

The Austin Police Department Firearm and Toolmark Section utilizes the AFTE Training Manual, dated March 3, 2001.

The Section will maintain a copy of the AFTE Training Manual as an addendum to our Section Manuals

Association  
Of  
Firearms & Tool Mark  
Examiners

TRAINING  
MANUAL

**March 3, 2001**

## **Introduction**

- A. Administrative Matters and Procedures
- B. Background/History of Firearms Identification and Current Trends
- C. Firearms and Ammunition Development and Current Trends
- D. Manufacture of Modern Firearms
- E. Manufacture of Modern Ammunition
- F. Instrumentation
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- H. Bullet Examinations and Comparisons
- I. Cartridge/Cartridge Case Examinations and Comparisons
- J. Shotshell/Shotshell Component Examinations and Comparisons
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- L. Toolmark Examinations and Comparisons
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- N. Research Project, Report Writing, Expert Testimony and External Laboratory Review and Tours

## INTRODUCTION

The following syllabus 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 syllabus is generic in its layout and allows some modification by the individual training officer or section chief to meet local conditions. It is paramount that you keep before you the primary and ultimate objective of this training period: to independently and competently 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 an 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 well 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 section equipment, the Technical Protocol Manual, Administrative Procedures Manual, the Quality Assurance Manual, the Safety Manual, as well as print, video and physical reference files. Integral to your course of study will be frequent daily contacts with section personnel with special expertise in certain areas. Do not hesitate to ask anyone a question, whether a technician, examiner or section chief.

Your study will include many printed references, including the basic material listed after each area of study. It is expected that during the training period that you will become thoroughly familiar with these basic references. Further, it should be noted that you should not restrict your efforts and research to those basic references. One of your primary sources of additional information will be the Firearm Section reference library. Familiarize yourself with the library's contents of all types, including the reference files, related indices, manufacturers' literature and the journal of the Association of Firearm and Tool Mark Examiners.

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

A research project or projects, in addition to certain collateral duties assigned as a learning experience may supplement your training syllabus. You should be prepared to discuss your preferences in regard to a project or projects and collateral duties with your training officer within thirty days after physically reporting to the section.

This training syllabus provides a framework for addressing the most important part of your training: Preparing you to independently and competently examine firearms/toolmark related evidence and independently and to competently reach conclusions and render opinions concerning your examinations and comparisons. This on-the-job, hands-on experience is the core of your training and you will be assigned to work with a training officer during your training period. This will insure that you have sufficiently covered each aspect of this training syllabus and have a basis for continuing to develop after you have graduated beyond your initial qualification and certification.

Your training will be monitored and assisted by your Training Officer, who have responsibility for training matters. All outside schools, tours, lectures and the training officer will coordinate contacts. Within sixty days of physically reporting to the section you should have completed pertinent sections of this training syllabus and you should be sufficiently knowledgeable about section operations and reference files to conduct tours of the section. This aspect of your training should also be coordinated with the training officer.

The Laboratory Director, Firearm Section Chief and/or your Training Officer will interview you in detail after you report to the section. They will be particularly concerned with you past training, experience, education, published articles and other credentials so that they may establish a base line in regard to your knowledge, skills and abilities with regard to the examiner position. Based on this information an Individual Training Plan (*ITP*) will be prepared for you which will contain projected completion dates for the established training goals. You will receive a copy of this ITP for your information and guidance. You will be expected to meet the standards set by your Training Officer for your successful completion of your training. These standards are set forth in the Administrative Guide as well as in your ITP.

### **Training Assessment**

- A trainee shall have successfully completed a qualifying test in each discipline and sub-disciplines before beginning supervised or independent casework responsibilities.
- Training assessment will be accomplished when
- All competency tests must be satisfactorily examined, documented and reported (minimum of 5)
- All training records documenting completion of training requirements, and trainee's credentials are approved by the Firearms Laboratory Supervisor
- The trainee successfully completes comprehensive standardized practical exams for the specific area of testing (for example: firearm examination, projectile comparisons, GSR – Distance testing).

A. ADMINISTRATIVE MATTERS AND PROCEDURES

1. Discuss the laboratory Quality Assurance Program and the Proficiency Testing Program with your Laboratory Director/ Firearm Section Chief.

\_\_\_\_\_  
Lab Director/Section Chief

\_\_\_\_\_  
Date

2. Discuss the laboratory policy regarding the reexamination of evidence with your Laboratory Director/Section Chief.

\_\_\_\_\_  
Lab Director/Section Chief

\_\_\_\_\_  
Date

3. Discuss the opportunities for advancement within the Firearm Section and the laboratory system with your Lab Director/Section Chief.

\_\_\_\_\_  
Lab Director/Section Chief

\_\_\_\_\_  
Date

4. Meet with the Lab Director and discuss the laboratory's mission, organization and capabilities. Tour the facilities and prepare a typed summary for your training officer regarding what you learned.

\_\_\_\_\_  
Lab Director/Section Chief

\_\_\_\_\_  
Date

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

5. Participate in a one week "*ride-along*" program with a crime scene evidence processing section. Observe the collection and preservation of physical evidence of all types, with emphasis on firearms-related evidence. Prepare a typed report for each day, citing crime scenes observed, evidence collected and the related crime scene search documentation generated, such as photographs, sketches, evidence logs, incident reports, etc.

\_\_\_\_\_  
Crime Scene Supervisor

\_\_\_\_\_  
Date

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

6. Discuss with your Lab Director/Section Chief the laboratory policies regarding the following:

- a. Providing telephonic results prior to issuance of a final laboratory report.
- b. Inquiries from the press and other media.
- c. Request to give a deposition in a criminal case.
- d. Request to testify in a civil case.
- e. Request to testify in a grand jury proceeding or a preliminary hearing.
- f. Providing a laboratory report to other agencies.

\_\_\_\_\_  
Lab Director/Section Chief

\_\_\_\_\_  
Date

7. Become familiar with the requirements and the facilities available for the secure storage of evidence within the section. Discuss this with the Lab Director/Section Chief and an examiner from the section.

\_\_\_\_\_  
Lab Director/Section Chief

\_\_\_\_\_  
Date

\_\_\_\_\_  
Student

\_\_\_\_\_  
Date

8. Become familiar with the requirements of section security in regard to firearms, electrical appliances, evidence while under examination, and section space security. Discuss this with the Section Chief and an examiner from the section.

