available). Photograph and note the differences in their mechanisms. Identify the major parts by name and make appropriate notes. • Remington Model 870 • Winchester Model 12 • Ithaca Model 37 • Browning Model A5 • Remington Model 1100 • Harrington & Richardson Topper Model 158 • L.C. Smith, side-by-side double-barrel • Beretta, Silver Snipe, over-under double-barrel • Mossberg Model 500			
8.9 Become familiar with the operation of each of the following 22 caliber firearms (if available). Photograph and note the differences in their mechanisms. Identify the major parts by name and make appropriate notes. • Browning Autoloading rifle • Winchester Model 62 rifle • Remington Model 582 rifle • Ruger Model 10/22 rifle • Ruger MKII pistol • Colt Woodsman or Huntsman pistol • Raven/Lorcin/Jennings pistol			
8.10 Become familiar with the operation of each of the following 25 Auto caliber pistols (if available). Photograph and note the differences in their mechanisms. Identify the major parts by name and make appropriate notes. • Raven Arms • Colt Jr. • Beretta • Bauer			
8.11 Become familiar with the Firearm and Toolmark Unit laboratory range and safety rules. Demonstrate how to render firearms in a safe condition, handle and carry firearms in the laboratory, and safety test fire each of the different types of firearms.			
8.12 Detail how the following safety mechanisms function with emphasis on how the firing mechanisms are blocked, interrupted or otherwise stopped from operating: • Thumb			

• Grip • Magazine • Firing pin block • Transfer bar • Hammer block			
8.13 Obtain a copy of and become familiar with the Firearm and Toolmark Unit Policy Manual for the examination of firearms.			
8.14 Discuss with your trainer the protocol to be used in determining whether a firearm can be made to fire without pulling the trigger.			
8.15 Research, define and/or determine the implications of the following terms as they relate to the safety of operating a firearm. • Excessive headspace • Barrel obstruction • Barrel bulge • Broken extractor • Push off • Trigger shoe • False half-cock • Slam-fire • Poor sear engagement • Defective safety • High primer • Rail splitting • Hairline cracks • Improper timing • Excessive pressure • Dented barrel • Jar-off • Hang fire / delayed fire • Dirty firearm • Loose-fitting parts • Broken / defective sear tip • Broken / defective sear notch • Subcaliber ammunition			
8.16 Define the term “misfire.” Discuss the causes of misfires, the actions to be taken in the event of a misfire and when a firearm should be fired remotely.			
8.17 Discuss the use of a primed cartridge case/shotshell for testing the potential accidental / unintentional discharge of a firearm. Include the following in your notes: • Drop test and related problems • Jar-off • Slam-fire • Push off • Defective safety • False half-cock • Broken parks • Loose-fitting parts			
8.18 Discuss how to test fire modified, damaged or potentially unsafe firearms. Demonstrate using a safe firearm provided by your trainer.			

8.19 If possible, attend armorer training classes offered by various firearms manufacturers.			
8.20 When / if available, shadow another examiner as they explore the possibility of restoring an inoperable firearm obtained in casework to an operation condition. Note the limitations and reservations which must be considered and discuss these with your trainer.			
8.21 Review and discuss the references in the Firearm and Toolmark Unit library, including: computer references, physical files, print media and websites.			
8.22 Visit websites for at least five major firearm manufacturers. Print out or electronically store the available reference material and evaluate the value and limitations of the manufacturer's websites from a forensic perspective.			
8.23 Visit the AFTE website and search the AFTE Journal index to research a particular firearm.			
8.24 Visit the current AFTE Recall / Safety Warning List on the AFTE website (found in Forums). Familiarize yourself with the structure of the list and the sources of the recalls and warnings.			
8.25 Discuss the significance of the following marks in the determination of the origin and/or source of a firearm or component. • Proof marks • Inspector marks • Factory numbers and markings • Serial numbers • Part numbers • Company logos			
8.26 Discuss the following topics and become familiar with their uses and limitations: • Marking evidence firearms • Determining whether an evidence firearm has been "recently" fired • Determining the manufacturer of a firearm by examining a part from the firearm • Determining the manufacturer of a firearm from a photograph and comparing an evidence firearm to a photograph			
8.27 Investigate how to submit / store / examine evidence firearms when they have been recovered from water. Become familiar with the methods, limitations and reservations that must be considered when restoring theses firearms to an operating condition in order to obtain test specimens.			
8.28 Discuss how to examine a firearm to determine if has been altered to fire full automatic. Examine a firearm that has been altered to fire full automatic (if available) and report your findings.			
8.29 Discuss and document other types of trace evidence that may be present on a firearm when submitted. Discuss the laboratory's priority for processing evidence and the evidentiary potential of certain types of evidence over others when present. • Blood • Bone • Tissue • Glass			

• Bore residues • Cylinder halos • Hair • Fibers • Fingerprints • DNA • Paint • Impression on breech block face			
8.30 Discuss the following concerns regarding the security and tracking of firearms as physical evidence: • Marking of evidence and packaging • Chain of custody documentation • Proper packaging			
8.31 Review the Firearm and Toolmark Unit range safety guidelines, making sure to address the following: • Basic safety rules and guidelines for handling firearms • Receiving firearms from investigators • Secure storage of firearm upon receipt • Shipment and transportation of firearms • General preliminary examination procedures • Safety checks for all firearms • Test firing protocols and safety • Eye and ear protection • Bullet recovery tanks and traps • General range rules			
8.32 Using firearms provided by your trainer, generate images suitable for use in case documentation using the following equipment: • Digital camera and lighting • Computer, monitor and printer			
8.33 Review with your trainer the firearm worksheet(s) used for determining the functionality of firearms in the Firearm and Toolmark Unit. Demonstrate the proper use of the worksheet using a firearm(s) selected by your trainer.			
8.34 Discuss the process of selecting the appropriate ammunition type for obtaining “known” or “test” specimens for a particular case or incident. Consider the possibility of cartridge interchangeability for both function testing and obtaining test specimens.			
8.35 Discuss the procedure for indexing ammunition for orientation in the firearm and marking ammunition to record their sequence of firing. Make not of the action mode used for each test and if firing a revolver or derringer which chamber they were fired in.			
8.36 Become familiar with the Firearm and Toolmark Unit policy and procedure regarding measurement uncertainty for overall and barrel length measurements. Complete the laboratory’s uncertainty of measurement training for overall and barrel length measurements. Upon successful training, complete the uncertainty of measurement process for overall and barrel lengths using the following firearms: • Revelation 350 Series K model 410 Gauge shotgun, serial number A732467			

• Remington 870 Wingmaster model 20 Gauge shotgun, serial number 993352X • DPMS A-15 model 223 REM/5.56x45mm rifle, serial number 10656 Research the manufacturer's specifications and measurements for each firearm. Discuss how and why manufacturer's specifications and actual measurements may differ.			
8.37 Examine a variety of firearms provided by your trainer using the Firearm and Toolmark Unit firearm worksheet(s). Test fire each using the different types of bullet recovery methods available in the laboratory. Properly obtain test specimens of fired bullets and cartridge cases and package them as you would in casework.			
8.38 Discuss the uses and limitations of casting firearm parts in relation to casework. Using one of the previous firearms provided, cast both the barrel and the breechface using casting material available in the laboratory.			
8.39 Complete training in the imaging of fired cartridge cases into the ATF's BrassTRAX / NIBIN database.			
8.40 Research, then discuss with your trainer the extent and limitations concerning testimony in firearm functionality.			
8.41 Research, then discuss with your trainer the administrative and technical review(s) of a firearm functionality case. See QP 31 – Reviews.			

8.0 Examination and Test Firing of Firearms (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Written exam				
Observation-based competency test*				
Oral exam**				

*This competency test serves to fulfill the assessment for Section 8.0 of the FATM Training Manual, in addition to the required competency test for authorization to perform this function.

**Oral exam questions, acceptable answers and criteria for acceptable performance shall be established and documented by the FATM Technical Manager or their designee prior to the trainee beginning the oral exam.

9.0 Theory of Identification and Range of Conclusions (top ↑)

OBJECTIVES

- Understand the principles on which the field of firearms and toolmarks examination stand
- Be extensively familiar with the AFTE Theory of Identification
- Be extensively familiar with the AFTE Range of Conclusions

INTRODUCTION

Firearm and toolmark examination, its pioneers and equipment, were originally focused on high profile crimes of violence using techniques based on empirical observations, good judgement, experience and training. All of this told them that each fired ammunition component bore unique markings, and that like fingerprints in humans, no two firearms bore the same individual characteristics. That sufficed for a period of years, until it was generally recognized that firearms identification was and is actually a very specialized subset of the umbrella discipline of general toolmarks identification. A convenient way to think about this is that single toolmarks in general are class, subclass and individual marks left by a harder object (a tool) acting on a softer object, that the steel parts of a firearm actually constitute a set of specialized steel tools that often leave unique microscopic marks on the softer metals of ammunition components. The problem arises when you consider that the discipline of firearms identification came to prominence historically before the conceptual basis and criteria for general toolmarks identifications (including firearms identification) had been articulated, defined and codified.

