



Idaho State Police Forensic Services

FIREARMS & TOOLMARK EXAMINER TRAINING MANUAL

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Revision History

Revision #	Description of Changes
1	Converted to Qualtrax
2	Converting to pdf in Qualtrax - no content revisions
3	Added multitude of training definitions and written/verbal exercises to sections 5.0, 6.0, 7.0, 9.0, 11.0, 12.0, 13.0 referenced additional FATM training manuals. Added fracture match to toolmarks. section Added courtroom testimony section and defined requirements for supervised cases.

1.0 Introduction

The following training plan will allow you as an examiner trainee to guide yourself through the various areas of knowledge integral to the field of firearms/toolmark identification. This training plan is generic in its layout and allows some modification by the individual, Discipline Leader/on-site trainer or lab manager to meet local conditions. It is paramount that you keep before you the primary and ultimate objective of this training period: to independently and completely examine and compare evidence relating to firearms and toolmark identification; to independently and competently render an opinion and reach conclusions relating to your examinations and comparisons; and to give expert testimony in court in matters encompassed within the broad definition of firearms/toolmark identification and to do this in a professional, competent and impartial manner. The obligation is yours to maximize on the effectiveness of the training period as an opportunity to learn everything possible in this field. The extent to which you exert yourself during this training and evaluation period will bear directly on the quality of your performance in the laboratory and on the witness stand. Note that your technical abilities and your testimony will, in turn, bear directly on the future situations of accused persons, and especially in the discipline of firearms/toolmark identification, the lives of accused persons can hang in the balance. You have a moral and ethical obligation to prepare yourself technically and professionally during training in order to be able to perform according to the most rigid standards.

You will be expected to carry out a study of all pertinent lab equipment, the Analytical Methods, the Safety Manual, as well as the physical reference files.

Your training will be monitored and assisted by the Discipline Leader/on-site trainer, who has responsibility for training matters. You will be expected to meet the standards set by the Discipline Leader/on-site trainer for your successful completion of your training.

The acceptance criteria for verbal/written examinations will require a minimum passing score of 80%. Practical exercises, mock court and competency tests will be reviewed by the trainer and/or technical lead and a pass/fail determination will be made. The trainee should demonstrate the appropriate knowledge, skills and abilities relevant to the practical exercise in order to pass. To pass a competency test the trainee should obtain the expected results with no unexplainable discrepancies. If the acceptance criteria are not met the trainer and/or technical lead will determine any remediation required prior to progressing in the training program.

2.0 Roles and Responsibilities

2.1 Supervisor

2.1.1 The Supervisor should monitor the progress of the trainee.

2.2 Technical Lead

2.2.1 The technical lead will monitor and assist in the completion of the training. The trainer has responsibility for training matters. The trainee will be expected to meet the standards set by the Discipline Leader/on-site trainer for successful completion of training. The Technical Lead will be responsible for final approval on the completion of each training section/module.

2.3 Trainer

2.3.1 The trainer is required to actively participate in the trainees' completion of the required sections of the Training Plan. The Technical Lead will be responsible for assigning training modules and setting the training timeline to be completed by the trainee.

Note: The Supervisor/Technical Leader/Trainer may be the same individual or a designee.

2.4 Trainee

2.4.1 It is recommended that the trainee keep a loose-leaf notebook of study notes on each of the items shown in the training plan for research, discussion, demonstration, study or practical work. This notebook can include handwritten notes, charts, graphs, photographs, brief photocopied material, etc., at your discretion, but it should address and broaden on each of the required items of study set out in the training plan. Organization of your notebook in a format which parallels the training plan is suggested. This notebook will serve as a ready reference in the months and even years following your qualification, and will assist in documenting the trainees' progress during training.

2.5 Training Period

2.5.1 It is recommended that the Trainee apply for the ATF National Firearms Examiners Academy (NFEA) or equivalent training program. If the application is not approved in-house training will begin, and reapplication for NFEA is recommended for the next session.

- 2.5.2 The length of the training period is approximately 24 months. Certain individuals may require less time than others, depending on experience, education, or learning ability.
- 2.5.3 Under the direct supervision of a qualified examiner, the trainee will assist with casework throughout the training period. This will familiarize the trainee with different forms of case evidence, packaging, applied analytical techniques and note-taking.

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3.0 Administrative Matters and Procedures

3.1 Background and Theory

- 3.1.1 An understanding of laboratory facilities and procedures both in general and specifically related to Firearms/Toolmark Identification is important to the success of the beginning trainee.

3.2 Objectives, Principles, and Knowledge

- 3.2.1 Become familiar with facilities and procedures of Idaho State Police Forensic Services in a general sense.
- 3.2.2 Become familiar with the facilities and procedures of the Firearms section of the Idaho State Police Forensic Services.

3.3 Health and Safety Hazards

- 3.3.1 None

3.4 Reading and Practical Exercises

- 3.4.1 Complete ISPFPS core training program.
- 3.4.2 Become familiar with the requirements and the facilities available for the secure storage of evidence within the lab. Discuss this with the Lab Manager and an examiner from the lab.
- 3.4.3 Become familiar with the requirements of lab security in regards to firearms, electrical appliances, evidence while under examination, and lab space security. Discuss this with an examiner from the lab.
- 3.4.4 Familiarize yourself with the Firearms Reference Collection (FRC):
 - i. Learn how to locate firearms in the FRC using the FRC printed inventory listings, and obtain up-to-date copies of this inventory for your use.
 - ii. Know the correct procedure for checking a firearm out of the FRC.
- 3.4.5 Familiarize yourself with the Range Rules and Safety Rules regarding firearms. To include:
 - i. Become familiar with the lab's bullet recovery systems and firearms range including its physical dimensions, construction of walls and backstop, and bullet velocity limitations.

- ii. Know how to test fire firearms thought to be possibly unsafe.
- iii. Become familiar with the use of all the equipment on the range.
- iv. Know the range rules and emergency medical treatment procedures.

3.4.6 Attend a Basic Firearm Safety Course at a local police department, firearms training facility, online or complete a comprehensive review of firearm handling and safety with the Trainer. Discuss the course with the trainer and document information learned.

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4.0 Background/History of Firearms Identification and Current Trends

4.1 Background and Theory

4.1.1 Firearms Identification dates back to the beginning of the 20th century and its roots may go back even farther. An understanding of the history of Firearms Identification gives the trainee an idea of the scientific and historical foundation on which the science is based, where the science is presently and what issues it may face in the future.

4.2 Objectives, Principles, and Knowledge

4.2.1 Learn to define Firearms Identification.

4.2.2 Become familiar with the history and scientific foundations of Firearms Identification.

4.2.3 Become familiar with the workings and terminology of Firearms Identification laboratories.

4.3 Health and Safety Hazards

4.3.1 None

4.4 Reading and Practical Exercises

4.4.1 Define the following terms:

- i. Firearms identification
- ii. Ballistics

4.4.2 Read the applicable sections from the basic references and prepare a report on the history, principles, evolution and scope of firearms identification in its broadest sense. Support your report by data accumulated in your notebook. Discuss this with the Discipline Leader/on-site trainer who will review your report.

4.4.3 Formulate an answer to the following questions:

- i. Is firearms identification an art or science?
- ii. What are the types of conclusions that can be reached in firearms identification comparisons?
- iii. What is the basis for each of the above conclusions?

- iv. Can experts in the field of firearms identification disagree regarding their conclusions? Why?
 - v. How does "probability" relate to firearms identification?
- 4.4.4 Familiarize yourself with the "Association of Firearms and Toolmark Examiners" (AFTE) to include its history, criteria for membership, committees, the AFTE glossary and the AFTE journal and be able to discuss them.
- 4.4.5 Research the status of the ongoing initiatives to link shootings using computer imagery such as NIBIN/IBIS. What information can be given to Agencies regarding these programs?
- 4.4.6 Visit and tour the various laboratories that provide firearms and toolmark examinations within your region. Coordinate this visit with the Lab Manager.
- 4.4.7 Become knowledgeable about the proficiency testing program administered by the outside independent testing services. Particularly be aware of testing and the results of testing conducted within the field of firearms and toolmark identification by this organization.
- 4.4.8 Be able to demonstrate a practical working knowledge of firearms terminology using the AFTE Glossary as the standard.

5.0 Firearms & Ammunition Development and Current Trends

5.1 Background and Theory

- 5.1.1 Firearms were first used almost 900 years ago. Since then they have undergone significant changes and are still changing today. A knowledge of the origins and evolution of firearms and ammunition is important to the trainee's understanding of the firearms and ammunition seen in casework.

5.2 Objectives, Principles, and Knowledge

- 5.2.1 Knowledge of the history and evolution of firearms.
- 5.2.2 Knowledge of the history and evolution of ammunition.