\_\_\_\_\_  
Lab Director/Section Chief

\_\_\_\_\_  
Date

\_\_\_\_\_  
Student

\_\_\_\_\_  
Date

9. Familiarize yourself with the Firearms Reference Collection (FRC):

- a. 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.
- b. Know the correct procedure for checking a firearm out of the FRC.

\_\_\_\_\_  
Lab Director/Section Chief

\_\_\_\_\_  
Date

\_\_\_\_\_  
Student

\_\_\_\_\_  
Date

10. Be briefed by the Section Chief in regard to his files, records and procedures in regard to delinquent cases, annual and sick leave, time and attendance, report files, ordering expendable supplies, purchase orders and obtaining necessary tools, equipment and protective clothing.

\_\_\_\_\_  
Lab Director/Section Chief

\_\_\_\_\_  
Date

\_\_\_\_\_  
Student

\_\_\_\_\_  
Date

11. Know the procedures utilized in the firearm section for handling and examining evidence that may be or is known to be infected by the AIDS virus or other diseases.

**(Use Training Assignment #1 to complete this objective.)**

\_\_\_\_\_  
Student

\_\_\_\_\_  
Date

12. Obtain a copy of the "*Technical Protocols for Handling of Firearms and Ammunition*" which includes safety rules and procedures. Familiarize yourself with its content and indicate you understand the rules and procedures contained therein by your signature below.

**(Use Training Assignment #1 to complete this objective.)**

\_\_\_\_\_  
Student

\_\_\_\_\_  
Date

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date



## **REFERENCE MATERIALS**

### **ADMINISTRATIVE MATTERS**

The following reference materials serve several purposes:

- to provide a wider range of resources for use in completing pre-course assignments should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

### **Basic**

Policies and procedure manuals for the laboratory

### **Firearms Safety**

Dutton, G., "Firearms Safety in the Laboratory", AFTE Journal, 1997; 29(1):37-41.

National Laboratory Center, Bureau of Alcohol, Tobacco and Firearms, "Firearms Safety Guidelines for the Forensic Firearms Examiner," current edition.

### **Chemical Safety**

Material Safety Data Sheets (MSDS), as applicable □ can be obtained in print or on disk from chemical supply houses.

National Laboratory Center, Bureau of Alcohol, Tobacco and Firearms, "National Laboratory Center Safety Procedures Manual," current edition.

Occupational Safety and Health Administration, 29 CFR Part 1910, Occupational Exposures to Hazardous Chemicals in Laboratories; Final Rule.

### **Biohazards**

Bigbee, P.D., "Collecting and Handling Evidence Infected with Human Disease-Causing Organisms," FBI Law Enforcement Bulletin, Jul. 1987.

---. The Law Enforcement Officer and Aids, U.S. Government Printing Office, current edition.

FBI Laboratory, Bloodborne Pathogen Exposure Control Plan, current edition.

Occupational Safety and Health Administration, Bloodborne Facts □ Hepatitis B Vaccination □ Protection for You, current edition.

---. Bloodborne Facts - Holding the Line on Contamination, current edition.

---. Bloodborne Facts - Personal Protective Equipment Cuts Risk, current edition.

---. Bloodborne Facts - Protect Yourself When Handling Sharps, current edition.

---. Bloodborne Facts - Reporting Exposure Incidents, current edition.

---. 29 CFR Part 1910.1030, Occupational Exposure to Bloodborne Pathogens; Final Rule, current version.

"AIDS/HIV Carriers, An Organizational Response" FBI Law Enforcement Bulletin, June 1989.

### **Personal Protective Equipment**

Ball, P. and Mikko, D., "Protective Optics," AFTE Journal, 1992; 24(1):80-81.

Occupational Safety and Health Administration, Hearing Conservation, current edition.

---. Personal Protective Equipment, current edition.

---. Respiratory Protection, current edition.

### **Lead Poisoning**

Cayton, J.C., "Blood Lead Tests," AFTE Journal, 1975; 7(1):40.

Geibel, J., "Ammunition Can Be Hazardous to Your Health (In More than the Obvious Way)," Police and Security News, May-Jun. 1992, p. 11.

Gregory, A.M., "At Close Range," American Society of Law Enforcement Trainers Journal, Vol. 4, No. 2.

Martinez, A.M., "Lead Poisoning," FBI Law Enforcement Bulletin, Aug. 1993, pp. 1-4.

Occupational Safety and Health Administration, Standards for Occupational Exposure to Lead, Chapter XVII, Title 29, U.S. Department of Labor, Section 1910.1025.

"Publication Availability: Lead Poisoning in Shooting Range □ A Menace or a Hoax," AFTE Journal, 1980; 12(4):101.

### **Physical Plant Safety**

Occupational Safety and Health Administration, 29 CFR 1910.155, Fire Protection Regulations, Subpart L.

### **Quality Assurance**

Association of Firearms and Tool Mark Examiners, "Association of Firearm and Tool Mark Examiners Quality Assurance Program □ 1986," AFTE Journal, 1986; 18(3):10.

Bradford, L.W., "Barriers to Quality Achievement in Crime Laboratory Operations," AFTE Journal, 1983; 15(2): 71.

---. "Forensic Firearms Identification, Competence or Incompetence," AFTE Journal, 1979; 11(2):12.

Brundage, D.J., "Proficiency Testing in Illinois," 1980; 12(4):76.

Hodge, E.E., "Guarding Against Error," AFTE Journal, 1988; 20(3):290-293.

---. "Guarding Against Error," AFTE Journal, 1989; 21(2):450-453.

Serrill, M.S., "Forensic Sciences: Overburdened, Underutilized," AFTE Journal, 1980; 12(4):58.

Lucas, D.M., "American Proficiency Testing Program," AFTE Journal, 1985; 17(1):26.

"Proficiency Testing Recommended for Crime Labs," AFTE Journal, 1979; 11(2):22.

Thornton, J.I., "Nationwide Crime Laboratory Proficiency Project," AFTE Journal, 1979; 11(2):23.

### **Individual Certification**

Kopera, J., "Summary of the Study of the Feasibility of Certification," AFTE Journal, 1992; 24(1):84-90.

Kowalski, K.F., "AFTE Certification Program," AFTE Journal, 1996; 28(4):287-290.

### **Laboratory Accreditation**

American Society of Crime Laboratory Directors, Laboratory Accreditation Board Manual, current edition.

Rabren, C.L., "Laboratory Accreditation," AFTE Journal, 1982; 14(3):36.

### **AFTE History and Development**

"Association of Firearm and Tool Mark Examiners Bylaws," AFTE Journal, 1990; 22(1):61-70.