For this reason, the Association of Firearm and Toolmark Examiners (AFTE) published the Theory of Identification and Range of Conclusions. These two definitions help unify the practitioners of the field as well as attempt to codify or explain the principles on which conclusions are drawn.

For every assignment that follows, physically locate and examine the items mentioned where possible.

THEORY OF IDENTIFICATION AND RANGE OF CONCLUSIONS ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
9.1 Answer the following questions: • Is the forensic science discipline of Firearm and Toolmark Examination an art or a science? • What are the types of conclusions that can be reached in Firearm and Toolmark Examination comparisons? • What is the basis for each of the above conclusions? • Is it possible for experts in the forensic science discipline of Firearm and Toolmark Examination to disagree regarding their conclusions? Why or why not? • How does “probability” relate to Firearm and Toolmark Examination?			
9.2 Describe the steps of the scientific method involved in the formation of a scientific theory.			
9.3 Define the foundational premise of uniqueness behind the applied science of Toolmark Identification. Include the following: • Manufacturing processes • Chip formation • Working surfaces • Tool wear • Subclass characteristics			

9.4 Discuss the AFTE Theory of Identification as it applies to impressed and striated toolmarks, including Firearm Examination as a subset of Toolmark Examination.			
9.5 With respect to the AFTE Theory of Identification, is a common source conclusion absolute? Why or why not?			
9.6 Answers the following questions: • Is the forensic science discipline of Firearm and Toolmark Examination an art or a science? • What are the types of conclusions that can be reached in Firearm and Toolmark Examination comparisons? • What is the basis for each of the above conclusions? • Is it possible for experts in the forensic science discipline of Firearm and Toolmark Examination to disagree regarding their conclusions? Why or why not? • How does "probability" relate to Firearm and Toolmark Examination?			
9.7 Be able to discuss the importance of studies involving consecutively manufactured tools/parts in relation to the validation of the AFTE Theory of Identification.			
9.8 Research and be able to discuss empirical and experimental studies of error rates in the field of Firearm and Toolmark Identification.			
9.9 Define the following and discuss them in relation to examinations, observations and interpretations in relation to Firearm and Toolmark Identification. • Subjective • Objective			
9.10 Define the following components of the AFTE Theory of Identification in your own words and discuss with your trainer: • To what is "sufficient agreement" related? • How is significance (with respect to "sufficient agreement") determined? • When is agreement deemed significant? • What does "sufficient agreement" mean?			
9.11 Respond to the following critique of the AFTE Theory of Identification and discuss with your trainer: "…the state method [AFTE Theory of Identification] is circular. It declares that an examiner may state that two toolmarks have a 'common origin' when their features are in 'sufficient agreement.' It then defines 'sufficient agreement' as occurring when the examiner considers it a 'practical impossibility' that the toolmarks have different origins."			
9.12 Define the following conclusions within the AFTE Range of Conclusions in your own words and discuss with your trainer. • Identification • Elimination • Inconclusive • Unsuitable			
9.13 Research the issue of contextual land confirmation bias and respond to the following questions, discussing them with your trainer: • Why is there a concern for the potential of contextual and confirmation bias, especially in the pattern matching disciples? • In what ways can examiners be influenced by bias?			

• What are some of the precautions that can be taken to reduce bias?			
9.14 Be able to discuss how the AFTE Theory of Identification along with the Range of Conclusions provide a framework for structuring and articulating identification criteria and possible conclusions that may be reached.			
9.15 Research the concept of consecutively matching striations (CMS) and respond to the following questions, discussing them with your trainer. • Define the concept of consecutively matching striations (CMS). • For which type of toolmarks can CMS be used? • How do those who utilize CMS differentiate between two-dimensional and three-dimensional toolmarks? • What is the minimum conservative quantitative criteria for three-dimensional striated toolmarks? • What is the minimum conservative quantitative criteria for two-dimensional striated toolmarks? • In what ways can the use of CMS and the minimum conservative quantitative criteria be used to bring a greater level of objectivity when identifying two toolmarks as sharing a common source?			
9.16 Research the range of conclusions used by the European Network of Forensic Science Institutes (ENFSI) and respond to the following questions, discussing them with your trainer. • What is likelihood ratio? • How are the range of conclusions used by ENFSI and the range of conclusions used by AFTE similar? • How are the range of conclusions used by ENFSI and the range of conclusions used by AFTE different?			
9.17 The AFTE Theory of Identification requires that in order to opine that two toolmarks share a common source, the observed correspondence must exceed the best correspondence observed in toolmarks from different sources and must be consistent with the range of correspondence expected in toolmarks known to share the same source. Often individuals will describe the best-known non-match as when they compared toolmarks from consecutively manufactured tools. It is important to know that while these are ***conditions*** under which the best-known non-match may be observed, this does not describe the best-known non-match. The best-known non-match must be described relative to the correspondence of marks observed in toolmarks created by different tools. Meanwhile, toolmarks generated by the same tool can have a wide range of correspondence that extends from the level of correspondence observed in known non-matching conditions to almost perfect agreement. To properly develop a personal criterion for identification, it is essential that the trainee not only examine and compare toolmarks in known matching and known non-matching conditions but can articulate what the correspondence in those different conditions looks like. So, the remainder of the training with respect to the AFTE Range of Conclusions			

is in conjunction with the training involving the comparison of bullets, cartridge cases, shotshells and toolmarks. For ***each*** comparison of toolmarks in a known match condition, the trainee should be prepared to respond to the following: • Describe how the least amount of observed correspondence appeared. • Describe how the greatest amount of observed correspondence appeared. • Discuss the overall range of correspondence that was observed. • Discuss how the correspondence observed in this comparison compared with the range of correspondence in other known matching toolmarks compared to this point. For ***each*** comparison of toolmarks in a known non-matching condition, the trainee should be prepared to respond to the following: • Describe how the best-known non-match correspondence appeared. • Discuss how the correspondence observed in this comparison compared with the correspondence observed in other known non-matching toolmarks compared to this point. • Has your concept of the best-known non-match been adjusted?			
9.18 After the different comparisons are completed, return to this section to respond to the following questions: • What does your best-known non-match look like? • What does the range of correspondence observed in known matching conditions look like? • What is the certainty with which you can express opinions of common source?			

9.0 Theory of Identification and Range of Conclusions (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				

10.0 Bullet Examinations and Comparisons (top ↑)

OBJECTIVES

- Be familiar with the types of marks a firearm can leave on a fired bullet
- Understand the importance and limitations of the types of marks a firearm can leave on a fired bullet
- Be comfortable with comparing bullets and form conclusions
- Know the required procedure and documentation for bullet examinations and comparisons

INTRODUCTION

This portion of your training will address one of the core applications of the discipline of firearms identification. In this current section you will specifically consider toolmarked items (bullets) marked by a type of tool (a firearm). These items, which may bear class, subclass, as well as microscopic marks, are as familiar as fingerprints are, even to the general public. These class marks, or general rifling characteristics, consist of caliber, direction of twist, number of lands and grooves and their dimensions. Subclass characteristics result from manufacturing processes related to the firearm and may be 'carried over' from one barrel to another. However, while all class and subclass characteristics found on fired bullets serve to narrow a larger group of items into a smaller subset, the striated toolmarks left on a fired bullet by the barrel of a firearm are unique and identifiable with a specific firearm. While applying the criteria for identification to the comparison of fired bullets, you will learn to use a standard technical protocol, a data collection worksheet and a logical approach to reporting your results in a formal report based on your raw data. Keep in mind that the techniques of comparison microscopy you will apply in this section are also at the heart of the comparisons of fired cartridge cases and shotshells you will examine in the next section.