5.3 Health and Safety Hazards

- 5.3.1 None

5.4 Reading and Practical Exercises

- 5.4.1 Review the history 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. Prepare a chronological outline of this early development.
- 5.4.2 Study the firearms reference collection noting in particular the types of firearms which are representative of commercial and military firearms development since the advent of metallic cartridges.
- 5.4.3 Trace the evolution of the rimfire cartridge from the mid-nineteenth century to the current generation of modern .22 caliber rimfire cartridges.
- 5.4.4 Study the history of centerfire cartridge development starting with black powder cartridges to the current generation of modern centerfire cartridges. Make notes to show the chronological history of this development.

- 5.4.5 Study the Standard Ammunition File (SAF), in particular cartridges and shotshells which are representative of commercial and military ammunition development during the past three decades.
- 5.4.6 Conduct a study of exterior bullet coatings. Determine how this new technology impacts the examinations conducted as a firearms examiner.

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6.0 Manufacture of Modern Firearms

6.1 Background and Theory

- 6.1.1 Each different manufacturing technique produces its own specific marks. It is important to Firearms Identification to determine if marks produced by these methods will produce marks which are individual and can be used to identify a toolmark back to a single source

6.2 Objectives, Principles, and Knowledge

- 6.2.1 Examine the different manufacturing methods and the marks they produce.
- 6.2.2 Determine how these methods are used in firearms manufacturing and if they will produce marks useful for identification.

6.3 Health and Safety Hazards

- 6.3.1 None

6.4 Reading and Practical Exercises

- 6.4.1 Numerous techniques are used in the manufacture of modern firearms. Research in detail these processes and set these out in your notes. Include but do not restrict your study to the following machining methods:

- | | |
|---|--|
| i. Shaping | x. Filing |
| ii. Planning | xi. Swaging |
| iii. Drilling | xii. Electrochemical machining (ECM) |
| iv. Reaming | xiii. Electrodischarge machining (EDM) |
| v. Turning | xiv. Investment casting |
| vi. Boring | xv. Metal injected molding (MIM) |
| vii. Milling-include both face milling and peripheral (slab) milling | xvi. Sawing |
| viii. Broaching | |
| ix. Abrasive machining-include honing, lapping, grinding, sanding, and ultrasonic methods | |

- 6.4.2 Become familiar with the basic nomenclature of handguns, rifles, and shotguns.

- i. Include, but do not restrict your study, to the following: breechface, breechbolt, bolt, bolt face, extractor, ejector, firing pin, rifling, barrel, lands, grooves, ramp, magazine, clip, ejection port, and receiver.
- ii. Point out these parts in several handguns, rifles and shotguns as applicable.
- iii. Discuss the manufacturing techniques which would have been used to fabricate and finish each of the parts and note the machining marks on each part.
- iv. Point out any "mark of abuse" which could contribute to the uniqueness of each part.
- v. Identify areas that machining marks might "carry over" to another firearm.

6.4.3 Research in detail the following rifling techniques:

- | | |
|---------------------|------------------|
| i. Broach | iv. hook method |
| ii. Button | v. scrape method |
| iii. Hammer forging | vi. ECM/EDM |

6.4.4 Obtain broaches and buttons for study from the lab training materials. Determine the difference between barrels which have been button rifled and those which have been broach rifled.

6.4.5 Discuss and define the following terms as they relate to firearms manufacture or firearms identification.

- | | |
|-------------------|-------------------|
| i. Chambering | v. Forcing cone |
| ii. Crowning | vi. Bore |
| iii. Ballizing | vii. Choke |
| iv. Bore slugging | viii. Choke tubes |

6.4.6 Research the history and current significance of proof marks as they relate to the manufacture of firearms.

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

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

6.4.9 What tooling methods produce conventional rifling versus polygonal rifling?

6.4.10 Name some manufacturers who produce firearms with polygonal barrels.

6.4.11 Define the following terms from the current version of the AFTE Glossary:

- | | |
|-------------------|-------------------------|
| i. Revolver | ix. Slide (pump) action |
| ii. Pistol | x. Single shot |
| iii. Rifle | xi. Submachine gun |
| iv. Shotgun | xii. Machine gun |
| v. Semiautomatic | xiii. Assault rifle |
| vi. Automatic | xiv. Muzzleloader |
| vii. Derringer | xv. Percussion firearm |
| viii. Bolt-action | |

6.4.12 Define the following terms from the current version of the AFTE Glossary:

- | | | |
|------------------------|---------------------------|------------------------|
| i. Action | xiv. Extraction | xxvii. Mainspring |
| ii. Barrel | xv. Firearm | xxviii. Muzzle |
| iii. Bore | xvi. Firing pin | xxix. Rifling |
| iv. Breech | xvii. Firing pin aperture | xxx. Safety mechanism |
| v. Breechface | xviii. Frame | xxxi. Sear |
| vi. Butt | xix. Function testing | xxxii. Sights |
| vii. Chamber | xx. Grip | xxxiii. Single action |
| viii. Crown | xxi. Grooves | xxxiv. Test fire |
| ix. Direction of Twist | xxii. Hammer | xxxv. Trigger |
| x. Discharge/Fire | xxiii. Hammerless | xxxvi. Trigger bar |
| xi. Double Action | xxiv. Handgun | xxxvii. Trigger group |
| xii. Dry firing | xxv. Hybrid Action | xxxviii. Trigger guard |
| xiii. Ejection | xxvi. Lands | xxxix. Trigger pull |

6.4.13 Define the following terms regarding revolvers from the current version of the AFTE Glossary:

- | | | |
|------------------------|------------------|--------------------|
| i. Crane | v. Ejector Rod | ix. Sear spring |
| ii. Cylinder | vi. Forcing Cone | x. Side plate |
| iii. Cylinder Gap | vii. Yoke | xi. Loading gate |
| iv. Cylinder alignment | viii. Sear notch | xii. Recoil shield |

xiii. Hammer Notch
xiv. Hammer Shroud

xv. Hammer Spur
xvi. Rebound slide

xvii. Hammer block
xviii. Transfer bar

6.4.14 Research different manufacturing methods that could have the potential to create sub-class characteristics on ammunition components examined.

6.4.15 *Optional/Funding Dependent:* Visit the manufacturing facilities of at least two firearms and/or barrel manufacturers such as Wilson barrels, Ruger, Smith and Wesson, Mossberg, Marlin and US Repeating Arms.

- i. Record notes in training notebook on each visit and produce a written report of the visit. Particular emphasis should be placed on manufacturing and rifling techniques used by each manufacturer, noting methods and procedures which leave unique manufacturing toolmarks on firearms parts which, in turn, produce individual microscopic marks on bullets, cartridge cases and shotshell casings. Coordinate these visits with the Discipline Leader/on-site trainer.

7.0 Manufacture of Modern Ammunition

7.1 Background and Theory

7.1.1 Ammunition is fundamental to the operation of modern firearms. A working knowledge of ammunition components and manufacturing techniques is important to almost every process in Firearms Identification.

7.2 Objectives, Principles, and Knowledge

7.2.1 Learn terms related to ammunition nomenclature and manufacturing

7.2.2 Determine the purpose of each component of modern ammunition.

7.3 Health and Safety Hazards

7.3.1 None

7.4 Reading and Practical Exercises

Written and Verbal Exercises:

7.4.1 Define in trainees' notebook and know the meaning of the following terms as they relate to modern ammunition and its manufacture:

- | | | |
|----------------------------|------------------------------|---------------------------------|
| i. Cartridge | xviii. Extractor groove | xxxv. swaging |
| ii. Cartridge case | xix. Gauge | xxxvi. cast lead bullet |
| iii. Primer | xx. Battery cup | xxxvii. mold marks |
| iv. Shotshell | xxi. Brass | xxxviii. truncated cone bullet |
| v. Shotshell casing | xxii. "Rule of 17" | xxxix. cannellure |
| vi. Bottleneck cartridge | xxiii. Wadding | xl. ogive |
| vii. rebated-rim cartridge | xxiv. Shot collar | xli. brass-coated lead bullet |
| viii. Rimless cartridge | xxv. Crimp | xlii. copper-coated lead bullet |
| ix. Rimmed cartridge | xxvi. Bunter | xliii. nylon-coated lead bullet |
| x. Semi-rimmed cartridge | xxvii. Bullet | xliv. "silvertip" bullet |
| xi. Shoulder | xxviii. round-nosed bullet | xlv. antimony |
| xii. Neck | xxix. "hollow-point" bullet | xlvi. arsenic |
| xiii. Mouth | xxx. bullet sizing | xlvii. chilled shot |
| xiv. Head | xxxi. wadcutter bullet | xlviii. high brass, low brass |
| xv. Headstamp | xxxii. semi-wadcutter bullet | xlix. lubaloy |
| xvi. Proof cartridge | xxxiii. soft point bullet | l. dram equivalent |
| xvii. Tapered cartridge | xxxiv. spitzer bullet | li. single base, double base |