Howe, W.J., "Report on the Formation of the Association of Firearm and Tool Mark Examiners," AFTE Journal, 1989; 21(2):118-119.

### **Ethics**

"AFTE Code of Ethics," AFTE Journal, 1991; 24(3):342-345.

"AFTE Code of Ethics," AFTE Journal, 1993; 25(1):ix.

"AFTE Procedures for Enforcement of the Code of Ethics," AFTE Journal, 1990; 22(4):457-470.

## B. BACKGROUND/HISTORY OF FIREARMS IDENTIFICATION AND CURRENT TRENDS

1. Define the following terms:

- a. Firearm identification
- b. Ballistics

***(Use Training Assignment #1 to complete this objective.)***

\_\_\_\_\_  
Training Officers

\_\_\_\_\_  
Date

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 Training Officer from the section who will review your report.

***(Use Training Assignment #1 and #2 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

3. Formulate an answer to the following questions:

- a. Is the Forensic Science Discipline of Firearm and Toolmark Identification an art or science?
- b. What are the types of conclusions that can be reached in firearm identification comparisons?
- c. What is the basis for each of the above conclusions?
- d. Is it possible for experts in the Forensic Science Discipline of Firearm and Toolmark Identification to disagree regarding their conclusions? Why or Why Not?
- e. How does "probability" relate to firearm identification?

***(Use Training Assignment #2 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

4. Familiarize yourself with the "Association of Firearm and Tool Mark Examiners" (AFTE), to include its history, current officers, criteria for membership, committees, the AFTE glossary and the AFTE journal and be able to discuss them.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

5. Discuss with system operators the status of the ongoing research initiatives to link shootings using computer imagery such as NIBIN (National Integrated Ballistics Information Network- formerly DRUGFIRE and IBIS). Prepare a report on this system.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

6. Visit and tour the various laboratories that provide firearms and toolmark examinations within your region. Coordinate this visit with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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. Discuss this with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

8. Be able to demonstrate a practical working knowledge of firearm terminology using the AFTE Glossary as the standard.

***(Use Training Assignment #4 and #5 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

9. Select a topic for a research project to be completed during your training period. Obtain approval from your Training Officer before initiation of the project. This project should contribute to the overall fund of information in the field of firearm identification. These results will be shared with the section upon completion. In addition, your results should be formatted for publication in the AFTE Journal and for presentation at an AFTE Meeting.

***(Use Training Assignment #3 to begin this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

## **REFERENCE MATERIALS**

### **FIREARMS IDENTIFICATION - HISTORY, PRINCIPLES, EQUIPMENT AND CURRENT DEVELOPMENTS**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

### **Books**

Association of Firearm and Tool Mark Examiners Standardization Committee, Glossary of the Association of Firearm and Tool Mark Examiners, 3<sup>rd</sup> edition, Available Business Printing, Inc., Chicago, 1994.

Burrard, G., The Identification of Firearms and Forensic Ballistics, 1st edition, Charles Scribner Sons, NY, 1934, revised edition, A.S. Barnes & Co., NY, 1964.

Davis, J.E., An Introduction to Tool Marks, Firearms and the Striagraph, Charles C. Thomas, Springfield, IL, 1958.

Gunther, J.D., and Gunther, C.O., The Identification of Firearms, John Wiley and Sons, Inc., New York, 1935.

Hatcher, J.S., Hatcher's Notebook, Military Service Publishing Company, Harrisburg, PA, 1947.

---. Firearms Investigation, Identification and Evidence, and Textbook of Pistols and Revolvers, Small Arms Publishing Company, Plantersville, SC, 1946.

Hatcher, J.S., Jury, F.J. and Weller, J., Firearms Investigation, Identification and Evidence, 2nd edition, Stackpole Books, Harrisburg, PA, 1957.

Himmelwright, A.L.A., "Forensic or Legal Ballistics" in Pistol and Revolver Shooting, The Macmillan Company, NY, 1928.

Heard, B.E., Handbook of Firearms and Ballistics: Examining and Interpreting Forensic Evidence, John Wiley & Sons, New York, 1997.

Mathews, J.H., Firearms Identification, Volumes I - III, Charles C. Thomas, Springfield, IL, 1962.

NRA Firearms Fact Book, 3rd edition, National Rifle Association, Fairfax, VA, 1989.

Rowe, W. H., "Firearms Identification", Forensic Science Handbook, Vol. II, 1988, Saferstein, R. (Ed.), Prentice Hall, Englewood Cliffs, NJ, pp. 393 – 461

AFTE Criteria For Identification Committee Report, "Theory of Identification, Range of Stria Comparison Reports and Modified Glossary Definitions", 1992; 24(3)

Barrett, M.R., "Microchip and the Bullet: A Vision of the Future, 1991; 23(3): 876-883.

Bates, J.S., "Investigation of the Assassination of President John F. Kennedy," 1981; 13(1):64.

Berg, S.O., "Drama of Forensic Ballistics," 1979; 11(3):44.

---. "Firearms Evidence and the Kennedy Assassination," 1970; 2(2):2-3.

Beck, R., "Alexander von Inostranzeff and the Technical Development of Optical Comparison Systems," 1989; 21(1):67-72.

Biasotti, A.A., "Bullet Bearing Surface Composition: Variables: Fired Bullets," 1981; 13(2):94.

---. "Characteristics in Firearms and Toolmark Identification," 1980; 12(4):81.

---. "Firearms and Toolmark Identification: A Forensic Science Discipline," 1980; 12(3):12.

---. "Methods Applied to the Comparison of Class and Individual Characteristics in Firearms and Toolmark Identification," 1989; 21(2):260-263.

---. "Photomicrography and Illumination: Some Critical Factors," 1979; 11(4):60.

---. "Proposal for a Computer Based Firearms Class Characteristics Information System," 1970; 2(1):12.

Biasotti, A.A. and Murdock, J., "State of the Art of Firearm & Toolmark Identification," 1984; 16(4):16.

Blackwell, R.J., and Framer, E.P., "Automated Firearms Identification System (AFIDS) Phase I," 1980; 12(4):11.

Bradford, L.W., "Forensic Firearms Identification: Competence or Incompetence," 1979; 11(2):12.

Brent, W., "Proved Guilty by Ballistics (Hadley vs Arizona)," 1973; 5(6):5.

Byron, D., "Computerized System for Identifying Firearms," 1982; 82(3):157.