BULLET EXAMINATIONS AND COMPARISONS ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
10.1 Define class characteristics, subclass characteristics and individual characteristics as they relate to the comparison of fired bullets.			
10.2 Define what is meant by, or determine the significance of, the following words, terms or phrases as they relate to the examination and comparison of fired bullets. • Slippage (skid marks) • Shaving • Obturation • Leading edge / trailing edge • Melting • Blow-by / gas cutting • Striation • Ogive • Bearing surface • General rifling characteristics • "insufficient individual microscopic marks" • Corrosion • Leading • "Limited individual microscopic marks" • "single-action" firing • "double-action" firing • Knurled and grooved cannelures • Stab crimp • Boattail			

• Open base • Closed base • Recessed base • Skived tip / hollow point • Flared base • Trace evidence aspects (lacquers, sealants, painted tips, biological materials, paint, fibers, glass, etc.)			
10.3 Discuss the importance and limitations of each of the following as they relate to the examination and comparison of fired bullet / bullet fragments: • Weight • Nominal caliber • Caliber family • Manufacturer • General rifling characteristics • Pitch of rifling • Depth of rifling • Jacket construction / composition			
10.4 Obtain a copy of and become familiar with the Firearm and Toolmark Unit Policy Manual for the examination of fired bullets.			
10.5 Review the AFTE Theory of Identification and AFTE Range of Conclusions. Determine what conclusions may be reached by the Firearm and Toolmark Examiner from our laboratory in relation to bullet examinations and how conclusions are documented. Review conclusions in reports generated by examiners in the Firearms and Toolmarks Unit. Discuss these conclusions with your trainer.			
10.6 Discuss the significance of trace evidence as it relates to the examination and comparison of fired bullets.			
10.7 Discuss how to “index” bullets for examination and comparison. Demonstrate for your trainer.			
10.8 Discuss lighting techniques as they relate to the comparison of fired bullets with your trainer. Demonstrate your proficiency in using these lighting techniques.			
10.9 Familiarize yourself with the laboratory’s ammunition reference collection. Learn how to search this file to determine the manufacturer of fired bullets. Demonstrate your proficiency in using this file to your trainer.			
10.10 Become familiar with the laboratory’s test fire reference collection. Determine its location, composition, firing system, and uses as a reference file. Discuss this with your trainer.			
10.11 Become familiar with the AFTE General Rifling Characteristic (GRC) database.			
10.12 Become familiar with the FBI General Rifling Characteristic (GRC) database.			
10.13 Compile a list of possible firearms in a “no-gun case” using the laboratory’s procedures and a relevant GRC file. Demonstrate proficiency of use to your trainer.			
10.14 Using fired bullets and bullet fragments provided to you by your trainer, determine their caliber, caliber family, manufacturer, and general rifling characteristics. Using the test fire reference collection, ammunition reference collection and GRC files, generate a list of			

firearms that could have been used to fire these bullet / bullet fragments.			
10.15 Determine and summarize the methods and techniques used to differentiate between lead bullets and bullet cores.			
10.16 Become familiar with the ammunition storage areas and learn how to locate test ammunition. Document and discuss with your trainer the reasons for using substitute ammunition or downloading ammunition for test firing.			
10.17 Microscopically compare bullets test fired from firearms with consecutively manufactured barrels. Observe the differences and similarities in the bullet stria. Document and discuss this with your trainer.			
10.18 Using the same 22 Long Rifle firearm, test fire two each of a variety of 22 Short, 22 Long and 22 Long Rifle ammunition and compare the test fired bullets with each other. Be sure to include different brands and different bullet styles, such as lead, copper-coated lead, and brass-coated lead bullets. Document and discuss your observations with your trainer. Take appropriate photographs and notes.			
10.19 Using the same 357 Magnum revolver, test fire two each of a variety of 38 Special and 357 Magnum caliber ammunition and compare the test fired bullets with each other. Be sure to include different brand sand different bullet styles, such as lead round nose, copper jacketed, Winchester brand Silvertip, and Federal brand Nyclad or Syntech. Discuss your observations with your trainer. Take appropriate photographs and notes.			
10.20 Using the same 9mm Luger pistol, test fire two each of a variety of 9mm Luger caliber ammunition and compare the test fired bullets with each other. Be sure to include different brand sand different bullet styles, such as RIP brand, Federal brand Hydra-Shok, PMC brand Starfire, Winchester brand Silver tip and Ranger SXT, Federal brand Nyclad or Syntech, full metal jacketed, total metal jacketed and frangible. Discuss your observations with your trainer. Take appropriate photographs and notes.			
10.21 Using the same 357 Magnum revolver, test fire two each of a variety of 38 Special and 357 Magnum caliber ammunition and compare the test fired bullets with each other. Be sure to include different brand sand different bullet styles, such as lead round nose, copper jacketed, Winchester brand Silvertip, and Federal brand Nyclad or Syntech. Discuss your observations with your trainer. Take appropriate photographs and notes.			
10.22 Using a nominal 30-caliber rifle, test fire two each of a variety ammunition and compare the test fired bullets with each other. Be sure to include jacketed soft point, copper jacketed, steel jacketed and nickel plated bullets. Discuss your observations with your trainer. Take appropriate photographs and notes.			
10.23 Using a 32 S&W revolver, test fire two each of 32 S&W and 32 Auto ammunition and compare the test fired bullets with each other. Discuss your observations with your trainer. Take appropriate photographs and notes.			
10.24 Test fire three different polygonally rifled pistols, such as Glock, H&K, IMI or Steyr, with two of the same cartridges. Compare the test fired bullets from each pistol with each and with the test fires from the			

other pistols. Discuss your observations with your trainer. Take appropriate photographs and notes.			
10.25 Discuss how potential subclass characteristics may be recognized and addressed during a microscopic bullet examination. Articulate the results using a photomicrograph representation of your findings.			
10.26 Compile a list of reasons why bullet identifications cannot be made in some cases, and why some barrels are bullets may preclude identifications. This list should include, but not be limited to, the results of the above exercises.			
10.27 Discuss the significance of identifying manufacturing toolmarks on a fired bullet from a shooting victim to those on unfired bullets from cartridges obtained from a suspect. Read the article in the April 1985 issue of the Crime Laboratory Digest concerning “Manufacturing Toolmark Identification on the Base of Jacketed Bullets.” (Re-print: Crum, R.A. “Manufacturing Toolmark Identification on the Base of Jacketed Bullets,” 1987; 19(4): 447-450.)			
10.28 Research, then discuss with your trainer the extent and limitations concerning testimony in bullet examination and comparison.			
10.29 Research, then discuss with your trainer the administrative and technical review(s) of a bullet examination and/or comparison case. See QP 31 – Reviews.			

10.0 Bullet Examinations and Comparisons (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Competency test*				
Oral exam**				

*Competency test's expected results shall be established and documented by the FATM Technical Manager or their designee prior to the trainee receiving the competency test.
*This competency test serves to fulfill the assessment for Section 10.0 of the FATM Training Manual, in addition to the required competency test for authorization to perform this function.
**Oral exam questions, acceptable answers and criteria for acceptable performance shall be established and documented by the FATM Technical Manager or their designee prior to the trainee beginning the oral exam.

11.0 Cartridge/Cartridge Case/Shotshell Examinations and Comparisons

(top ↑)

OBJECTIVES

- Be familiar with the types of marks a firearm can leave on a cartridge/cartridge case/shotshell
- Understand the importance and limitations of the types of marks a firearm can leave on a fired cartridge case or shotshell
- Be comfortable with comparing cartridges/cartridge cases/shotshells and form conclusions
- Know the required procedure and documentation for cartridge case and shotshell examinations and comparisons

INTRODUCTION

This portion of your training will address another of the core applications of the discipline of firearms identification. In this section, you will consider a category of toolmarked items (cartridges, cartridge cases, shotshells and fired shotshells) marked by a specific type of tool (a firearm). These marks are the result of firing a gun as well as by working a cartridge or shotshell through the action of a firearm. The marks may include extractor and ejector marks, firing pin impressions, breech or bolt face marks, chamber marks due to obturation, anvil marks, magazine marks, etc., all of which reflect both class and individual characteristics. Although these types of marks may not be as familiar to the general public as the unique marks which can be left on fired bullets, they can nonetheless have a great impact on the presentation of a case in court. The class characteristics left on cartridges and shotshells are valuable due to their size, shape and relative positioning, and due to the fact that they can assist in narrowing the field of possible firearms involved in an incident through the use of the GRC File and other publications. In addition to class and possible subclass marks, the unique microscopic detail which can be left on these components may also be identified with aa specific firearm. Although these identifications are just as valid as with bullets, the meaning of them will vary with the type of mark, as you will see. The theory of identification, the criteria for identification and the types of conclusions which are possible apply in this specialized area as well as in bullet identifications.

CARTRIDGE/CARTRIDGE CASE EXAMINATIONS AND COMPARISONS ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
11.1 Define class characteristics, subclass characteristics and individual characteristics as they relate to the comparison of cartridge cases.			
11.2 Determine the types of marks that may be left on a cartridge case or cartridge during the chambering, extraction and firing. View slow motion videos of firing sequences using semi-automatic firearms. Give examples of different class characteristics that are specific to particular firearms.			
11.3 Obtain a copy of and become familiar with the Firearm and Toolmark Unit Policy Manual for the examination of cartridges and cartridge cases.			
11.4 Read the following article from the spring 2001 issue of the AFTE Journal and discuss manufacturing marks with your trainer: “Overview of Manufacturing Marks on Center Fire Cartridges”			
11.5 Review the AFTE Theory of Identification and AFTE Range of Conclusions. Determine what conclusions may be reached by the Firearm and Toolmark Examiner from our laboratory in relation to cartridge case examinations and how conclusions are documented.			