- 7.4.2 Sketch the cross-section of Berdan and Boxer primers, showing their relationship to the head of the cartridge.
- 7.4.3 Discuss the purpose and essential ingredients of priming mixture used in modern cartridges.
- 7.4.4 Know the difference between caliber and caliber type. Illustrate this difference by relating these terms to a discussion of the .22 caliber, .30 caliber and .38 caliber families of cartridges.
- 7.4.5 What is the difference between caliber (true), caliber type (nominal caliber), and caliber designation (specific caliber)?
- 7.4.6 Compare the following cartridges and describe their interchangeability:
- | | |
|-------------------------------|--|
| i. 45 Auto and 45 GAP | v. 357 Magnum, 38 Special, and 38 S&W |
| ii. 10 mm Auto and 40 S&W | vi. 9mm Luger, 380 Auto, and 9mm Makarov |
| iii. 44 Magnum and 44 Special | vii. 32 S&W and 32 Auto |
| iv. 9mm Luger and 357 SIG | |
- 7.4.7 Prepare a document that includes the bullet diameter, bullet weight, and cartridge design of the following handgun calibers. Include a short write-up on the history and development of each cartridge with an (*). Using the laboratory's ammunition reference collection, look at cartridges in each of the calibers and note their design differences.
- | | | |
|-----------------------|-------------------------|-------------------------|
| i. 22 Short | xi. 380 Auto* | xxi. 38 Long Colt |
| ii. 22 Long | xii. 9mm Luger* | xxii. 10 mm Auto |
| iii. 22 Long Rifle | xiii. 9mm Makarov* | xxiii. 40 S&W |
| iv. 25 Auto* | xiv. 38 Special* | xxiv. 41 Magnum |
| v. 32 Auto* | xv. 357 Magnum | xxv. 44 Magnum |
| vi. 32 S&W* | xvi. 357 SIG* | xxvi. 44 Special* |
| vii. 32 S&W Long | xvii. 38 S&W* | xxvii. 45 Auto* |
| viii. 32 H&R Magnum | xviii. 38 S&W Long | xxviii. 45 GAP |
| ix. 32 Short Colt | xix. 38 Colt New Police | xxix. 45 Colt* |
| x. 32 Colt New Police | xx. 38 Short Colt | xxx. 50 Action Express* |
- 7.4.8 Prepare a document that includes the bullet diameter, bullet weight, cartridge design, and parent design (if applicable) of the following rifle

calibers. Using the laboratory's ammunition reference collection, look at cartridges in each of the calibers and note their design differences.

- | | |
|-----------------------|----------------------|
| i. 45-70 Government | ix. 7.62 x 39 Soviet |
| ii. 30-40 Krag | x. 308 Winchester |
| iii. 30-30 Winchester | xi. 243 Winchester |
| iv. 30-06 Springfield | xii. 7mm Rem Mag |
| v. 35 Remington | xiii. 300 Win Mag |
| vi. 250 Savage | xiv. 223 Remington |
| vii. 270 Winchester | xv. 5.45 x 39 Soviet |
| viii. 30 Carbine | |

7.4.9 *Optional/Funding Dependent:* Visit at least two ammunition-manufacturing facility such as Remington, Federal or Winchester to observe the manufacture of rimfire and centerfire cartridges and shotshells.

- i. Make detailed notes of the manufacturing processes and generate a written report. Particular emphasis should be placed on pellet and bullet manufacture, shotshell casing and cartridge case manufacture and the steps involved in the loading of cartridges and shotshells.

8.0 Instrumentation and Equipment

8.1 Background and Theory

8.1.1 Instruction in the care and use of instrumentation and equipment is important to their proper use and maintenance.

8.2 Objectives, Principles, and Knowledge

8.2.1 Proper use of Microscopes used in Firearms Identification.

8.2.2 Proper use and calibration of measuring devices and other equipment used in Firearms Identification

8.3 Health and Safety Hazards

8.3.1 None

8.4 Reading and Practical Exercises

8.4.1 Differentiate between the following:

- i. Compound microscope
- ii. Stereo microscope
- iii. Comparison microscope

8.4.2 Review the instruction manual for our stereomicroscopes.

8.4.3 Review instruction manuals and the mechanical and optical aspects of our microscopes in the lab. Note the differences and similarities in each, both mechanically and optically.

8.4.4 Familiarize yourself with the following types of light sources which are in use in the lab on the comparison microscopes.

- i. fluorescent
- ii. Fiber optics (with and without filters)

8.4.5 Using each type of light source in the field of view on a comparison microscope, note the differences in the quality of each using the following different surfaces: lead bullets, jacketed bullets, various types of cartridge cases, and various types of surfaces containing toolmarks. Manipulate the above light sources with respect to angle and vary the

intensity of the light source if possible. Gain an appreciation for the effects of varying the angle and intensity for each light source on each type of surface. Discuss this with the Discipline Leader/on-site trainer.

8.4.6 Prepare the microscope for your personal use, including adjustments to your personal vision requirements, and familiarize yourself with each set of objective lenses on your comparison microscope. Become familiar with the various digital camera systems in the lab.

8.4.7 Become familiar with and demonstrate the use of the following equipment:

- | | |
|--|---|
| i. Speed micrometer | vi. Gauge blocks |
| ii. Inertia bullet puller | vii. Barrel rods |
| iii. Steel rule | viii. Stage micrometer |
| iv. Reticle in ocular lens of binocular microscope | ix. Water recovery tank, to include cleaning and priming wand |
| v. Balances and scales located in the lab | x. Barrel casting materials |
| | xi. Calipers |

8.4.8 Review the maintenance and calibration of the balances and other equipment/instrumentation in the firearms lab.

8.4.9 During the training period under direct supervision of the trainer, perform all required maintenance and checks for the equipment used in the Firearms section. Document your completion of the tasks.

9.0 Examination of Firearms

9.1 Background and Theory

9.1.1 There are a wide variety of firearm manufacturers, types and action. The manufacture, make and model can usually be determined by examining markings on the firearm. Type can be determined by a visual examination as can the action. Firearms should be examined to determine if they are safe to fire before they are test fired

9.2 Objectives, Principles, and Knowledge

9.2.1 Be able to characterize the firearm including manufacturer, make, model and action.

9.2.2 Be able to determine if a firearm is safe to test fire.

9.3 Health and Safety Hazards

9.3.1 Follow all firearm safe handling rules.

9.3.2 Lead exposure

9.4 Reading and Practical Exercises

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

- | | |
|---|---------------------------------|
| i. revolver, single and double action | iv. Bolt-action rifle |
| ii. auto-loading pistol, single and double action | v. auto-loading rifle |
| iii. Derringer and single shot pistols | vi. pump-action rifle |
| | vii. Various single shot rifles |
| | viii. Submachine gun |
| | ix. Assault rifle |

9.4.2 Explain and illustrate the differences between a gas-operated and a recoil-operated auto-loading shotgun.

9.4.3 Explain and illustrate the differences between the following types of auto-loading pistols:

- | | |
|----------------------------------|-------------------------|
| i. Blowback action | iv. Short recoil action |
| ii. Delayed blowback action | v. Long recoil action |
| iii. gas-delayed blowback action | |

9.4.4 Revolvers

9.4.4.1 Discuss with the TC how the following safeties function and how to check their function:

- i. Hammer block
- ii. Safety notch / quarter cock, half cock
- iii. Rebounding hammer
- iv. Transfer bar
- v. Key lock

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

9.4.4.3 Describe the procedure for measuring trigger pull.

9.4.4.4 How can trigger pull be lightened in a revolver?

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

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

9.4.4.7 What is a top break revolver?

9.4.4.8 Of Colt, Smith & Wesson and Ruger; which manufacturer does not use a side plate?

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

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

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

9.4.5 Pistols

9.4.5.1 Define the following terms using the current version of the AFTE Glossary:

- Backstrap
- Chamber
- Front Strap
- Ejector
- Ejection port
- Extractor
- Feed ramp
- Magazine
- Magazine floorplate
- Receiver
- Take down
- Barrel lug
- Inertia firing pin
- Striker
- Magazine follower
- Magazine spring
- Magazine well
- Recoil spring
- Recoil spring guide
- Slide
- Slide Stop

9.4.5.2 Discuss with the TC how the following safeties function and how to check their function:

- i. Grip safety
- ii. Magazine safety
- iii. Thumb/manual safety
- iv. Decocker
- v. Trigger safety
- vi. Disconnect
- vii. Cocking indicator
- viii. Loaded chamber indicator
- ix. Firing pin block
- x. Key