Cassidy, F.H., "Information on History of Comparison Microscopes," 1989; 21(1):67-72.

Chamberlain, D., "Microscope Comparison Bridge," 1972; 4(1):9.

Collins, J.M., "IBIS Manual Bullet Acquisition: Mounting Stub Modification," 1997; 29(1):70-72.

Crossman, E.B., "Qualifications of a Ballistics Expert," 1985; 17(3):119.

Dillon, J.H. and Sibert, R.W., "FBI Laboratory's DRUGFIRE Program," 1990; 22(2) :216.

Gardner, G.Y., "Computer Identification of Bullets," 1979; 11(2):26

Garland, P.V., "Reexamination of Firearms Evidence in the Robert F. Kennedy Assassination," 1976; 8(3):complete issue.

Garrison, D.H., "Guns of Brownsville," 1986; 18(4):65.

---. "Gunsmith and the Soldier", (Churchill vs. Burrard), 1987; 19(2): 181-187.

Goddard, C.H., "Criminal Investigation Laboratory as an Aid to Law Enforcement in the Far East," 1985; 17(3):100.

---. "Firearms as Evidence," 1980; 12(4):93.

---. "History of Firearms Identification," 1980; 12(4):38.

---. "History of Firearms Identification," 1985; 17(1):55.

---. "History of Firearms Identification," 1989; 21(2):263-278.

---. "History of Firearms Identification to 1930," 1993; 25(3):214-228.

---. "Identification of Projectiles in Criminal Cases," 1987; 19(4):393-402.

---. "Scientific Identification of Firearms and Bullets," 1979; 11(4):97.

---. "Valentine Day Massacre: A Study in Ammunition Tracing," 1980; 12(1):44.

Goebel, R., "Comparison SEM First Experiments in Forensic Application," 1983; 15(2):47.

Grove, C.A., Judd, G, and Horn, R., "SEM: A New Technique for Firearms Examination," 1972; 4(1):19.

Hall, A.L., "Missile and the Weapon," 1980; 12(4):85.

Howe, W.J., "Report on the Formation of The Association of Firearm and Toolmark Examiners," 1989; 21(2):118-119.

Hueske, E.E., "Preliminary Report on the Application of Fiber Optic Videomicroscopy to Firearm and Toolmark Examination," 1990; 22(3):280-287.

Inbau, F.E., "Scientific Evidence in Criminal Cases: Firearms Identification - Ballistics'," 1981; 13(2):75.

---. "Scientific Evidence in Criminal Cases: Firearms Identification -Ballistics," 1989; 21(2):280-293.

Juling, R.J. and Stern, W.W., "Overview of Firearms Identification Evidence for Attorneys, I. Salient Features of Firearms Evidence," 1981; 13(4): 128.

Katterwe, H., "Comparison Scanning Electron Microscope," 1983: 15(3):141.



Lambert, R.R., "Firearms Identification," 1971; 3(3):23.

Lansing, J.F., "Customized Comparison Microscope," 1973; 5(5):25.

Lee, H.C., "Firearm Related Evidence: The Nicola Sacco and Bartolomeo Vanzetti Case," 1985; 17(3):13.

Lawyers Cooperative Publishing Co., "Firearms Identification AM JUR PROOF OF FACTS," 1983; 15(3):31.

Lutz, M.C., "Consecutive Revolver Barrels," 1970; 2(5):24.

---. "Evaluation of New Fiber Optics System," 1986; 18(1):12.

Mann, M., Espinoza, E.O., and Scanlan, M.D., "Firearms Examinations by Scanning Electron Microscopy: Observations and An Update on Current and Future Approaches," 1992; 24(3): 294-303.

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Matty, W., "Comparison of Three Individual Barrels Produced from One Button Rifled Barrel Blank," 1985; 17(3):64.

---. "Comparison of Three Individual Barrels Produced from One Button Rifled Barrel Blank," 1989; 21(2):370-374.

Meyers, C.R., "Firearms and Toolmark Identification: An Introduction," 1993; 25(4):281-285.

---. "Objective vs. Subjective Boondoggle," 1987; 19(1):24-30.

---. "Objective vs. Subjective Boondoggle," 1989; 21(2):413-419.

---. "Mythical Striation Match," 1992; 24(4):364-365.

Miller, J., "Book Review: The Law and Forensic Ballistics by T.A. Warlow," 1997; 29(2):239, 173.

Molnar, S., "Comparison Scope Effects Simulated by Use of Photography," 1971; 3(3):18.

---. "What is a Firearms Examiner: Some Provocative Thoughts," 1970; 2(7):36.

---. "What is a Firearms Examiner: Some Provocative Thoughts," 1989; 21(2):128-131.

Moran, B., "Building an Inexpensive High Intensity Fluorescent Lighting System for the Comparison Microscope," 1997; 29(1):49-54.

---. "Manual and Automated Bullet and Cartridge Case Comparison Systems: A Commentary," 1997; 29(1):55-57.

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Prieto, M.A., "Firearms Identification Preface", 1982, 14(2): 17- 43.

Rathman, G.A., and Ryland, S.G., "Use of the SEM-EDXA as an Aid to the Firearms Examiner," 1987; 19(4):338-392.

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---. "Some Historical Notes on the Comparison Microscope," 1978; 10(1):7.

---. "Some Historical Notes on the Comparison Microscope," 1989; 21(2):215-217.

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Thomas, F., "Striation Matching and Forensic Firearms Identification," 1980; 12(3):31.

Thompson, R.M., Desrosiers, M., and Hester, S., "Computerized Image Analysis for Firearms Identification: The Integrated Ballistic Identification System: IBIS," 1996; 28(3):194-203.

Uchiyama, T., "Automated Landmark Identification System," 1993; 25(3):172-196.

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---. "Change of Rifling Marks of the Bullets Fired from a Revolver," 1986; 18(4):40.

---. "Correction: Automatic Comparison Model of Land Marks," 1990; 22(3):346.

---. "Criterion for Land Mark Identification," 1988; 20(3):236-251.

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C. FIREARMS & AMMUNITION DEVELOPMENT  
AND CURRENT TRENDS

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 and discuss it with your Training Officer.

***(Use Training Assignment #3 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

2. Visit the firearm collection of a museum in your region and observe first-hand those firearms that constitute examples of early firearms and ammunition development. Meet the curator of the collection and obtain their views and opinions on those firearms that are developmental benchmarks. Coordinate this tour with your Training Officer and discuss the tour with them afterwards.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

***(Use Training Assignment #4 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

5. Study the history of centerfire cartridge development starting with black powder cartridges to the current generation of modern centerfire cartridges. Make notes to show the chronological history of this development and discuss these with your Training Officer.