Review conclusions in reports generated by examiners in the Firearms and Toolmarks Unit. Discuss these conclusions with your trainer.			
11.6 Discuss the significance of trace evidence as it relates to the examination and comparison of cartridge cases.			
11.7 Discuss how to "index" cartridge cases for comparisons. Demonstrate for your trainer.			
11.8 Discuss lighting techniques as they relate to the comparison of fired cartridge cases with your trainer. Demonstrate your proficiency in using these lighting techniques.			
11.9 Test fire a variety of firearms spanning multiple makes, models and calibers at least twice each. Be sure to include both centerfire and rimfire calibers. Examine markings imparted to the fired cartridge cases. Determine which part of the firearm produced these markings. Cycle at least two cartridges through each of the same firearms and examine the markings imparted to the unfired cartridges. Determine which part of the firearm produced these markings. This exercise may require the firearms to be field stripped or further disassembly to assess locations imparting markings.			
11.10 Using the test fired cartridge cases and cartridges from Exercise 2, microscopically compare all markings to each other. Include the comparison of firing pin impressions, firing pin drag marks, breechface marks, chamber marks, anvil marks, extractor marks, ejector marks, feed ramp marks, slide drag marks, slide scuff marks, ejection port marks and magazine marks. Photograph the results of your comparisons.			
11.11 Test fire 38 Special, 357 Magnum, 9mm Luger and 22 Long Rifle revolvers and pistols at least twice using CCI, Remington, Federal, and Winchester ammunition with both nickel and brass primers. Microscopically examine and photograph the markings.			
11.12 Test fire a 22 Long Rifle Smith & Wesson revolver using six 22 Long Rifle cartridges, six 22 Long cartridges and six 22 Short cartridges by the same manufacturer. Mark each cartridge to signify which chamber of the cylinder it was fired in. Examine and photograph the markings imparted to the fired cartridge cases.			
11.13 Become familiar with the AFTE Class Characteristics Matrix database.			
11.14 Discuss the possibility of comparing and identifying reloading marks on cartridges/cartridge cases. Identify the various types of marks that may be indicative of reloaded ammunition. Become familiar with commonly used reloading equipment and the procedures used in reloading cartridges.			
11.15 Discuss the feasibility of comparing and identifying manufacturing toolmarks such as bunter marks on a fired cartridge case from a crime scene with cartridges associated with a suspect. Identify the various types of manufacturing toolmarks that may be present on cartridges or cartridge cases.			
11.16 Test fire at least two cartridges from a 30 Carbine U.S., M1 Carbine rifle (if available) and compare all marks on the test fired cartridge cases to each other. Cycle at least two cartridges from this same firearm and compare all marks observed.			
11.17 Compare test fires from various firearms prior to and after the breech and bore are cleaned.			

11.18 Perform a series of examinations in a mock ongoing investigation that incorporates bullets, cartridge cases, firearms and the use of a comparison microscope.			
11.19 Determine when Magnesium Smoking would be of value in examination and/or comparison of cartridge cases. Determine if the OSBI Firearms and Toolmarks Unit has procedures and/or the materials needed to conduct Magnesium Smoking on cartridge cases.			
11.20 Compare test fired cartridges from firearms with consecutively manufactured breechfaces and/or firing pins. Observe the differences and similarities in the stria and discuss this with your trainer.			
11.21 Compile a list of common headstamps. Familiarize yourself with the AFTE Headstamp Gallery and commercially available headstamp guides. Discuss these with your trainer.			
11.22 Test fire the following 12 Gauge shotguns or similar models using at least two shotshells from each shotgun. Microscopically compare the marks imparted to these fired shotshells to include the following types of marks: firing pin impressions, breechface marks (on primer, battery cup and head), extractor marks, ejector marks, chamber marks, shell stop marks and any other mechanism marks. Photograph these marks and discuss the significance of identifying any of these types of marks with your trainer. • Marlin Model 55 or 50 bolt action • Remington Model 1100 semi-automatic • Mossberg Model 500 pump action • J.C. Higgins Model 1011 top-break single shot • Stevens Model 311 side-by-side double barrel			
11.23 Cycle three shotshells with a pump action 12 Gauge shotgun. Microscopically compare the markings observed and determine whether the extractor, ejector and any other marks are identifiable.			
11.24 Research, then discuss with your trainer the extent and limitations concerning testimony in cartridge/cartridge case/shotshell examination and/or comparison.			
11.25 Research, then discuss with your trainer the administrative and technical review(s) of a cartridge/cartridge case/shotshell case. See QP 31 – Reviews.			

11.0 Cartridge/Cartridge Case/Shotshell Examinations and Comparisons

(top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Competency test(s)* [to include cartridges, cartridge cases and shotshells together or separately]				
Oral exam**				

*Competency test's expected results shall be established and documented by the FATM Technical Manager or their designee prior to the trainee receiving the competency test.

*This competency test(s) serves to fulfill the assessment for Section 11.0 of the FATM Training Manual, in addition to the required competency test for authorization to perform this function.

**Oral exam questions, acceptable answers and criteria for acceptable performance shall be established and documented by the FATM Technical Manager or their designee prior to the trainee beginning the oral exam.

12.0 Shotshell Component Examinations (top ↑)

OBJECTIVES

- Understand the importance and limitations of the types of marks a firearm can leave on shotshell components
- Know the required procedure and documentation for shotshell component examinations
- Be familiar with the types of shotshell components, what they reveal about the shotshell they came from and/or the firearm that fired them

INTRODUCTION

Shotshells and fired shotshells can be treated, examined and compared in the same manner as cartridges and fired cartridge cases. However, the other components of a shotshell (e.g., shot, buffer, wad) have examinations and conclusions all their own.

SHOTSHELL COMPONENT EXAMINATIONS AND COMPARISONS ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
12.1 Determine what types of examinations may be conducted and what conclusions can be reached from an examination of the following components. • Shot, deformed and intact • Fired cardboard, felt or fiber wads • Fired plastic wads • Fired shotshells • Unfired shotshells • Shot buffer material • Shot collar and shot cup			
12.2 Becomes familiar with the use of the laboratory's ammunition reference collection regarding the determination of gauge and manufacturer of fired shotshell components. Learn the limitations regarding making such determinations. Demonstrate proficiency in using the ammunition reference collection to your trainer.			
12.3 Test fire one or more sawed off shotguns using various types of ammunition with different wad designs to include Remington shotshells with Power Piston wads. Alternately, obtain test fired shotshells wads from a shotgun with a barrel that was sawed off with a hacksaw or similar tool. Microscopically compare marks observed on the test shotshell wads.			
12.4 Locate and discuss with your trainer the procedure for 'sampling' when doing examinations of shotshell pellets.			
12.5 Using a 12 Gauge Remington, Model 1100 shotgun, obtain at least two fired shotshells with each of the following types of ammunition. Recover a representative number of fired shot pellets and fired shot wads from each type of ammunition. Or use the collection of such fired shotshells found in the laboratory. Compare marks observed on the test fired shotshells to each other. Compare fired components to unfired components of the same ammunition type. Discuss the significance of your findings with your trainer. • 12 Gauge Remington, 2 ¾" Magnum, 00 Buck			

• 12 Gauge Remington, 2 ¾" Shur-Shot, #8 shot • 12 Gauge Federal, 2 ¾" Magnum, 00 Buck • 12 Gauge Federal, 2 ¾" Field Load, #9 shot • 12 Gauge Activ, 2 ¾" Field Load, #7 shot • 12 Gauge Activ, 2 ¾" Magnum, BB shot • 12 Gauge Winchester, 2 ¾" Xpert, #6 shot • 12 Gauge Winchester, 2/34" Super-X, #7 shot			
12.6 Discuss in detail the procedures used in reloading shotshells and become familiar with commonly used shotshell reloading equipment. Determine how to recognize reloaded shotshells from an examination of the fired shotshell and/or its components.			
12.7 Research the current U.S. shot sizes and weights and obtain a chart reflecting this data. Become familiar with the variations worldwide in shot size and composition. Learn the significance of the "Rule of 17" as it applies to shot size.			
12.8 Research, then discuss with your trainer the extent and limitations concerning testimony in shotshell component examination.			
12.9 Research, then discuss with your trainer the administrative and technical review(s) of a case containing shotshell components. See QP 31 – Reviews.			

12.0 Shotshell Component Examinations (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Observation-based competency test*				

*This competency test serves to fulfill the assessment for Section 12.0 of the FATM Training Manual, in addition to the required competency test for authorization to perform this function.

13.0 Gunshot Residue Examinations and Distance Determination (top ↑)

OBJECTIVES

- Understand and be able to articulate how and when gunshot residues are deposited.
- Understand, be able to perform and explain the examinations used in the detection of gunshot residues.
- Know the extent and limitations associated with qualitative analysis of gunshot residues.

INTRODUCTION

Various phenomena related to terminal ballistics directly affect the daily work of a firearms examiner. These include the impact of bullets, shot pellets, and gunshot residues projected from the muzzle of a firearm onto the clothing of a shooting victim, or onto other objects. These impacts and residue depositions provide the basis for muzzle-to-target distance determinations, often a critical element in a courtroom presentation. Such distance determinations are also one requirement to determine bullet paths based on bullet holes and impact sites, where they exist. In this section you will become familiar with the determination of muzzle-to-target distances based on gunshot residues and shot pellet patterns, and become proficient in the documentation and detection of gunshot residues.