9.4.5.3 Explain the cycle of fire for a semiautomatic pistol.

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

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

9.4.5.6 Name some pistol manufacturers that use hidden serial numbers.

9.4.5.7 Describe how to perform a function check on a pistol with an exposed hammer versus a striker fired pistol.

9.4.5.8 Describe the differences between Smith & Wesson model Sigma series and Glock pistols.

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

9.4.5.10 Describe Glock connectors (include angle degree, angle direction, and trigger pull).

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

9.4.6 Rifles

9.4.6.1 Describe the following actions and provide an example of a firearm which uses each mechanism:

- | | |
|---|---------------------|
| i. Roller delayed blowback | iv. Lever action |
| ii. Gas operated (to include direct impingement and gas piston) | v. Trap door |
| iii. Bolt action | vi. Rolling block |
| | vii. Martini action |

9.4.6.2 Define the following terms:

- | | | |
|--------------------------|--------------------------------------|--------------------------|
| i. Long gun | viii. Stock | xvi. Tilting breechblock |
| ii. Carbine | ix. Stripper Clip | xvii. Muzzle flash |
| iii. Rifle | x. Rotary magazine | xviii. Muzzle break |
| iv. Mannlicher Type Bolt | xi. Drum magazine | xix. Flash suppressor |
| v. Mauser Type Bolt | xii. Machine gun | xx. Floating firing pin |
| vi. Musket | xiii. Receiver bridge (split bridge) | |
| vii. Silencer | xiv. Receiver ring | |
| | xv. Rotating bolt | |

9.4.6.3 Describe the function of a cross bolt safety.

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

9.4.6.5 Explain the difference between push feed and control feed.

- 9.4.6.6 Name three rifles that use a push feed system.
- 9.4.6.7 Name three rifles that use a control feed system.
- 9.4.6.8 Why can't you have a plunger type ejector with control feed?
- 9.4.6.9 What is meant by the term "microgroove rifling"? Name some manufacturers that use microgroove rifling.
- 9.4.6.10 What is a fluted chamber and give an example of a firearm that has one.
- 9.4.6.11 Why can only blunt-nose bullets be used in tubular magazines?
- 9.4.6.12 What is selective fire?
- 9.4.6.13 What does it mean to fire from an open bolt?
- 9.4.6.14 What is an en bloc clip? Give an example of a firearm that uses an en bloc clip.
- 9.4.6.15 Describe the differences between an AK-47 and SKS. How can these firearms be modified to fire full auto?
- 9.4.6.16 Describe how to perform a function check on a lever action rifle.
- 9.4.6.17 List two rifles with free floating firing pins.
- 9.4.7 **Shotguns**
- 9.4.7.1 Describe the following actions and provide an example of a firearm which uses each mechanism:
- | | |
|-----------------|--|
| i. Pump action | iv. Boxlock action |
| ii. Long recoil | v. Sidelock action (back action, bar action) |
| iii. Break open | |

9.4.7.2 Define the following terms:

- | | | |
|----------------------------|--------------------------------|--------------------------|
| i. Choke | ix. Side by side shotgun | xvii. Automatic safety |
| ii. Choke tube | x. Nonselective single trigger | xviii. Barrel guide |
| iii. Forcing cone | xi. Selective single trigger | xix. Inertia block |
| iv. Forearm | xii. Single - Double trigger | xx. Ventilated rib |
| v. Forend | xiii. Backboring | xxi. Barrel porting |
| vi. Shotgun | xiv. Overbore | xxii. Primary extraction |
| vii. Double barrel shotgun | xv. Cartridge stop | xxiii. Recoil pad |
| viii. Over/under shotgun | xvi. Barrel selector | xxiv. Combination gun |
| | | xxv. Pistol grip |

9.4.7.3 Describe magazine cut off and its purpose.

9.4.7.4 Describe magazine plug and its purpose.

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

9.4.7.6 Describe the function of the front trigger and back trigger in a break open shotgun.

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

9.4.7.8 Discuss with the trainer common safeties on shotguns and how to check their function.

9.4.7.9 Describe the billiard ball effect.

9.4.7.10 Describe Journee's formula.

9.4.7.11 Describe how a choke functions and list common degrees of chokes from most constriction to least constriction.

9.4.7.12 What is a poly choke and why is it popular?

9.4.7.13 Describe a screw in choke.

- 9.4.8 Discuss with the Discipline Leader/on-site trainer from the unit the protocol to be used in determining whether a firearm "can be made to fire without pulling the trigger".
- 9.4.9 Research, define, and/or determine the implications of the following terms as they relate to safety in the operation of a firearm.
- | | | |
|------------------------|--------------------------|--------------------------------------|
| i. Excessive headspace | ix. high primer | xvi. Battery (in and out of battery) |
| ii. Barrel obstruction | x. rail splitting | xvii. Malfunction |
| iii. barrel bulge | xi. hairline cracks | xviii. Misfire |
| iv. Broken extractor | xii. improper timing | xix. Misfeed |
| v. Push off | xiii. excessive pressure | xx. Stove pipe |
| vi. Trigger shoe | xiv. dented barrel | xxi. Slamfire |
| vii. False half-cock | xv. Accidental discharge | |
| viii. defective safety | | |
- 9.4.10 Explore the capabilities in restoring an inoperable evidence firearm to operating condition and also know the limitations and reservations which must be considered.
- 9.4.11 Review and record the references in the lab library which can be used to identify the manufacturer and/or source of a firearm using the following criteria:
- | |
|-----------------------------------|
| i. Proof marks |
| ii. Inspector marks |
| iii. Factory numbers and markings |
| iv. Serial number |
| v. Part numbers |
| vi. Company logos |
- 9.4.12 Become familiar with the capabilities and limitations of the lab in regard to these areas:
- | |
|---|
| i. Marking evidence firearms |
| ii. Determining whether an evidence firearm has been fired since it was last cleaned |
| iii. Determining the manufacturer of a firearm from an examination of a part from a firearm |
| iv. Determining the manufacturer of a firearm from a photograph and comparing an evidence firearm to a photograph |

- 9.4.13 Become knowledgeable about how to submit evidence firearms to the laboratory when they have been recovered from water or when they are in a rusted condition. Also become familiar with the capabilities, limitations, and reservations which must be considered when restoring such firearms to operating condition to obtain test specimens from them.
- 9.4.14 Become knowledgeable about how to conduct an examination to determine if a firearm has been altered to fire full automatic. Using a firearm which has been altered to fire full automatic, conduct this type of examination and verbally report your findings.

Practical Exercises:

- 9.4.15 For each of the following firearms partially disassemble and reassemble a representative sample, photograph, note differences in operational mechanism and be able to identify major parts by name.
- i. representative sample of revolvers
 - ii. semiautomatic firearms
 - iii. submachine guns
 - iv. military and civilian center fire rifles
 - v. shotguns
 - vi. rimfire revolvers, pistols and rifles

Using the above firearms:

- a. Study the various safety mechanisms employed in each design. Include thumb safety, grip safety, magazine safety, firing pin block, transfer bar, and any other mechanical safety. Illustrate how the firing mechanisms are blocked, interrupted, or otherwise stopped from operating.
- b. Demonstrate how to place firearms in a safe condition, how to load and unload each, how to handle and carry these firearms in the laboratory, and how to safely test fire each of these different types of firearms.
- c. Familiarize yourself with the lab equipment used for measurement of trigger pull. Determine the trigger pull on at least one firearm from each group of firearms.

- d. Demonstrate using one firearm from each group of firearms, how to determine whether a firearm "can be made to fire without pulling the trigger".

9.4.16 Attend Armorer's training offered by various manufacturers of firearms, at their manufacturing facilities if possible. Coordinate these with the Discipline Leader/on-site trainer.

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10.0 Serial Number Restoration

10.1 Background and Theory

- 10.1.1 Stamping a serial number in metal deforms the metal below the surface of the visible number. Under certain circumstances a removed number can be recovered by treating the surface with chemical reagents.

10.2 Objectives, Principles, and Knowledge

- 10.2.1 Alteration methods.
- 10.2.2 Recovery methods.
- 10.2.3 Serial number references.

10.3 Health and Safety Hazards

- 10.3.1 Safe gun handling procedures.
- 10.3.2 Lead exposure.
- 10.3.3 Caustic and acidic chemicals.