***(Use Training Assignment #5 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date



6. Study the Firearm Section Standard Ammunition File (*SAF*) with the Firearms examiner to whom it is assigned, noting in particular cartridges and shotshells that are representative of commercial and military ammunition development during the past three decades.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

7. Conduct an in depth study of exterior bullet coatings which have been developed in the last decade. Prepare a report concerning how this new technology impacts the firearm examiner.

***(Use Training Assignment #5 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

8. Obtain a copy of the (most recent) studies concerning cartridge effectiveness conducted by the FBI. Prepare a report listing trends you see unfolding in cartridge and bullet development and show any historical significance to these findings.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

9. Prepare an overview of the recent development in handguns and how this information might be of significance to the firearm examiner.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

## **REFERENCE MATERIALS**

### **HISTORY OF BLACK POWDER AS A PROPELLANT**

The following reference materials serve several purposes:

- to provide a wider range of resources should you have a particular interest given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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## **REFERENCE MATERIALS**

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#### D. MANUFACTURE OF MODERN FIREARMS

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:

- |                              |                              |
|------------------------------|------------------------------|
| a. Shaping                   | i. Abrasive machining-       |
| b. Planing                   | include honing, lapping,     |
| c. Drilling                  | grinding, sanding, and       |
| d. Reaming                   | ultrasonic methods           |
| e. Turning                   | j. Sawing                    |
| f. Boring                    | k. Filing                    |
| g. Milling-include both face | l. Swaging                   |
| milling and peripheral       | m. Electrochemical machining |
| (slab) milling               | n. EDM                       |
| h. Broaching                 | o. Investment casting        |

**(Use Training Assignment #6 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

**(Use Training Assignment #7 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

3. Research in detail the following rifling techniques:
- |                   |                  |
|-------------------|------------------|
| a. Broach         | e. Scrape method |
| b. Button         | f. ECM           |
| c. Hammer Forging | g. EDM           |
| d. Hook method    |                  |

**(Use Training Assignment #8 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

***(Use Training Assignment #8 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

5. Discuss and define the following terms as they relate to firearm manufacture or firearms identification.
- a. Chambering
  - b. Crowning
  - c. Ballizing
  - d. Bore slugging
  - e. Forcing cone
  - f. Bore
  - g. Choke
  - h. Choke tubes

***(Use Training Assignment #8 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

6. Research the history and current significance of proof marks as they relate to the manufacture of firearms. Discuss this with your Training Officer.

***(Use Training Assignment #8 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

7. Visit the manufacturing facilities of at least six firearms and/or barrel manufacturers such as Wilson barrels, Ruger, Smith and Wesson, Mossberg, Marlin and US Repeating Arms. Record notes in your notebook on each visit and produce a written report of your visit for the Firearm Section files and an oral report for Firearm Section members. Particular emphasis should be placed on manufacturing and rifling techniques used by each manufacturer, noting methods and procedures which leave unique manufacturing toolmarks on firearm parts which, in turn, produce individual microscopic marks on bullets, cartridge cases and shotshell casings. Coordinate these visits with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

## **REFERENCE MATERIALS**

### **MODERN FIREARMS DEVELOPMENT AND OPERATING SYSTEMS**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

#### **Books**

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Remington 1100 Shotguns (120 min.)	H&K Models 91,93,94 Rifles (60 min.)
Browning Hi-Power Pistol (97 min.)	S&W, 1st, 2nd, 3rd, Generation Pistols (105 min.)
Remington 870 Shotguns (95 min.)	S&W Revolvers (120 min.)
AR-15 Rifles (120 min.)	M1 Garand/M1A Rifles (90 min.)
Winchester 94 Rifles (120 min.)	Ruger 10/22 Rifles (60 min.)
SKS Rifles (120 min.)	Mossberg 500 Shotgun (90 min.)
Ruger Standard Auto MKI/MKII (90 min)	Beretta 92/Taurus P-92 Pistols (90 min.)
AKS/MAK 90 Type Rifles (91 min.)	M1/M2 .30 Carbine (90 min.)
Ruger Mini-14 Rifles (90 min.)	FN FAL Rifles (128 min.)
Glock 17,19,21,23 Pistols (60 min.)	Hi-Standard Auto Pistols (111 min.)

Lenny Magill Productions "Bill Wilson Presents" videotapes series including the following titles:

CZ-75 (72 min.)  
Sig Sauer P226 (74 min.)

Lenny Magill productions videotapes under the following titles:

Mastering the AR-15 (120 min.)	Rock'n Roll # 2 (50 minutes)
Center X M1A/M14 (120 min.)	Complete Sigma (45 min.)
Mastering Revolvers (70 min.)	U.S. Marines Firepower (75 min.)
Rock'n Roll #1(45 min.)	Complete Ruger .22 Pistol (67 min.)
Complete Ruger P-Series (45 min.)	Mastering the Mini-Glock (110 min)
U.S. Government training films converted to videotape and marketed by GunVideo, 4585 Murphy Canyon Road, San Diego, CA:	
Thompson Sub-Machine Gun (97 min)	min.)
Infantry Weapons and Their Effects (30 min.)	Fundamentals of Small Arms (30 min.)
Weapons of the Infantry (41	B.A.R.-Browning Automatic Rifle (20 min.)

Videotapes from other sources marketed by Lenny Magill Productions under the following titles:

Firestorm  
(60 min.)

Shooting the Uzi the Israeli Way  
( 70 min.)

Knob Creek Machine  
Gun Shoot (60 min.)

The Colt M-16 Rifle  
(20 min.)

Anite Productions, P.O. Box 375, Pinole, CA, videotapes under the following titles:

Deadly Force (100 min.)

Deadly Weapons (106 min.)

Deadly Effects (60 min.)

Dillon Productions, 8009 East Dillon's Way, Scottsdale, AZ. videotape:

Firestorm in the Desert - Machine Gun Magic (117 min.)

A & E Television Networks, 126 Fifth Avenue, New York, NY, videotape series:

The Story of the Gun, Vol. I-IV (50 min. each volume)

Magnum Research, Inc., 7110 University Avenue, N.E., Minneapolis, MN, videotape:

Desert Eagle Pistol and Friends (20 min.)