Your study of the analysis of gunshot residues on clothing or other items will include microscopic and chemical tests to detect physical effects, nitrite compounds, lead, copper and copper alloys (cuprous materials). These physical effects, chemical depositions and patterns of residues can be detected on evidence items and reproduced on test materials at known distances using the suspect's firearm and the same type of ammunition as used in the crime. These techniques have wide application in a variety of shooting scenarios.

At the end of this section you will consider the mission, role and work of medical experts in his/her work relating to gunshot would effects. It will be important on a continuing basis for you to understand the normal division of labor between the medical field and firearms examinations. Typically, custom and tradition dictate the medical field's work begins at the plane of the body. In other words, medical personnel don't perform firearms-related examinations, and you don't interpret effects on the human body. This often creates areas of overlapping interest, such as muzzle-to-victim distance determinations. Your distance determinations are based on reproducible residues found on objects such as clothing, whereas the medical examiner's distance determinations are based on analysis of wound effects, that is, effects on the body in the form of trauma.

REQUIRED READING

	DATE COMPLETED	TRAINEE INITIALS
AFTE Glossary, 6th Edition. Sections 3 and 5.		
Bailey – Research Article: Digital infrared photography to develop GSR patterns		
Barnes & Helson - An Empirical Study of Gunpowder Residue Patterns		
Bonfanti & Gallusser - Problems Encountered in the Detection of Gunshot Residues		
Cole, Ross & Thorpe - Gunshot Residue and Bullet Wipe Detection Using a Single Lift Technique		
Deobald - Spiral Pattern		
Didson & Stengel - Recognizing Vaporized Lead from Gunshot Residue		
Dillon - A Protocol for Gunshot Residue Examinations in Muzzle-to-Target Distance Determinations		
Dillon - A Protocol for Shot Pattern Examinations in Muzzle-to-Target Distance Determinations		
Dillon - Black Powder Background		
Dillon - Graphical Analysis of the Shotgun-Shotshell Performance Envelope in Distance Determination Cases		

Dillon - Laboratory Examinations Conducted Within the Field of Firearms Identification		
Dillon - The Manufacture of Conventional Smokeless Powder		
Dillon - The Modified Griess Test		
Dillon - The Sodium Rhodizonate Test		
Dillon – Gunshot Residues and Shot Patterning Glossary		
Gunshot Residues and Shot Pattern Tests		
Laboratory Examinations conducted Within the Field of Firearms Identification: A Tracing of the Acceptance by the Courts of their Use in Expert Testimony		
Hueske - Gunshot Residue Testing of Blood Stained Garments		
Lekstrom & Koors - Copper and Nickel Detection on Gunshot Targets by Dithiooxaminde Test		
Lichtenberg - The Ammunition was Leadfree		
Lindman - The Weathering-Time Factor in GSR-Proximity Determinations		
Matty - An Unusual Source of Gunshot Residue Particles		
Nichols - Expectations Regarding Gunpowder Depositions		
Owens & George - Gunshot Residue Examinations- Modification in the Application of the Sequence of Chemical Tests		
Schous - A Sequence of Chemically Specific Chromophoric Tests for Nitrite Compounds, Copper and Lead in Gunshot Residues		
Shem - Bleeding as a Source of Lead Particulates on Clothing		
Shem - The Vaporization of Bullet Lead by Impact		
Veitch - An Examination of the Variables That May Be Encountered in Gun Shot Residue Patterns		
Williams & Koons - Composition of Firearm Ammunition Primer Mixtures		

GUNSHOT RESIDUE EXAMINATION & DISTANCE DETERMINATION ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
13.1 Describe the residues and debris that are projected from the muzzle of a firearm (or the cylinder gap of a revolver) when a cartridge is fired. Pay particular attention to the relative distance the different residues/materials travel.			
13.2 Describe the following tests and methods. Include the specific circumstances in which each could be useful. • Conventional Modified Griess test • Reverse Griess test • Sodium Rhodizonate test • Bashinski transfer • Blotting transfer • Dithiooxamide test • 2-Nitroso-1-Naphthol test • Quantofix® test • Diphenylamine test			
13.3 Prepare a written report which describes in detail the chemical reactions that take place in the burning of smokeless powder, the modified Griess test, the Dithiooxamide test and the Sodium Rhodizonate test.			
13.4 When next prepared, aid in the preparation of the chemicals and the test papers used in the following tests (review the relevant Safety Data Sheets before preparing reagents):			

• Modified Griess test • Dithiooxamide (DTO) test • Sodium Rhodizonate test			
13.5 Prepare a written report discussing the interpretation and reporting of shot pattern distance determination testing results. Include in your discussion: • The limitations of testing procedures • The importance of using the same shotshells and firearm • The behavior of buffers, wads and shot cups • The definition of and how the evaluate “flyers” on evidence or test materials			
13.6 Prepare a written report discussing the interpretation and reporting of gunshot residue (GSR) distance determination testing results. Include in your discussion: • The limitations of testing procedures • The importance of using the same ammunition and firearm • The importance of test target material selection • The difficulties of interpreting the distance based on the absence of GSR around a bullet hole			
13.7 Read the article entitled “Graphical Analysis of the Shotgun/Shotshell Performance Envelope in the Distance Determination Cases” in the AFTE Journal, October 1989 issue. Discuss this article in a short summary.			

13.8 Research and discuss the potential effects of the following on GSR testing and distance determinations:
• Distance
• Caliber
• Weapon type
• Chokes
• Barrel length
• Rifled vs. smooth barrels
• Intervening objects
• Bloody garments
• Effects of weather
• Ammunition related phenomena
  ○ Caliber
  ○ Propellant type (disk, flake, ball, etc.)
  ○ Primer (type, size, age, etc.)			

13.9 Describe the use of infrared imaging techniques related to the visualization of GSR around bullet holes on dark fabrics. If available, use infrared imaging to document a GSR pattern on a dark garment. Discuss the advantages and disadvantages of the infrared imaging of GSR with your trainer.			
13.10 If possible, attend an autopsy or examine photographs/reports of shooting victim(s). Observe and note any indications of GSR, as well as the physical effects of projectile(s) on the body. Prepare a report on your observations and include any information obtained concerning distance determination, bullet effects, causes of death, direction of bullet travel or other pertinent information.			
13.11 Demonstrate your proficiency in conducting the following tests and methods using the Firearms and Toolmarks Policies:			

• Conventional Modified Griess test • Reverse Griess test • Sodium Rhodizonate test • Bashinski transfer • Blotting transfer • Dithiooxamide test			
13.12 Research cartridge case ejection pattern testing and discuss in a written report. Discuss the potential value and limitations of cartridge case ejection pattern testing.			
13.13 Using specimens provided by your trainer, demonstrate proficiency in conducting "gunshot residue examinations." Include note taking, photo-documentation, microscopic and chemical examinations and accurately determining the qualitative results of gunshot residue examinations.			
13.14 Research, then discuss with your trainer the extent and limitations concerning testimony in gunshot residue/distance determination.			
13.15 Research, then discuss with your trainer the administrative and technical review(s) of a gunshot residue/distance determination case. See QP 31 – Reviews.			

13.0 Gunshot Residue Examination and Distance Determination (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Competency test*				
Oral exam**				

*Competency test's expected results shall be established and documented by the FATM Technical Manager or their designee prior to the trainee receiving the competency test.
*This competency test serves to fulfill the assessment for Section 13.0 of the FATM Training Manual, in addition to the required competency test for authorization to perform this function.
**Oral exam questions, acceptable answers and criteria for acceptable performance shall be established and documented by the FATM Technical Manager or their designee prior to the trainee beginning the oral exam.

14.0 Toolmark Examinations and Comparisons (top ↑)

OBJECTIVES

- Be familiar with the types of marks a tool can leave on a softer surface
- Understand the importance and limitations of the types of marks a tool can leave on softer surface
- Be comfortable with comparing tools and unknown toolmarks, and form conclusions
- Know the required procedure and documentation for toolmark examinations and comparisons

INTRODUCTION

This section of your training relates to the broad topic of general toolmark examinations, comparisons and identifications. By implication, this also includes consideration of the criteria for making identifications, concerns about the admissibility of expert testimony regarding examination results (the Daubert decision) and study of a wide variety of toolmark examinations. As indicated in Section 6.0, the historically early development of firearms identification pre-dated the recognition of the generalized concept of toolmark identification due to the fact that the early focus was on the crimes of violence involving firearms. With a few early exceptions, most early forensic scientists did not recognize this specialized nature of firearms identification. For several decades of the twentieth century, it was regarded as a stand-alone discipline. Gradually as practitioners and theoreticians began to publish articles in professional journals it became obvious that the specialized equipment and concepts described in Section 7.0 which were developed for firearms identification could also be applied to toolmarks in general, using the same or similar criteria for identifications, and that firearms identification was only one facet of a larger picture. Essentially, theory caught up with actual practice, allowing toolmark work to form the broader umbrella under which forensic firearms examinations have a place.