10.4 Reading and Practical Exercises

Written and Verbal Exercises:

- 10.4.1 Read the Handbook of Methods for the Restoration of Obliterated Serial Numbers by Treptow. Prepare a summary on the Theory of Serial Number Restoration.
- 10.4.2 Sketch the entire stressed area above and below the indentation of a stamped item and depict what remains when the indented area is removed.
- 10.4.3 Make a list of the various methods used to mark items by private industry. This list should include but not be restricted to: casting, stamping, dot matrix, laser and electrical discharge machining.
 - i. Determine the effect each of these marking techniques has on the subsurface of the marked area.
 - ii. Determine how the marking methods used can directly affect the ability of the examiner to restore any obliterated markings and why.
- 10.4.4 Define the term "plastic deformation" of metal.

- 10.4.5 Document the difference between cold rolled steel and cast iron metal.
- 10.4.6 Define and document the effect that the following types of alterations will have on the subsurface of the marked item and how it will impact on the results of the examiner.
- i. Grinding
 - ii. Restamping
 - iii. Pinging
 - iv. Gouging
 - v. drilling
 - vi. welding
 - vii. filing
 - viii. combinations of the above
- 10.4.7 Determine the telltale signs that can be left by the various alteration methods. Discuss how these signs will determine your specific approach to the restoration attempt.
- 10.4.8 Determine the different types of lighting (e.g., incandescent and fluorescent) and how they can improve or enhance the restoration results. Document how the angle of incidence of these lighting techniques might vary the results.
- 10.4.9 Discuss the various methods of surface preparation such as sanding and polishing and how they will affect the results in the restoration attempt.
- 10.4.10 Determine the chemical reaction that takes place when etching is done and place in your notebook the appropriate chemical formulations for the general reactions of acid with steel and aluminum.
- 10.4.11 Determine whether the reaction rate for the stressed area is faster or slower than the etching rate of the rest of the surface and why.
- 10.4.12 Determine the specialized equipment that might be used in number restoration and discuss these with the Discipline Leader/on-site trainer.
- 10.4.13 Determine the various ways photography can be utilized to document the process of serial number restoration. Also discuss its limitations.

- 10.4.14 Research the various kinds of magnifying and enhancing equipment used for number restoration and explain when and why each would be used.
- 10.4.15 Become familiar with the following chemicals:
- i. CuCl_2
 - ii. NaOH
 - iii. HCl
 - iv. HNO_3
 - v. K_2SO_4
 - vi. H_2SO_4
 - vii. FeCl_3
- 10.4.16 Obtain the proper safety equipment (e.g., eyewear, masks, gloves, and lab coats) before attempting any chemical restorations. Review the chemical hygiene policies to insure proper safety precautions are used.
- 10.4.17 Define and place in your notebook these common chemical terms:
- i. Frys Reagent
 - ii. Turner's Reagent
 - iii. Davis' Reagent
- 10.4.18 Become knowledgeable of the numbering systems and methods used by various firearms manufacturers including but not limited to Colt, Ruger, Smith & Wesson, US Repeating Arms (Winchester) and Remington.
- 10.4.19 Discuss the best chemicals and techniques to use in number restoration of the following firearms:
- i. Colt pistol
 - ii. Smith & Wesson revolver
 - iii. RG Industries revolver
 - iv. Ruger stainless steel revolver
 - v. Winchester rifle
 - vi. shotgun case hardened receiver
 - vii. shotgun alloy receiver
 - viii. chrome/nickel 25 caliber auto-loading pistol
- 10.4.20 Document how the combination of brief application of CuNH_4Cl_2 followed by normal NaOH application can shorten the processing time on aluminum.

- 10.4.21 Prepare a short summary of why alternating HNO₃ and HCl can work so well on chrome or nickel-plated firearms.

Practical Exercises:

- 10.4.22 Obtain several sample serial numbers from the Discipline Leader/on-site trainer; alter the serial numbers using different methods and then attempt to restore them. Prepare notes and photographs to substantiate your conclusions and results.
- 10.4.23 Document the methods used and lessons learned during the restoration process.
- 10.4.24 Obtain several pieces of aluminum that have had stamped numbers removed. Attempt to restore these numbers using various techniques. Prepare notes and photographs to substantiate your conclusions and results.
- 10.4.25 Research the effect of electricity on the reaction time of the different chemical techniques you have learned. Conduct restorations using this method.
- 10.4.26 Using the appropriate bar code appendix from the firearms section procedures manual, select a firearm from the reference collection and decode the associated serial number, if firearm is not available decode barcode from a purchased item. Take appropriate notes/photographs.
- 10.4.27 Successfully complete a serial number restoration competency test.
- 10.4.28 Successfully complete a written or oral examination dealing with serial number restoration.
- 10.4.29 Successfully complete mock court dealing with serial number restoration.
- 10.4.30 Successfully complete supervised case requirements.
- 10.4.31 Successfully complete technical review training.

11.0 Gunshot Residue Examinations and Distance Determinations

11.1 Background and Theory

- 11.1.1 When fired a firearm produces smoke, partially burnt powder and vaporous lead. These products can be deposited onto the target in a pattern that changes with distance. This pattern can be reproduced allowing the examiner to determine an approximate muzzle to target distance for the original shot. Shotgun pellet patterns can also be reproduced. The passage of a bullet can leave copper and/or lead wipe which can be chemically tested for.

11.2 Objectives, Principles, and Knowledge

- 11.2.1 Producing test patterns.
- 11.2.2 Preparing chemicals.

11.3 Health and Safety Hazards

- 11.3.1 Safe gun handling procedures.
- 11.3.2 Chemical hazards.

11.4 Reading and Practical Exercises

Written and Verbal Exercises:

- 11.4.1 Obtain a copy of and be familiar with the lab protocol for Distance Determination examinations.
- 11.4.2 Described in detail the chemical reactions which take place in the burning of smokeless powder, the modified Griess test and the Sodium Rhodizonate test.
- 11.4.3 Read the article entitled "Graphical Analysis of the Shotgun/Shotshell Performance Envelope in the Distance Determination Cases" in the AFTE Journal, October, 1989 issue. Prepare a summary of the significance of the article
- 11.4.4 In general, explain the steps involved in evaluating an article of clothing for the presence of a gunshot residue pattern.

- 11.4.5 Describe why and how you would conduct a Modified Griess test.
- 11.4.6 Describe why and how you would conduct a Sodium Rhodizonate test.
- 11.4.7 How would you conduct a Sodium Rhodizonate test when the substrate is dark and the reaction cannot be observed?
- 11.4.8 What are the characteristics of a contact shot?
- 11.4.9 Why is a range reported / what is the purpose of a bracket?
- 11.4.10 How does choke affect spread?
- 11.4.11 Discuss with your trainer the basic laboratory steps for conducting distance determinations, examination conclusion limitations, and the potential effects of the following:
- i. Barrel length
 - ii. Powder morphology
 - iii. Ammunition type
 - iv. Intermediate objects
 - v. Handling of clothing

Practical Exercises:

- 11.4.12 Demonstrate your proficiency in preparing the chemicals used in the modified Griess test and the Sodium Rhodizonate test including the test media and the photographic paper.
- 11.4.13 Demonstrate your proficiency in conducting the following techniques, following appropriate lab protocol.
- i. Conventional Griess test
 - ii. Reverse Griess test
 - iii. (c) Sodium rhodizonate test
 - iv. Bashinsky transfer
 - v. blotting transfer
- 11.4.14 Perform a competency test conducting "muzzle-to-garment" distance tests, with at least one sample involving the deposition of gunshot residues and one sample involving shot patterns.

- 11.4.15 Successfully complete a written or oral examination dealing with distance testing.
- 11.4.16 Successfully complete a mock court dealing with distance testing.
- 11.4.17 Successfully complete supervised case requirements.
- 11.4.18 Successfully complete technical review training.

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12.0 Bullet Examinations and Comparisons

12.1 Background and Theory

- 12.1.1 When a firearm is fired markings are imparted on the bullet by the barrel. These markings include class characteristics from the rifling and individual characteristics imparted by imperfections in the barrel caused by manufacturing methods, wear and damage.

12.2 Objectives, Principles, and Knowledge

- 12.2.1 Become familiar with terminology.
- 12.2.2 Be able to characterize a fired bullet and determine what conclusions can be drawn from it.
- 12.2.3 Become familiar with bullet comparisons.

12.3 Health and Safety Hazards

- 12.3.1 Safe gun handling procedures.
- 12.3.2 Lead exposure.