## **REFERENCE MATERIALS**

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## E. MANUFACTURE OF MODERN AMMUNITION

1. Define in your notebook and know the meaning of the following terms as they relate to modern ammunition and its manufacture:

- |                             |                               |
|-----------------------------|-------------------------------|
| a. Cartridge                | bb. Copper-coated lead bullet |
| b. Jacketed bullet          | cc. Headstamp                 |
| c. Cartridge case           | dd. Nylon-coated lead bullet  |
| d. Bullet sizing            | ee. Proof cartridge           |
| e. Primer                   | ff. "Silvertip" bullet        |
| f. Wadcutter bullet         | gg. Tapered cartridge         |
| g. Shotshell                | hh. Antimony                  |
| h. Semi-wadcutter bullet    | ii. Extractor groove          |
| i. Shotshell casing         | jj. Arsenic                   |
| j. Soft point bullet        | kk. Gauge                     |
| k. Bottleneck cartridge     | ll. Chilled shot              |
| l. Spitzer bullet           | mm. Battery cup               |
| m. Rebated-rim cartridge    | nn. High brass, low brass     |
| n. Swaging                  | oo. Brass                     |
| o. Rimless cartridge        | pp. Lubaloy                   |
| p. Cast lead bullet         | qq. "Rule of 17"              |
| q. Rimmed cartridge         | rr. Dram equivalent           |
| r. Mold marks               | ss. Wadding                   |
| s. Semi-rimmed cartridge    | tt. Single base, double base  |
| t. Truncated-nosed bullet   | uu. Shot collar               |
| u. Shoulder                 | vv. Boattail bullet           |
| v. Cannelure                | ww. Crimp                     |
| w. Neck                     | xx. Casting seam              |
| x. Ogive                    | yy. Bunter                    |
| y. Mouth                    | zz. Sprue                     |
| z. Brass-coated lead bullet | aaa. Bullet                   |
| aa. Head                    | bbb. Round-nosed bullet       |

***(Use Training Assignment #9 and Practical Exercise #1 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

***(Use Training Assignment #10 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

3. Discuss the purpose and essential ingredients of priming mixture used in modern cartridges.

***(Use Training Assignment #10 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

4. Know and discuss 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.

***(Use Training Assignment #10 and Practical Exercise #2 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

5. Visit at least one ammunition-manufacturing facility such as Remington, Federal or Winchester to observe the manufacture of rimfire and centerfire cartridges and shotshells. Make detailed notes of the manufacturing processes and generate a written report for section files. Also, prepare an oral presentation for section members upon your return. 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. Coordinate this visit with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

## **REFERENCE MATERIALS**

### **MODERN AMMUNITION EVOLUTION AND MANUFACTURE**

The following reference materials serve several purposes:

- to provide a wider range of resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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## F. INSTRUMENTATION

1. Differentiate between the following:

- a. compound microscope
- b. stereo microscope
- c. comparison microscope

***(Use Training Assignment #30 and Practical Exercise #7 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

2. Study the instruction manual for the various brands of stereo microscopes. Determine how to insert a reticle and how to check the calibration of the microscope.

***(Use Practical Exercise #7 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

3. Familiarize yourself with the instruction manuals and the mechanical and optical aspects of the various brands of comparison microscopes in the Firearm Section. Note the differences and similarities in each, both mechanically and optically.

***(Use Training Assignment #30 and Practical Exercise #7 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

4. Familiarize yourself with the following types of light sources, which are in use in the Firearm Section on the comparison microscopes.

- a. Fluorescent
- b. Fiber optics (*with and without filters*)

***(Use Training Assignment #30 and Practical Exercise #7 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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 impressed and striated 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 your Training Officer.

**(Use Training Assignments #30 and #31 and Practical Exercises #7 and #8 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

6. Set up a comparison microscope for your vision requirements and focus the "hairline." Prepare the microscope for your personal use, and familiarize yourself with each set of objective lenses on your comparison microscope. Become familiar with the different types of Polaroid film and/or other photographic systems used in the Firearm Section with the comparison microscopes. Master the use of the Polaroid Land film holder. Using all of the objective lenses, make timed exposures of the same objects while varying the intensity and angle of the light sources. Calculate the magnification for each set of objective lenses on your comparison microscope.

**(Use Training Assignment #30 and Practical Exercise #7 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

7. Become familiar with and demonstrate the use of the following equipment:
- a. speed micrometer
  - b. inertia bullet puller
  - c. steel rule
  - d. reticle in ocular lens of binocular microscope
  - e. Ainsworth scale
  - f. balances and scales located in the Firearm Section
  - g. Stage micrometer
  - h. Digital (electronic) micrometer
  - i. depth gauge (Federal brand or equivalent for firing pin impression measurements)

**(Use Training Assignment #31 and Practical Exercise #8 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

## **REFERENCE MATERIALS**

### **MICROSCOPY AND INSTRUMENTATION**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

### **AFTE Journal**

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---. "Reference Manual, Photostar Automatic Camera System"

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## **Basic References**

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G. EXAMINATION OF FIREARMS

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.
  - a. revolver, single and double action
  - b. autoloading pistol, single and double action
  - c. derringer and single shot pistols
  - d. bolt-action rifle
  - e. autoloading rifle
  - f. pump-action rifle
  - g. various single shot rifles
  - h. submachine gun
  - i. assault rifle
  - j. Muzzle loading firearm
  - k. Percussion revolvers

***(Use Training Assignment #11 to complete this objective.)***

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Training Officer

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Date

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

***(Use Training Assignment #12 to complete this objective.)***

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Training Officer

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Date

3. Explain and illustrate the differences between the following types of autoloading pistols:

- a. blowback action
- b. delayed blowback action
- c. gas-delayed blowback action
- d. short recoil action
- e. long recoil action

***(Use Training Assignment #12 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

4. Partially disassemble and reassemble the following revolvers. Photograph and note the differences in their mechanisms. Identify each part by name.
- a. Smith & Wesson double-action revolver
  - b. Colt double-action revolver
  - c. Ruger double-action revolver
  - d. "Old style" Ruger single-action revolver
  - e. "New style" Ruger single-action revolver