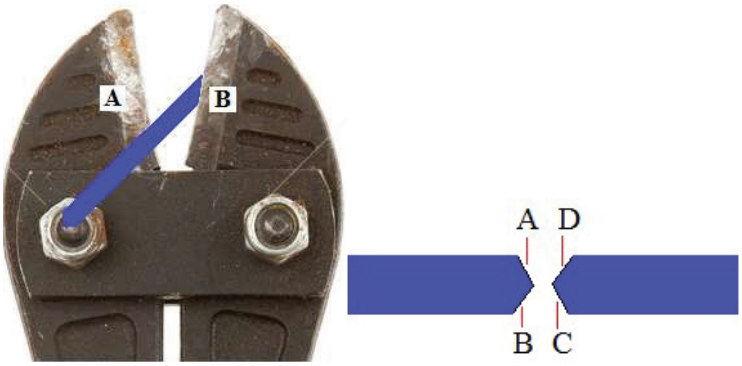
In this section, the emphasis is on identification criteria, courtroom admissibility issues and exercises which emphasize the diverse nature of toolmark examinations. All of this background is equally applicable to the bullet and cartridge case examinations as we have seen in Section 10.0 and 11.0.

Creating Your Test Cuts / Marks:

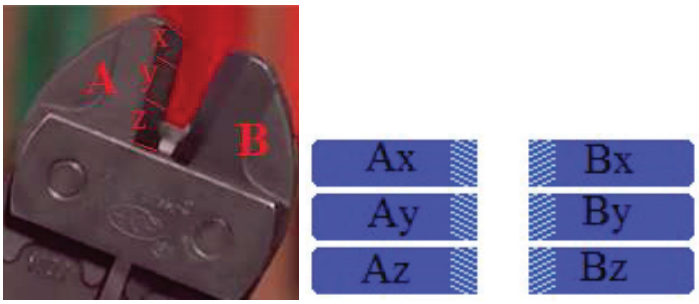
Different tools have various working surfaces. Each surface is finished separately, and possibly by different processes. For this reason, it is important to properly label and track the working surfaces and the marks they make. Label the tool and test medium to orient how the tool was used/held when the test toolmark was made.

Example: impressed screwdriver toolmark

If the tool has more than one surface that will leave toolmarks, (i.e. bolt cutters with two, two-sided blades) label each surface and each test toolmark with the corresponding surface. **The opposite side of the bolt cutter would be labeled C and D, and the resulting test toolmarks would also be labeled C and D.



If the working surface of the tool is larger than the test medium, ensure the test toolmarks are labeled to represent which area they were made with.



A way to avoid this issue is to flatten the test medium or use a sheet of test medium as to get the whole working surface on one piece of test medium.

It is best to start in a softer material, like lead. This is because you do not want to change the tool's surface(s) while creating the test toolmarks. If a proper comparison cannot be conducted with the lead test toolmarks, move onto a harder material such as copper or aluminum.

Conducting Your Comparisons:

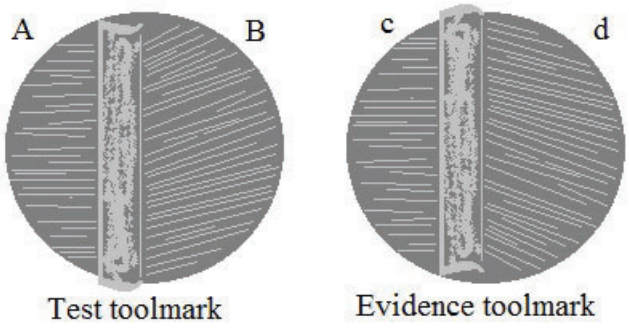
With so many working surfaces, it may become difficult to keep track of what toolmarks have been compared to which test toolmarks. A helpful way to avoid this confusion is to label each toolmark.

Example:

**The class characteristics of these toolmarks indicate the padlock was cut with a pinching tool. As pinching tools have two opposing blades, there are four working surfaces to evaluate and compare.

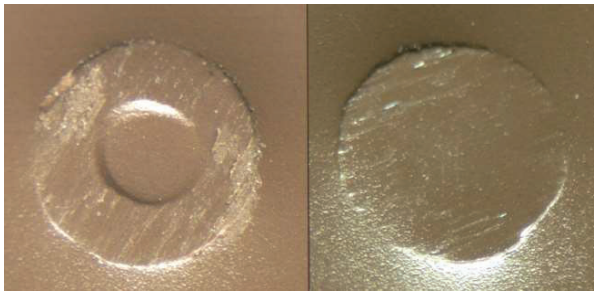
Before putting the test toolmarks and evidence toolmark on the comparison microscope, take a step back and evaluate which toolmarks should be compared to one another.

In the figure below, 'Test toolmark A' to 'Evidence toolmark c' and 'Test toolmark B' to 'Evidence toolmark d' are the comparisons to be conducted.



For transparency, and to allow another examiner to come behind you and know exactly how you performed your analysis, make notes, sketch and/or photograph the labeling system you create for the case. When naming photographs, use the labeling system so the photograph can easily be recreated on the comparison microscope.

Use good judgment to decide which toolmarks need to be compared. If the tool cannot physically make the mark, there is no reason to compare the two. An example would be a set of plumber's pliers and a round door knob. If the pliers cannot open widely enough to reach the toolmarks on opposite sides of the knob, those pliers could not have made the toolmarks. However, caution should be taken when comparing class characteristics versus individual characteristics. There is the potential for class characteristics to not 'transfer' to the marked item. For example, the same punch (tool) made these two toolmarks. The lack of the inner circle cannot be used for elimination, as the diameter of the punch is similar/the same. The presense of the inner circle is the result of more pressure being applied to make the toolmark.



REQUIRED READING

	DATE COMPLETED	TRAINEE INITIALS
Baldwin, D., et al. *The Forensic Examination and Interpretation of Tool Marks.* Hoboken, NJ: Wiley-Blackwell, 2013.		
Cochrane, D.W. "Class Characteristics of Cutting Tools and Surface Designations." *AFTE Journal* 17.3 (1985): 73-82.		
Deforest, Peter R., R.E. Gaensslen, and Henry C. Lee. *Forensic Science: An Introduction to Criminalistics.* New York: McGraw-Hill, 1983: chapter 9.		
Miller, Jerry. "An Introduction to the Forensic Examination of Toolmarks." *AFTE Journal* 33.3 (2001): 233-248.		
Miller, Jerry and Glen Beach. "Toolmarks: Examining the Possibility of Subclass Characteristics." *AFTE Journal* 37.4 (2005): 296-345.		

TOOLMARK EXAMINATIONS AND COMPARISONS

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
14.1 Review the section entitled "Manufacture of Modern Firearms" (Section 5.0). The machining methods described represent the same basis for toolmark identification as for firearm examination. Discuss with your trainer.			
14.2 Define terms "tool" and "toolmark identification." Determine the range of conclusions that may be reached in toolmark identification and discuss the definitions and range of conclusions in detail.			
14.3 Discuss the significance of examining submitted tools first for trace evidence. List several types of trace evidence that may be encountered. Discuss with your trainer the potential evidentiary value of trace evidence observed on tools or evidence displaying toolmarks, and the prioritization they should receive in forensic examinations.			
14.4 In a mock case involving a toolmark examination where no tool is submitted, determine the types of conclusions that may be reached. Consider the type of tool, size of the tool and the action employed by the tool. Consider how the quality of the toolmark may impact the comparison results. By examining the toolmark, note any unusual tool characteristics or features. Discuss a 'no tool' case with your trainer.			
14.5 Define the following words/terms as they relate to toolmark examinations and give three examples of tools or maneuvers that could produce each category: • Shearing action • Pinching action • Scraping action • Slicing action • Gripping action • Prying action • Crimping action • Impressed toolmark • Striated toolmark • Fracture			
14.6 Define "class characteristics" as it applies to toolmark identification. Considering the types of tool and tool actions from the exercises above, describe their respective class characteristics in detail.			
14.7 Obtain at least two tools representative of each tool action category listed in #5 above. Produce toolmarks with each tool and determine the class characteristics of the toolmarks. When generating toolmarks, vary the angle ad force applied with each tool. Evaluate and identify the working surface of each tool and potential for individual characteristics.			
14.8 Discuss how subclass characteristics apply to the manufacture of different mechanical tools, what they might look like and how they might affect comparisons.			
14.9 Using soft copper wire and lead wire with diameters of approximately ¼", make cuts with tools that employ a shearing, pinching and slicing action. Compare and attempt to identify the toolmarks on the copper wire with those on the lead wire for each tool used. Support your conclusions with photographs and note any lighting considerations due			