12.4 Reading and Practical Exercises

Written and Verbal Exercises:

- 12.4.1 Obtain a copy of and familiarize yourself with the lab protocol for the examination of fired bullets.
- 12.4.2 Define or determine the significance of the following terms/phrases as they relate to the examination and comparison of fired bullets.
 - i. Slippage
 - ii. Shaving
 - iii. Obturate
 - iv. Leading edge and trailing edge
 - v. Melting
 - vi. blow-by
 - vii. Striation
 - viii. Individual microscopic marks
 - ix. Ogive
 - x. bearing surface
 - xi. class characteristics
 - xii. general rifling characteristics
 - xiii. insufficient individual microscopic marks
 - xiv. corrosion
 - xv. leading
 - xvi. "limited individual microscopic marks"
 - xvii. "single-action" firing
 - xviii. "double-action" firing

- 12.4.3 Know the importance of and limitations of determining the following, as they relate to the examination and comparison of fired bullets or bullet fragments:
- i. Weight
 - ii. Caliber
 - iii. Manufacturer
 - iv. Caliber type
 - v. general rifling characteristics
 - vi. pitch of rifling
 - vii. depth of rifling
- 12.4.4 Become familiar with the Known Specimen File (KSF). Know its location, composition, filing system and uses as a reference file.

Practical Exercises:

- 12.4.5 Familiarize yourself with the General Rifling Characteristics (GRC) file. Know how to use this file to compile a list of firearms in a "no-gun case". Demonstrate your proficiency in using the GRC file using samples provided by your on-site trainer.
- 12.4.6 Using provided test bullets and other fired bullets and bullet fragments demonstrate your proficiency in accurately determining caliber, caliber type, manufacturer, and rifling characteristics of these fired bullets. Prepare a list of firearms which could have been used to fire these bullets provided to you. Use the KSF, SAF, and GRC files in conducting these examinations.
- 12.4.7 Using test bullets fired from polygonal rifled barrels, demonstrate your proficiency in accurately determining the rifling characteristics of these fired bullets. Compile a list of firearms which could have been used to fire these bullets using the GRC file.
- 12.4.8 Become knowledgeable about the facilities in the lab for the recovery of fired test bullets. Know when and how to use the horizontal recovery tank and fiber box and their limitations. Observe and assist the Discipline Leader/on-site trainer from the lab in the recovery of fired bullets using each of these methods.

- 12.4.9 Familiarize yourself with the ammunition storage areas in the lab. Know how to locate test ammunition. Know the reasons for using substitute ammunition or down-loading ammunition for test firing. Know the proper procedure for down-loading ammunition for test firing. Under supervision of the Discipline Leader/on-site trainer prepare and fire down-loaded test ammunition.
- 12.4.10 Microscopically compare test bullets from "consecutively-made" barrels. Observe and document the differences and similarities in the striations.
- 12.4.11 Using the same .22 caliber firearm, test fire two each of at least three brands of 22 LR caliber ammunition, using both plated (copper and brass washed) and lead bullets. Attempt to identify the test bullets to each other. Take appropriate photographs and notes.
- 12.4.12 Using the same .357 Magnum caliber revolver, test fire two each of at least three brands of 38 special and .357 Magnum caliber ammunition, using jacketed, plated and lead bullets. Attempt to identify the test bullets to each other. Take appropriate photographs and notes.
- 12.4.13 Using the same 9mm Luger pistol, test fire two each of at least 3 brands of 9mm ammunition, ensuring both jacketed and plated bullets are used. Attempt to identify the test bullets with each other. Take appropriate photographs and notes.
- 12.4.14 Using the same .30 caliber rifle test fire two each of at least two different brands of ammunition and compare the tests with each other.
- 12.4.15 Using the same .32 S & W caliber revolver test fire two each of the following cartridges and compare the test bullets with each other.
- i. .32 S & W caliber Remington with lead bullet
 - ii. .32 Auto caliber Remington with full metal case jacketed bullet
- 12.4.16 Test fire a representative sample of Polygonal or Hexagonal rifling profile pistols. Using two test bullets from each pistol, make microscopic comparisons of the test bullets.
- 12.4.17 Microscopically compare bullets before and after that have been fired from a gun and then the barrel of the gun was cut and the muzzle end was crowned.

- 12.4.18 Microscopically compare bullets before and after that have been fired from a gun and then the barrel of the gun was cleaned.
- 12.4.19 Microscopically compare bullets test fired from three different firearms of the same make and model.

Written and Verbal explanations based on Practical Exercises:

- 12.4.20 Compile a list of reasons as to why bullet identifications cannot be made in some cases, and why some barrels and bullets can preclude or tend to preclude identifications. This list should include, but not be limited to, the results of the above testing.
- 12.4.21 Read the article in the April 1985 issue of the Crime Laboratory Digest concerning "Manufacturing Toolmark Identification on the Base of Jacketed Bullets". Discuss the significance of identifying manufacturing toolmarks on a fired bullet from a victim with those on unfired bullets loaded into cartridges from the suspect.
- 12.4.22 Determine the feasibility of determining caliber and/or the rifling characteristics of a fired bullet from an examination of a bullet hole in metal. To complete this test:
- 12.4.23 Compare test bullets with each other before and after from a barrel that has been "Slugged"

13.0 Cartridge/Cartridge Case Examinations and Comparisons

13.1 Background and Theory

- 13.1.1 When a firearm is fired markings are imparted on the cartridge case. These markings include class characteristics and individual characteristics. Class characteristics can be used to determine caliber, make and model of a possible firearm. Individual characteristics can be used to show a common origin.

13.2 Objectives, Principles, and Knowledge

- 13.2.1 Be able to characterize a fired cartridge case and determine what conclusions can be drawn from it.
- 13.2.2 Become familiar with cartridge case comparisons

13.3 Health and Safety Hazards

- 13.3.1 Safe firearm handling procedures

13.4 Reading and Practical Exercises

Written and Verbal Exercises:

- 13.4.1 Obtain a copy of and be familiar with the lab protocol for the examination of cartridges and cartridge cases.
- 13.4.2 Describe "class characteristics" of the markings on a cartridge or a fired cartridge case. Determine the types of marks which can be left on a cartridge case/cartridge during loading/extracting and firing. Review a videotape regarding the slow motion of firing sequences using semiautomatic firearms.
- 13.4.3 Read the following two articles in the October 1989 issue of the AFTE journal and discuss them with the Discipline Leader/on-site trainer in the lab.
- i. "Firing Pin Impressions - Their Measurement and Significance"
 - ii. "Firing Pin Impressions - Their Relation to Hammer Fall Conditions"
- 13.4.4 What are class characteristics as they apply to cartridge cases/shotshell cases

- 13.4.5 What types of marks can be left on a cartridge/shotshell during the loading/extracting process?
- 13.4.6 What types of marks can be left on a cartridge case during the firing process?
- 13.4.7 Be familiar with the following terms from the current version of the AFTE Glossary:
- i. Anvil marks
 - ii. Breechface marks
 - iii. Cycling marks
 - iv. Ejector marks
 - v. Extractor marks
 - vi. Firing pin aperture shear
 - vii. Firing pin drag mark
 - viii. Firing pin impression
 - ix. Magazine lip marks
 - x. Primer flow back
- 13.4.8 What are the different types of breechface marks and what manufacturing processes make these marks?
- 13.4.9 What is the significance of manufacturing marks on cartridges/shotshells and cartridge cases/shotshell cases?
- 13.4.10 What is the significance of bunter marks?
- 13.4.11 What marks can be used to differentiate between a cartridge case fired in an AK vs. an SKS type rifle?
- 13.4.12 What are some possibilities for subclass characteristics on fired cartridge cases? How can subclass influence be ruled out?
- 13.4.13 What is the significance of a fluted chamber? Provide an example(s) of firearms manufacturers that produce fluted chambers.
- 13.4.14 What firearms manufacturers use elliptical shaped firing pins?
- 13.4.15 What manufacturer(s) is known for producing ejection port (cyclone/tornado) marks on cartridge cases?
- 13.4.16 What are some known sources of manufacturer produced subclass characteristics in cartridges and which manufacturers produce them?

- 13.4.17 Prepare a short written report about comparing and identifying reloading type marks on shotshells/cartridges and/or shotshell/cartridge cases. Identify the various types of marks which may be indicative of reloaded ammunition.
- 13.4.18 What is MIM? What firearm parts are MIM? What manufacturers use MIM parts? What challenges does this present to the firearms discipline?