**(Use Training Assignment #15 to complete this objective.)**

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Training Officer

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Date

5. Field strip and reassemble the following pistols. Note and photograph differences in their mechanisms. Identify each part by name.
- a. 9mm Luger Browning, Hi-power, pistol
  - b. .45 Auto caliber U.S. Pistol, Model 1911A1, pistol
  - c. 9mm Luger Steyr, GB, pistol
  - d. 9mm Luger Glock, Model 17, pistol
  - e. 9mm Luger Beretta, Model 92F, pistol
  - f. 9mm Luger SIG-Sauer, Model 226, pistol
  - g. 9mm Luger Smith & Wesson, Model 669, pistol
  - h. 9mm Luger H&K, P7, pistol
  - i. 357 Magnum Desert Eagle pistol
  - j. 9mm Luger Walther P38 pistol
  - k. 380 Automatic Walther PPK pistol
  - l. 8mm Arisaka Type 14 pistol
  - m. 9mm Luger P08 pistol

**(Use Training Assignments #16, #17, and #18 to complete this objective.)**

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Training Officer

\_\_\_\_\_  
Date

6. Field strip and reassemble the following submachine guns. Note differences in the mechanism and operation of each. Make appropriate photographs for your notes and identify the major parts by name.
- a. .45 Auto caliber RPB Industries, M10, submachine gun (open bolt and closed bolt)
  - b. 9mm Luger SWD Inc., M11/Nine, submachine gun
  - c. 9mm Uzi submachine gun
  - d. 9mm H&K, MP5, submachine gun
  - e. .45 Auto caliber US M3 submachine gun
  - f. 9mm Intratec, TEC 9, submachine gun
  - g. .45 Auto caliber Thompson submachine gun

**(Use Training Assignment #19 to complete this objective.)**

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Training Officer

\_\_\_\_\_  
Date

7. Familiarize yourself with the operation of each of the following firearms. Identify the major parts by name and make appropriate notes.
- a. .30-06 Springfield caliber U.S. Rifle, Model M1
  - b. .308 Winchester caliber U.S. Rifle, Model M14
  - c. .223 Remington caliber U.S. Rifle, Model M16
  - d. .300 Savage caliber, Savage, Model 99, rifle
  - e. .30-30 Winchester caliber Winchester Model 94 rifle
  - f. 7.62x39mm caliber AK47/74 and SKS rifle
  - g. .30-40 Krag caliber U.S. Rifle 1898
  - h. .303 British caliber Lee Enfield rifle
  - i. .30-06 Springfield caliber U.S. Rifle, Model 1903

**(Use Training Assignments #21 and #22 to complete this objective.)**

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Training Officer

\_\_\_\_\_  
Date

8. Familiarize yourself with the operation of each of the following shotguns. Identify the major parts by name and make appropriate notes.
- a. Remington, Model 870, shotgun
  - b. Winchester, Model 12, shotgun
  - c. Ithaca, Model 37, shotgun
  - d. Browning, Model A5, shotgun
  - e. Remington, Model 1100, shotgun
  - f. Harrington & Richardson, Topper Model 158, shotgun
  - g. L.C. Smith, side-by-side, double-barrel, shotgun
  - h. Savage, Model 311, side-by-side, double-barrel, shotgun
  - i. Beretta, Silver Snipe, over-under, double-barrel, shotgun

**(Use Training Assignment #23 and #24 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

9. Familiarize yourself with the operation of each of the following firearms. Identify the major parts by name and make appropriate notes.
- a. .22 caliber Browning autoloading rifle
  - b. .22 caliber Winchester, Model 62, rifle
  - c. .22 caliber Remington, Model 582, rifle
  - d. .22 caliber Ruger, Model 10/22, rifle
  - e. .22 caliber Ruger, MKII, pistol
  - f. .22 caliber Colt, Woodsman, pistol
  - g. .22 caliber Raven, Lorcin, Jennings

**(Use Training Assignment #25 to complete this objective.)**

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Training Officer

\_\_\_\_\_  
Date

10. Familiarize yourself with the operation of each of the following firearms. Identify the major parts by name and make appropriate notes.
- a. .25 Auto caliber Raven Arms pistol
  - b. .25 Auto caliber Colt Jr. pistol
  - c. .25 Auto caliber Beretta pistol
  - d. .25 Auto caliber Bauer pistol

***(Use Training Assignment #20 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

11. Familiarize yourself with the Firearm Section Range Rules and Safety Rules regarding firearms. Demonstrate, using firearms from No. 4 through No. 9 above and others, 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.

***(Use Training Assignments #15 through #25 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

12. Using the firearms in No. 4 through No. 9 above, 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.

***(Use Training Assignments #15 through #29 and Practical Exercises #3 through #6 to complete this objective.)***

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Training Officer

\_\_\_\_\_  
Date

13. Familiarize yourself with the Firearm Section equipment used for measurement of trigger pull. Determine the trigger pull on at least one firearm from each of the firearms listed in the No. 4 through No. 9 groups, using various methods and compare the results.

***(Use Training Assignments #15 through #29 and Practical Exercises #3 through #6 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

14. Discuss with your Training Officer the protocol to be used in determining whether a firearm "*can be made to fire without pulling the trigger.*" Demonstrate, using one firearm from each of the No. 4 through No. 9 groups of firearms above, how to conduct this type of examination.

***(Use Training Assignments #15 through #29 and Practical Exercises #3 through #6 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

- |    |                                     |    |                    |
|----|-------------------------------------|----|--------------------|
| a. | excessive headspace                 | j. | defective safety   |
| b. | bore obstruction                    | k. | high primer        |
| c. | barrel bulge                        | l. | rail splitting     |
| d. | broken extractor                    | m. | hairline cracks    |
| e. | push off                            | n. | improper timing    |
| f. | trigger shoe                        | o. | excessive pressure |
| g. | false half-cock                     | p. | dented barrel      |
| h. | slam-fire                           | q. | jar-off            |
| i. | inadequate/improper sear engagement |    |                    |

***(Use Training Assignment #28 and Practical Exercise #5 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

16. Become familiar with the Section firearm range including its physical dimensions, construction of walls and backstop, and bullet velocity limitations. Know how to test fire firearms thought to be possibly unsafe. Become familiar with the use of all the equipment on the range. Know the range rules and emergency medical treatment procedures.