to the reflective properties and color differences of the copper and lead wire.			
14.10 Select two flat-bladed tools such as a screwdriver and a pry bar. Make both impressed and striated marks on a piece of copper or brass sheeting, and on a piece of lead sheeting for each tool. Microscopically compare the toolmarks on the brass and copper sheeting with the test marks in the lead sheeting. Attempt to identify the appropriate toolmarks to the appropriate tools. Photograph your comparisons and document differences observed in the quality of the toolmarks made by each tool.			
14.11 Discuss why the orientation of the tool might be important when making test marts. Using a flat-bladed screwdriver, produce striated test marks at varying 10-degree angles. Microscopically compare the test marks to each other and discuss your observations. Explain why the orientation of a tool may or may not be important for other types of tools.			
14.12 Obtain a doorknob that may be used to make test toolmarks. Have your trainer produce impressed and striated marks with a tool that has a serrated jaw working surface to simulate a “break-in.” With the same tool, produce test marks in lead attempting to reproduce the marks using a similar tool pressure and orientation. Microscopically compare and attempt to identify the toolmarks on the doorknob to those on the lead material.			
14.13 Using a drive pin punch, produce impressions in a piece of brass sheeting and in a piece of lead sheeting. Compare and attempt to identify the toolmarks on the two types of sheeting. Document your conclusions using photographs.			
14.14 Using an ax blade with numerous defects intercompare and attempt to identify cuts made to a piece of seasoned wood, such as dowel rod. Ensure that your cuts are consistent with respect to the orientation of the ax to the wood and the direction of the grain. Document your conclusions with photographs.			
14.15 Using the same ax as in #14 above, make cuts in a section of large-diameter telephone cable. Examine the effects the slicing action has on multi-stranded cable. Note the quality and quantity of the microscopic marks on each wire strand, and the challenges involved in this type of comparison. Photograph the sliced end of the cable.			
14.16 Describe the class characteristics of toolmarks made by single versus double edged knives. Using a fixed blade knife, make multiple cuts and stabs into the sidewall of a used tire. Intercompare and attempt to identify the toolmarks produced by the knife and document your conclusions with photographs and notes. Discuss with your trainer how the results of your examination might be altered if the knife had been sharpened or used for an extended period of time between a questioned and a test cut.			
14.17 Discuss why saws, files and abrasive tools cannot be identified to the toolmarks they produce when used conventionally. Cite any exceptions to this rule.			
14.18 Discuss with your trainer the different types and colors of casting material available. Demonstrate proficiency in making toolmark casts and discuss the advantages and disadvantages of different types and colors over another.			

14.19 Discuss how you would report the various range of conclusions possible on a toolmark examination.			
14.20 Perform a series of inter-comparisons between two known matches and two known non-matches of test standards for each of the tool classes. Document your observations.			
14.21 Describe other types of toolmark exams that may be encountered such as locks and keys, staplers, etc.			
14.22 Conduct examinations of toolmark evidence submitted from crime scenes that are part of a simulated "ongoing investigation."			
14.23 Research, then discuss with your trainer the extent and limitations concerning testimony in toolmark examination and comparison.			
14.24 Research, then discuss with your trainer the administrative and technical review(s) of a toolmark case. See QP 31 – Reviews.			

14.0 Toolmark Examinations and Comparisons (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Written exam				
Competency test*				
Oral exam**				

*Competency test's expected results shall be established and documented by the FATM Technical Manager or their designee prior to the trainee receiving the competency test.
*This competency test serves to fulfill the assessment for Section 14.0 of the FATM Training Manual, in addition to the required competency test for authorization to perform this function.
**Oral exam questions, acceptable answers and criteria for acceptable performance shall be established and documented by the FATM Technical Manager or their designee prior to the trainee beginning the oral exam.

15.0 Serial Number Restoration (top ↑)

OBJECTIVES

- Perform serial number restoration through physical and chemical means
- Understand and be able to explain how and why serial number restorations are possible

INTRODUCTION

A serial number is a unique or non-repeating number applied by manufacturers to identify an item or object. Serial number restoration or retrieval is the application of scientific techniques for the retrieval or recovery of the manufacturer's applied number which has been obliterated.

Because of the importance of manufacturer's applied numbers for identification purposes, the criminal element has historically sought out techniques for altering or obliterating them altogether. Common methods employed today include filing, grinding, peening, overstamping, punching, drilling and welding. While these techniques can be successful to some extent, they are counterbalanced by a wide array of forensic techniques used to restore them.

Fortunately for investigative agencies and law enforcement in general, the restoration of obliterated serial numbers to a visible and readable condition can be accomplished by creating a contrast between what remains of the original number and its surrounding area. This is possible due to certain physical qualities and mechanical properties of the crystalline structure of metals. All metals are polycrystalline in structure, incorporating irregularly shaped crystals or grains. These form during the cooling and solidification of metals from the molten state. The size of the metallic crystals is controlled by regulating the cooling rate, with a direct effect on the metal's mechanical properties. When a number is stamped into metal, the crystalline structure surrounding the stamped number will exhibit altered hardness, strength, magnetic, electrical and chemical properties. Just how deep these effects will be dependent on the type of metal and the stress applied by the stamping tool. If a serial number is filed or ground down, often there will be areas remaining which contain the altered crystalline structure which can be treated by various techniques, revealing the original stamped number.

Since the chemical restoration techniques utilized in the Firearms and Toolmarks Unit can cause damage to the firearm, especially if/when it drains into unseen cavities of the firearm, all other functionality testing of the firearm is to be completed before serial number restoration is attempted.

In this section, the principles of how restoration of obliterated marks is possible are explored. In addition, the proper procedure for restoration is researched. This proper procedure emphasizes the use of caution, as any metal removed from the marks cannot be replaced. For this reason, extreme care and patience should be used when prepping the surface through slow and steady polishing (either through manual or mechanical means). This same care and patience should also be used when applying the chemical etchants. Try to prevent excess etchant from draining into cavities within the firearm. Try to avoid pooling of the etchant, as the effectiveness of the etchant is difficult to monitor. Try to remove all etchant prior to packaging, as the etchant will continue to react with the metal if not removed.

SERIAL NUMBER RESTORATION ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
15.1 Read the Handbook of Methods for the Restoration of Obliterated Serial Numbers by Treptow. Be prepared to discuss the theory behind serial number restoration.			

15.2 Obtain the proper personal protective equipment (e.g. eyewear, masks, gloves and lab coats) before attempting any chemical/mechanical restorations. Review the chemical hygiene policies to ensure proper safety precautions are used.			
15.3 Define "serial number" and "serial number restoration."			
15.4 Obtain a stamped piece of metal from your trainer and sketch the entire stressed area above and below the indented marks. Describe what remains when the indented area is removed.			
15.5 List the various methods used by manufacturers to mark products we commonly encounter as evidence items. This list should include by not be restricted to: casting, stamping, embossing, debossing, coining, vibratory pencil, pin stamping, laser and electrical discharge machining. • Discuss the effect each of these marking methods has on the subsurface of the marked area • Discuss the marking methods used that can directly affect the ability of the examiner to restore obliterated markings and why			
15.6 Define the term "plastic deformation" of metal.			
15.7 Briefly discuss the difference between cold rolled steel and cast iron metal.			
15.8 Discuss the effect that the following types of alterations may have on the subsurface of marked items and how it may impact an examiner's results. • Grinding • Over stamping • Peening • Gouging • Heating • Puddling • Welding • Removal • Scratching / filing • Drilling • Painting • Combination of the above			
15.9 Discuss the selection of a specific approach to a restoration attempt based on distinct characteristics observed for various alteration methods.			
15.10 Discuss various methods of surface preparation, such as sanding and polishing, and how they may affect the results in a restoration attempt.			
15.11 Discuss the use of various types of chemicals to restore serial numbers.			
15.12 Determine whether the reaction rate of the stressed area is faster or slower than the etching rate of the remaining surface and explain why.			
15.13 Discuss the technique known as Magnetic Particle Inspection (MPI) and why the method is nondestructive. Explain what types of firearms this method may be used on.			
15.14 Discuss the restoration method of an obliterated Barcode 39 serial number using chemical processing, manual decryption and automatic decoding.			