Practical Exercises:

- 13.4.19 Test fire at least twice 6 semiautomatic firearms.
- i. Using the test fired cartridge cases, visually relate the markings imparted to the fired cartridge case with the part on the firearm which produced these markings.
 - ii. Load and extract at least two cartridges from each of the firearms and visually relate the markings imparted to the unfired cartridges with the part on the firearm which produced these markings.
 - iii. Microscopically intercompare all of the markings with each other. Include the following types of markings in your microscopic comparisons: firing pin impression, breechface marks, chamber marks, anvil marks, extractor marks, ejector marks, ramp marks, and magazine marks. Photograph the results of your comparisons.
- 13.4.20 Test fire the following firearms, at least twice with each brand, using comparable CCI, Remington, Federal, and Winchester ammunition of the appropriate caliber type. Select ammunition with both nickel and brass primers. Microscopically intercompare and photograph the markings as completed above.
- i. .38 Special caliber Smith & Wesson revolver
 - ii. .357 Magnum caliber Smith & Wesson revolver
 - iii. 9mm Smith & Wesson pistol
 - iv. .22 long Rifle caliber Ruger pistol
- 13.4.21 Test fire and compare the cartridge cases from at minimum, two to three different firearms of the same make and model.
- 13.4.22 Index the cartridges and test fire a .22 Long Rifle caliber Smith and Wesson revolver using the same manufacturers' ammunition. Fire six .22

Long Rifle caliber cartridges, six .22 Long caliber cartridges, and six .22 Short caliber cartridges. Intercompare and photograph the markings imparted to the fired cartridge cases.

- 13.4.23 Test fire a .30 Carbine caliber U.S. Carbine and compare the test cartridge cases with each other. Compare all of the marks imparted to the fired cartridge cases. Load and extract cartridges from this same firearm. Note and compare all of the marks imparted to the test cartridges.
- 13.4.24 Explore the possibility of comparing and identifying reloading-type marks on cartridges/cartridge cases. Identify the various types of marks which may be indicative of reloaded ammunition. Become familiar with the reloading equipment in the lab and the procedures used in reloading cartridges. Reload several cartridges and compare reloading-type marks on these cartridges with each other.
- 13.4.25 Determine the feasibility of comparing and identifying manufacturing toolmarks on a fired cartridge case from the scene of a crime with cartridges which can be associated with the suspect. Identify the various types of manufacturing toolmarks which may be present on cartridges or cartridge cases.

14.0 Shotshell/Shotshell Component Examinations and Comparisons

14.1 Background and Theory

- 14.1.1 When a shotgun is fired markings are imparted on the shotshell. These markings include class characteristics and individual characteristics. Class characteristics can be used to determine gauge, make and model of a possible firearm. Individual characteristics can be used to show a common origin.

14.2 Objectives, Principles, and Knowledge

- 14.2.1 Become familiar with terminology.
- 14.2.2 Become familiar with characterizing shotshell components and fired shot.
- 14.2.3 Shotshell comparisons.

14.3 Health and Safety Hazards

- 14.3.1 Safe gun handling procedures.
- 14.3.2 Lead exposure.

14.4 Reading and Practical Exercises

Written and Verbal Exercises:

- 14.4.1 Determine what type of examinations can be conducted and what conclusions can be reached from an examination of the following components. Discuss this with the Discipline Leader/on-site trainer.
 - i. shot, deformed and undeformed
 - ii. Fired card or fiber wads
 - iii. Fired plastic wads
 - iv. Fired shotshell casings
 - v. Unfired shotshells
 - vi. Shot buffer material
 - vii. Shot collar and shot cup

- 14.4.2 Familiarize yourself with the use of the SAF in regard to the determination of gauge and manufacturer of fired shotshell components. Know the limitations in regard to making such determinations. Demonstrate your proficiency in using the SAF to conduct this type of search.

Practical Exercises:

- 14.4.3 Using a shotgun, saw off a portion of the barrel. Test fire this shotgun using a Remington shotshell with a power piston wad. Recover the test shotshell wads and make microscopic comparisons of marks imparted to the test wads.
- 14.4.4 Test fire 4 shotguns using at least two test shotshell casings from each shotgun and microscopically compare the marks imparted to these shotshell casings. Include in your comparisons the following types of marks: firing pin impression, breechface marks (primer, battery cup, and head), extractor marks, ejector marks, chamber marks, and any other mechanism marks. Photograph these marks and document the significance of identifying any of these types of marks.
- 14.4.5 Using a 12 gauge semiautomatic shotgun, using at least two test shotshell casings with a representative sample of 12 gauge shotshell ammunition. Use small size shot, mediums size shot, buckshot and slugs for this test. Also recover a representative number of the fired pellets and fired wadding from each test firing. Compare markings on these test shotshell casings with each other. Examine the fired components which were recovered and compare them to unfired components of the same type. Document the significance of your findings.
- 14.4.6 Discuss in detail the procedures used in reloading shotshells and familiarize yourself with the shotshell reloading equipment in the lab. Know how to recognize reloaded shotshells from an examination of the shotshell casing and/or its components. Reload shotshells using the shotshell reloading equipment in the lab and examine the reloaded shotshells for reloading-type marks.

- 14.4.7 Successfully complete a written or oral examination dealing with firearm examination.
- 14.4.8 Successfully perform a competency test that includes at least one cartridge case comparison, one bullet comparison and a shotshell or shotshell component examination and comparison.
- 14.4.9 Successfully complete a mock court dealing with firearm examination.
- 14.4.10 Successfully complete supervised case requirement.
- 14.4.11 Successfully complete technical review training.

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15.0 Toolmark Examinations and Comparisons

15.1 Background and Theory

- 15.1.1 Toolmarks can be found at crime scenes from burglary to murder. The marks left by tools can include class characteristic and individual characteristics. Class characteristics can be used to determine the type of tool and to determine if a tool is consistent or inconsistent with the mark. Individual characteristics can be used to show a common origin.

15.2 Objectives, Principles, and Knowledge

- 15.2.1 Define terminology and types of tools.
- 15.2.2 Toolmark comparisons.

15.3 Health and Safety Hazards

- 15.3.1 Sharp edges.

15.4 Reading and Practical Exercises

Written and Verbal Exercises:

- 15.4.1 Obtain a copy of and familiarize yourself with the lab protocol for the examination toolmarks.
- 15.4.2 Review your notes in reference to the section entitled "Manufacture of Modern Firearms". Those machining methods are the basis for toolmark identification as they were for firearms identification. However, it should be noted that in the broad definition of toolmarks identification, certain other related types of examinations are also performed.
- 15.4.3 Define the word "tool" and toolmarks identification in the narrow sense of the expression. Define Toolmark Identification in its broadest sense, and determine the kinds of conclusions which may be reached in the toolmark identification.
- 15.4.4 Determine and document the significance of examining submitted tools first for foreign deposits and itemize several types of such deposits.

- 15.4.5 In a case involving a toolmark examination where no tool is submitted, determine the types of conclusions which can be reached. Consider such things as the type of tool, size of tool, action employed by tool, value of toolmark for comparison purposes, and unusual tool features. Discuss the "no tool" case with the Discipline Leader/on-site trainer. Can you eliminate a toolmark without a tool? Why or why not?
- 15.4.6 Define the following terms as they relate to toolmark identification and give three examples of tools or methods which could produce each category:
- i. Shearing
 - ii. Pinching
 - iii. Fracture
 - iv. scrape mark
 - v. impression
 - vi. slicing
- 15.4.7 Discuss the fact that generally saws, files, and abrasive tools are not identifiable with the marks they produce.
- i. What problems are generally encountered with respect to the identification of toolmarks produced by a saw?
 - ii. What problems are generally encountered with respect to the identification of toolmarks produced by files and abrasive tools?
 - iii. Cite any exceptions to this rule.
- 15.4.8 What are differences in class characteristics of shearing, pinching, and slicing actions?
- 15.4.9 What factors can affect the reproduction of a toolmark?
- 15.4.10 Does varying the angle and force with which each tool is used change or alter the questioned toolmarks?
- 15.4.11 Is there a difference in the quality of toolmarks produced by a tool in different mediums?

- 15.4.12 Is there a potential for the surface of a tool to change using different mediums?
- 15.4.13 During a microscopic examination/comparison, what problems can be observed on a multi-stranded cable cut using a slicing action?
- 15.4.14 What problems are generally encountered with respect to the identification of toolmarks produced by a saw?
- 15.4.15 Explain the random processes that produce uniqueness in surface fractures.
- 15.4.16 Define fracture match.
- 15.4.17 Describe a "physical fit" examination.
- 15.4.18 Explain plastic deformation in non-brittle fractures

Practical Exercises:

- 15.4.19 Define the term "class characteristics" as it applies to toolmark identification. Using the tools of methods selected as examples in the paragraph above, describe their respective class characteristics in detail.
- 15.4.20 Select at least two tools representative of each category in 15.4.6 above from the lab. Produce toolmarks with each tool and observe the class characteristics of the toolmark. Vary the angle and force with which each tool is used.
- 15.4.21 Using soft copper wire of approximately 1/4-inch diameter, make cuts through it with the tools which employ a shearing, pinching and slicing action. Make test cuts in lead using the same tools. Attempt to identify the cuts in the copper wire as having been made by the same tool as that which cut the test lead. Support your results with photographs and note

any lighting considerations made necessary by the color difference between copper and lead.

- 15.4.22 Select a flat-bladed tool such as a screwdriver and a pry bar and make marks in a piece of copper or brass sheeting. Make the same type of marks in lead with both tools. Microscopically compare those in the brass or copper sheeting with the test marks in the lead. Attempt to identify the appropriate marks with the appropriate tool. Photograph your results and comment on the difference in the quality of marks made by each tool.
- 15.4.23 Using a drive pin punch, produce an impression in a piece of brass sheeting. Produce a set of test marks in lead and intercompare these two marks. Attempt to identify these as having been made by the same tool. Support your results by photographs.
- 15.4.24 Using a junked doorknob and a serrated-jawed tool, have the Discipline Leader/on-site trainer produce impressions and scrape marks like those produced by an attempt at an entry. Obtain test marks on an item similar to the doorknob. Microscopically compare the marks on the doorknob with those on the test material. Identify the tool with the marks on the doorknob and reproduce the tool-doorknob orientation and relate each mark to its respective serration on the tool.
- 15.4.25 Obtain a section of multi-strand wire and cut it with pinching and shearing type tools. Make detailed observation notes regarding the effects of the cutting action on a multi-stranded cable. Note the quality and extent of microscopic marks of each strand and comment on the problems involved in identifications of this sort. Photograph the cut end of the cable.
- 15.4.26 Obtain a used tire and make cuts and stabs into the sidewall with a fixed blade knife. Attempt to make comparisons of the toolmarks produced by the knife. Support your results with photographs and notes. Determine how the results of your examinations might be altered if the knife had been sharpened after making the questioned cuts, or if the knife had

been used for an extended period of time after making the initial questioned cuts.

- 15.4.27 Investigate pressure/contact examinations in regard to objects which may have been in contact with each other for an extended time. Research several cases of this type and set these out in your notes.
- 15.4.28 Demonstrate making of casts of toolmarks. Discuss the potential of such casts and of photographs alone in making toolmarks identifications.
- 15.4.29 You will receive 3 sets of broken objects. 1) Broken screwdriver tips 2) broken key blanks 3) a broken grip plate(s). Complete the appropriate worksheets, documenting observations with photos and/or sketches. At least a minimum, one of the 3 practical sets shall be additionally examined using opposite/reverse lighting and casting methods. Be prepared to discuss all conclusions and observations of method limitations.
- 15.4.30 Tear and cut various samples of tape; document observations of cut versus torn edges, and any limitations of source conclusions.
- 15.4.31 Successfully complete a written or oral examination dealing with toolmark examination.
- 15.4.32 Successfully perform a toolmark competency test.
- 15.4.33 Successfully complete a mock court dealing with toolmark examination. (An additional mock court not required if completed during the Firearms comparison mock court)
- 15.4.34 Successfully complete supervised case requirement
- 15.4.35 Successfully complete technical review training.

16.0 Courtroom Testimony

16.1 Background and Theory

- 16.1.1 The communication of the results of an analysis to a jury is the ultimate goal of every forensic scientist. Therefore they must not only be able to perform the analysis but be able to explain that analysis to a jury with little or no scientific knowledge. They must also be able to defend their analysis from assaults by opposing counsel and other experts.

16.2 Objectives, Principles and Knowledge

- 16.2.1 Through reading, observation of actual and simulated testimony, discussions with the trainer, preparations for and participating in mock court the trainee will gain familiarity with courtroom procedures and testimony.

16.3 Health and Safety Hazards

- 16.3.1 None

16.4 Reading and Practical Exercises

- 16.4.1 Read Chapter one “Legal Aspects of Forensic Science” in Forensic Science Handbook by Richard Saferstein and discuss it with your trainer.
- 16.4.2 If possible attend moot courts of other trainees during your training period and evaluate the demeanor and professionalism of the trainee, if applicable. This can be in any discipline. Discuss this with your trainer.
- 16.4.3 Attend the testimony of several analysts. This can be in any discipline. Discuss their testimony with the analyst and your trainer.
- 16.4.4 Define the following terms or phrases, as they apply to testimony in the field of firearms/toolmark identification.
- i. Expert witness
 - ii. Beyond a reasonable doubt.
 - iii. hearsay
 - iv. opinion
 - v. voir dire
 - vi. Daubert/Frye

- 16.4.5 Prepare a list of qualification questions which can be used by the prosecutor in court to qualify you as an expert witness. Include in this questions which can be used as a guide for the introduction in court of evidence which you have examined.
- 16.4.6 Prepare a CV.
- 16.4.7 Prepare for and participate in a mock court in each sub-discipline you have completed training and competency testing for.
- 16.4.8 Attend a courtroom testimony class if possible.

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17.0 Supervised Cases

17.1 Background and Theory

- 17.1.1 Supervised cases allows the trainer to evaluate the trainee's performance on actual case work.

17.2 Objectives, Principles, and Knowledge

- 17.2.1 To determine if the trainee can apply their training to actual case work.

17.3 Health and Safety Hazards

- 17.3.1 None

17.4 Reading and Practical Exercises

- 17.4.1 Upon successful completion of competency testing and the Quality Manager having reviewed and approved the training documentation, the Trainee will be responsible for the analysis of one case in each sub-discipline under close supervision. A firearms case counts as both a firearms and toolmark case as long as both impressed and striated marks are included.

Analysis notes for supervised casework will be reviewed by the trainer and documentation of this placed in the case file. Based on this case the onsite trainer will determine if the trainee can work independently or needs to perform additional supervised cases. Upon completion of this requirement and the approval of the Quality Manager the trainee can begin unsupervised casework.

18.0 Technical Review Training

18.1 Background and Theory

- 18.1.1 The purpose of technical review is to ensure that the conclusions are supported by the examination documentation, are reasonable, and within the constraints of validated scientific knowledge.

18.2 Objectives, Principles, and Knowledge

- 18.2.1 To provide the trainee with experience in the technical review process.

18.3 Health and Safety Hazards

- 18.3.1 None

18.4 Reading and Practical Exercises

- 18.4.1 Read through copies of reports generated by other examiners for the purpose of familiarization with report format and phraseology. Compile a reference file which reflects correct phraseology divided into appropriate categories. Discuss this with your trainer.

- 18.4.2 The trainee shall technically review for training purposes another analysts' cases for a period of six months or 25 cases whichever comes first. These reviews will be submitted to the trainer for evaluation and the results compared to the actual review results. No significant differences should be present. Technical reviews can be done on cases from any sub-discipline covered in this training program. After successfully completing this requirement the trainee can perform casework technical review in all sub-disciplines.

Basic References:

- Policies and procedure manuals for the laboratory
- Manufacturer's procedure and operation manuals
- "AFTE Glossary" AFTE Standardization Committee
- Virginia Firearms and Toolmark training plan, rev 2006
- Washington State Patrol Firearm and Toolmark Training Manual
- "Basic Firearms/Toolmarks Course" California Department of Justice
- "Cartridges of the World" BARNES
- "Encyclopedia of Modern Firearms, Parts and Assembly, Vol I." BROWNELL
- "Firearms and Ammunition Fact Book" NRA STAFF
- "Firearms Identification" Vol. I, MATHEWS
- "Firearms Investigation, Identification and Evidence" HATCHER, JURY, and WELLER
- "Gun Digest Book of Exploded Firearms Drawings" MUNTZ
- "Gunshot Wounds" DiMAIO
- "Handbook of Firearms and Ballistics" HEARD
- "Handbook of Forensic Science" FBI
- "Handbook of Methods for the Restoration of Obliterated Serial Numbers" TREPTOW
- "Handgun and Shoulder Arms Assembly" NRA
- "Hatcher's Notebook" HATCHER
- "History and Development of Small Arms Ammunition, Vol. 1-3, HOYEM
- "Hodgdon's Reloading Data Manual" HODGDON POWDER CO.
- "Hornaday Handbook of Cartridge Reloading" HORNADAY STAFF
- "Introduction to Tool Marks, Firearms, and the Striagraph" DAVIS
- "Identification of Firearms and Forensic Ballistics" BURRARD
- "Machine Shop Practice Vol 1 & 2" K. H. MOLTRECHT
- "Military Small Arms of the Twentieth Century" HOGG and WEEKS
- "NRA Firearms Source Book" BUSSARD & WORMLEY
- "NRA Guidebook to Shoulder Arms" NRA STAFF
- "Silencer History and Performance" PAULSON
- "Small Arms of the World" W.H.B. Smith
- "Speer Reloading Manual" SPEER STAFF
- "The Book of Rifles" SMITH & SMITH
- "The Identification of Firearms and Forensic Ballistics" BURRARD
- "The Illustrated Encyclopedia of Handguns" ZHUK
- "The Microscope a Practical Guide", G. H. NEEDHAM
- "The Guide for the Integrated Ballistics Identification System", Forensic Technology