15.15 Research relevant peer reviewed journals to determine that best techniques to use in the restoration of obliterated serial numbers in plastic.			
15.16 Research the effect of direct current (DC) electricity on the reaction time of the different chemical reagents available. Include the proper polarity and voltage for enhanced etching/development of obliterated characters.			
15.17 Discuss any additional equipment that might be used for serial number restoration.			
15.18 Discuss the different types of lighting available (e.g., incandescent, infrared (IR), ultraviolet (UV) and fluorescent) and how they may improve or enhance restoration results. Explain how the angle of incidence of these lighting techniques might vary the results.			
15.19 Discuss the appropriate documentation, photography techniques and procedures to be used before, during and after attempting to restore obliterated serial numbers (e.g., pooling, various preparation methods, etc.).			
15.20 Research the various kinds of magnifying and enhancing equipment used for serial number restoration and explain when and why each would be used.			
15.21 Become familiar with the following chemicals: • $CuNH4Cl_2$ • $CuCl_2$ • NaOH • HCl • HNO_3 • H_3PO_4 • Aqua Regia • H_2SO_4 • $FeCl_3$ • HF			
15.22 Record how to prepare each of these reagents/solutions as well as what types of metal they should be used on: • Fry's reagent • Ferric chloride solution • Turner's reagent • Davis' reagent • Acidic ferric chloride solution • Nitric acid 25% solution • Sodium hydroxide 10% solution			
15.23 Become familiar with the numbering systems and methods used by manufacturers of frequently encountered firearms including, but not limited to, Colt, Ruger, Smith & Wesson, Glock, Hi-Point, Beretta, Winchester and Remington.			
15.24 Determine the most suitable chemicals and techniques to use in an attempted serial number restoration for the following firearms: • Colt pistol • Smith & Wesson revolver • RG Industries revolver • Ruger stainless steel revolver • Shotgun alloy receiver			

• Chrome/nickel pistol • Winchester rifle • Shotgun case hardened receiver			
15.25 Obtain several firearms with serial numbers or stamped pieces of metal from your trainer. Alter the serial numbers using different methods and then attempt to restore them. Document your results and conclusions with notes and photographs.			
15.26 Be prepared to discuss with your trainer the methods used and lessons learned during the restoration processes.			
15.27 Discuss with your trainer how the combination of a brief application of $CuNH4Cl_2$ followed by a normal application of NaOH can shorten the processing time on aluminum.			
15.28 Discuss with your trainer why alternating HNO_3 and HCl may be very effective in restoring serial numbers on chrome or nickel-plated firearms.			
15.29 Discuss the advantages of maintaining a database to record the various manufacturer's serial number structures in casework. Become familiar with the laboratory's serial number database.			
15.30 Become familiar with the AFTE Serial Number Search database and the ATF Serial Number Structure Guide. Discuss with your trainer the importance of utilizing the laboratory's firearms reference collection and serial number database to research serial number structures and font types.			
15.31 Obtain a selection of firearms or other pieces of metal with altered serial numbers from your trainer. Determine the appropriate technique(s) and equipment that will be utilized and attempt to restore the altered serial numbers. Provide documentation (notes and photographs) of the restoration attempts and discuss the results with your trainer.			
15.32 Research the location and format of secondary or "hidden" serial numbers that may be present on various makes and models of firearms. Discuss with your trainer.			
15.33 If possible, attend a serial number restoration course/workshop. Discuss any differences with the training versus OSBI-specific procedures for serial number restoration with your trainer.			
15.34 Research, then discuss with your trainer the extent and limitations concerning testimony in serial number restoration.			
15.35 Research, then discuss with your trainer the administrative and technical review(s) of a serial number restoration case. See QP 31 – Reviews.			

15.0 Serial Number Restoration (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Observation-based competency test**				

**This competency test serves to fulfill the assessment for Section 15.0 of the FATM Training Manual, in addition to the required competency test for authorization to perform this function.

16.0 Expert Testimony (top ↑)

OBJECTIVES

- Be familiar with the court system(s) in the state of Oklahoma
- Understand the extent and limitations of firearm and toolmark examination testimony
- Complete moot court scenarios
- Have a greater understanding of how to best present oneself in the courtroom as an expert witness

INTRODUCTION

This section of your training addresses the ultimate service which can be rendered by a forensic laboratory examiner: the presentation of impartial, accurate and credible expert court testimony regarding items of physical evidence. You will be very much involved in this in the future so it is essential that you learn courtroom skills well. The hard fact is that even if your analyses at the laboratory bench are complete, accurate and represent the highest quality work, if you cannot credibly deliver your results on the witness stand, your efforts are to little or no avail. Essentially your role in court is to give voice to the meaning of physical evidence, and that requires good oral communication skills of a specialized type. The previous sections in your training manual have helped you to learn the substance of your forensic field, but this section will focus on the delivery of this substance to a lay jury. Such an environment is often very stressful, and it should always be stressful to at least some degree. This is normal and healthy in that it helps you keep your edge and maintain your alertness on the stand.

The intent of these moot courts is that you learn what to expect when you enter a courtroom as an expert witness, and that you have the confidence and knowledge to perform at your best. Your trainer and/or the FATM Technical Manager will do their utmost to provide you with a positive learning environment, with constructive feedback designed to help you not only survive in court, but to excel. Keep in mind that knowledge builds confidence, and that this is what this section is all about.

EXPERT TESTIMONY ACTIVITIES

	DATE COMPLETED	TRAINEE INITIALS	TRAINER INITIALS
16.1 Develop a system for the administration of your cases. Formulate a method for taking and maintaining case notes, documenting essential data on which you base your conclusions and maintaining chain of custody. Discuss the importance of effective case management, case documentation and chain of custody documentation with your trainer.			
16.2 Read through case reports generated by at least two examiners from the section. Note the various report formats and wording for the different categories of testing within the field of Firearm and Toolmark Examination (e.g. firearm examination, bullet/cartridge case examination, cartridge case/bullet comparisons, serial number restoration, gunshot residue examination, etc.). Discuss with your trainer.			
16.3 Witness the testimony of other examiners (in any forensic discipline) and evaluate their strengths and weaknesses regarding courtroom demeanor, professionalism and efficiency of communication. Discuss with your trainer. (This may be combined with #7 below.)			
16.4 Define the following terms or phrases as they apply to Firearm and Toolmark testimony. Discuss their meanings with your trainer. • Expert witness • "Reasonable degree of scientific certainty" • Absolute certainty			

• Practical certainty • Hearsay • Opinion • Voir dire • Sustained • Overruled • Prosecution • Defense			
16.5 Prepare a list of "qualification questions" which can be used by a prosecutor to qualify an examiner as an expert witness in court. Formulate responses to questions pertaining to accreditation, certification, proficiency testing, training, technical review, administrative review, procedures, etc. Discuss these with your trainer.			
16.6 Witness at least two firearm and toolmark examiners testify as an expert witness in a firearm or toolmark case. Discuss their testimonies with each examiner. Coordinate this with your trainer.			
16.7 Prepare a list of metaphors/analogies to assist in explaining the following technical concepts to a jury. Other examiners in the field may be consulted for this exercise. Discuss these metaphors/analogies with your trainer. • Comparison microscope • Class characteristics • Subclass characteristics • Individual characteristics • Cycle of fire • Firearm actions • Trigger pull • Uncertainty of measurement			
16.8 Using mock casework provided by your trainer, complete moot court exercises that encompass the different categories of testing within the field of firearm and toolmark examination (e.g. firearm and toolmark examination, bullet/cartridge case examinations, bullet/cartridge case comparisons, serial number restoration, gunshot residue examination, etc.). Consult with other firearm and toolmark examiners regarding personal recommendations or advice for courtroom testimony. These discussions should be in-depth and cover all aspects of courtroom testimony.			
16.9 Become familiar with the AFTE Code of Ethics and the ANAB Guiding Principles. Discuss these with your trainer.			
16.10 If able, attend testimony training such as Advanced Expert Witnessing for Forensic Laboratory Scientists, as offered by Critical Victories.			
16.11 Review the Witness Critique and Qualified Testimony Review forms with your trainer. Discuss how to distribute and complete.			

16.0 Expert Testimony (top ↑)

ASSESSMENT

	DATE COMPLETED	SCORE	TRAINEE INITIALS	TRAINER INITIALS
Completion of all section activities				
Moot Court*				

*The current Qualified Testimony Review form will be used as the guideline for moot court performance. Any 'disagree' or 'strongly disagree' ratings will result in failure of the moot court.

SECTION APPROVAL SIGN-OFFS (top ↑)

SECTION	SUBJECT	DATE	EMPLOYEE INITIALS	MANAGEMENT INITIALS
2.0	Administrative Matters			
3.0	Evolution of Early Firearms and Ammunition			
4.0	Development, Operating Systems and Manufacture of Modern Firearms			
5.0	Modern Ammunition			
6.0	Background/History of Firearm and Toolmark Examination and Current Trends			
7.0	Instrumentation			
8.0	Examination and Test Firing of Firearms			
9.0	Theory of Identification and Range of Conclusions			
10.0	Bullet Examinations and Comparisons			
11.0	Cartridge/Cartridge Case/Shotshell Examinations and Comparisons			
12.0	Shotshell Component Examinations			
13.0	Gunshot Residue Examinations and Distance Determination			
14.0	Toolmark Examinations and Comparisons			
15.0	Serial Number Restoration			
16.0	Expert Testimony			

APPROVAL (top ↑)

FATM Technical Manager: Katelyn J. Millar 10/10/2023

Katelyn J. Millar DATE

OSBI CSD Director: Digitally signed by J. Janice Joslin
DN: cn=J. Janice Joslin, o=Oklahoma State Bureau of Investigation, ou=CSD Administration, email=janice.joslin@osbi.ok.gov, c=US
Date: 2023.10.10 15:00:10 -05'00' 10/10/2023

J. Janice Joslin DATE

HISTORY

REVISION	EFFECTIVE DATE	HISTORY
00	08-01-2022	Reformatted entire training manual to align with ISO/IEC 17025:2017 Standards and AR 3125. Additionally, reformatted to include a table of contents and consistent font type/size formatting.
	12-01-2022	Annual review. No changes made.
01	10-16-2023	Incorporated deviations and other suggestions [see Track Changes document]