***(Use Training Assignment #28 and Practical Exercise #5 to complete this objective.)***

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Training Officer

\_\_\_\_\_  
Date

17. Attend armorer training offered by various manufacturers of firearms, at their manufacturing facilities, if possible. Coordinate these with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

18. Explore the capabilities in restoring an inoperable evidence firearm to operating condition and also know the limitations and reservations, which must be considered. Discuss these with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

19. Review and record the references in the Firearm Section library, which can be used to identify the manufacturer and/or source of a firearm using the following criteria:
- a. proof marks
  - b. inspector marks
  - c. factory numbers and markings
  - d. serial number
  - e. part numbers
  - f. company logos

**(Use Training Assignment #29 and Practical Exercise #6 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

20. Discuss the following topics with your Training Officer and become familiar with the capabilities and limitations of the section in regard to these areas:
- a. Marking evidence firearms, recognition, documentation, recovery, and retention of trace evidence from the bore of a firearm prior to test firing.
  - b. Determining whether an evidence firearm has been "*recently*" fired
  - c. Determining the manufacturer of a firearm from an examination of a part from a firearm.
  - d. Determining the manufacturer of a firearm from a photograph and comparing an evidence firearm to a photograph

**(Use Training Assignment #29 and Practical Exercise #6 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

21. 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.

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Training Officer

\_\_\_\_\_  
Date

22. Discuss with your Training Officer 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.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

**REFERENCE MATERIALS**  
**GENERAL PRELIMINARY EXAMINATIONS OF FIREARMS**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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## H. BULLET EXAMINATIONS AND COMPARISONS

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

a.	characteristics	class
slippage	l. riflingm.	general
b.		"insufficie
shaving	nt individual microscopic marks"	
c.	n. corrosion	
obturation	o. leading	
d.leading edge and	p. "limited	
trailing edge	individual microscopic marks"	
e.	q. "single-	
melting	action" firing	
f.	r. "double-	
blow-by	action" firing	
g.	s. knurled &	
striation	grooved cannellure	
h.individual	t. stab	
microscopic marks	crimp	
i.	u. Boattail	
ogive	v. open	
j.	base	
bearing surface	w. closed	
k.	base	
	x. recessed	
	base	
	y. skived	
	tip/hollow point	
	z. trace	
	evidence aspects (lacquers, sealants, painted tips)	

**(Use Training Assignment #32 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

2. As they relate to the examination and comparison of fired bullets or bullet fragments, know the importance of, and limitations of, determining the following:

- a. weight
- b. caliber
- c. caliber type
- d. manufacturer
- e. general rifling characteristics
- f. pitch of rifling
- g. depth of rifling
- h. jacket construction/composition

Discuss this with your Training Officer.

**(Use Training Assignment #33 and Practical Exercise #9 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date



3. Familiarize yourself with the Standard Ammunition File (SAF). Know how to search this file manually and by use of the computer in order to determine the manufacturer of fired bullets. Demonstrate your proficiency in using this file to your Training Officer.

***(Use Training Assignment #33 and Practical Exercise #9 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

4. Become familiar with the Known Specimen File *(if your laboratory maintains such a file)*. Know its location, composition, filing system, and uses as a reference file. Discuss this with your Training Officer.

***(Use Training Assignment #33 and Practical Exercise #9 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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 to your Training Officer.

***(Use Training Assignment #33 and Practical Exercise #9 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

6. Using test bullets and other fired bullets and bullet fragments provided to you, demonstrate your proficiency in accurately determining caliber, caliber type, manufacturer, and rifling characteristics of these fired bullets. Also, prepare a list of firearms that could have been used to fire these bullets provided to you. As necessary, use the KSF, SAF, and GRC files in conducting these examinations.

***(Use Training Assignments #34 and #35 and Practical Exercises #8a and #10 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

7. Determine the methods and techniques used to differentiate between lead bullets and bullet cores.

***(Use Training Assignment #42 and Practical Exercise #16.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

8. 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 that could have been used to fire these bullets using the GRC file.

**(Use Training Assignment #38 and Practical Exercise #13 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

9. Become knowledgeable about the facilities in the section for the recovery of fired test bullets. Know when and how to use the horizontal recovery tank and cotton boxes and their limitations. Observe and assist your Training Officer in the recovery of fired bullets using each of these methods. Know and observe all safety rules.

**(Use Training Assignment #39 and Practical Exercise #14 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

10. Familiarize yourself with the ammunition storage areas in the section. Know how to locate test ammunition after correctly selecting test ammunition using the SAF. Discuss with your Training Officer the reasons for using substitute ammunition or downloading ammunition for test firing. Know the proper procedure for downloading ammunition for test firing. Under supervision of your Training Officer prepare and fire downloaded test ammunition.

**(Use Training Assignment #39 and Practical Exercise #14 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

11. Test fire "consecutively-made" barrels and/or microscopically compare test bullets from "consecutively-made" barrels. Observe the differences and similarities in the striations and discuss this with your Training Officer.

**(Use Training Assignment #46 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

12. Using the same .22 caliber firearm, test fire two each of the following cartridges and attempt to identify the test bullets with each other. Take appropriate photographs and notes.
- a. .22 Long Rifle caliber Remington with lead bullets
  - b. .22 Long Rifle caliber Winchester with lead bullets
  - c. .22 Long Rifle caliber Remington with brass-coated lead bullets
  - d. .22 Long Rifle caliber Winchester with copper-coated lead bullets
  - e. .22 Long caliber Remington with lead bullets

**(Use Training Assignment #40 and Practical Exercise #15 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

13. Using the same .357 Magnum caliber revolver, test fire two each of the following cartridges and attempt to identify the test bullets with each other. Take appropriate photographs and notes.
- a. .38 Special caliber Remington lead round-nosed bullet
  - b. .38 Special caliber Remington jacketed bullet
  - c. .357 Magnum caliber Remington jacketed bullet
  - d. .357 Magnum caliber Winchester Silvertip bullet
  - e. .357 Magnum caliber Federal Nyclad bullet

**(Use Training Assignment #37 and Practical Exercise #13 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

14. Using the same 9mm Luger pistol, test fire two each of the following cartridges and attempt to identify the test bullets with each other. Take appropriate photographs and notes.
- a. 9mm Luger Federal Hydra-shok
  - b. 9mm Luger PMC Starfire
  - c. 9mm Luger Remington full metal jacket
  - d. 9mm Luger Winchester Silvertip
  - e. 9mm Luger CCI total metal jacket
  - f. 9mm Luger Black Talon/Ranger SXT
  - g. 9mm Luger Federal Nyclad

**(Use Training Assignment #36 and Practical Exercise #11 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

15. Using a .22 caliber rifle, test fire and recover two test bullets and identify these bullets with each other. Cut off approximately three inches of the muzzle of the barrel and crown the muzzle end of the barrel. Test fire and recover two test bullets using the same ammunition as above. Microscopically compare these bullets with each other and with the previously fired test bullets.

**(Use Training Assignment #43 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

16. Using a 30 caliber rifle, test fire two each of the following cartridges and compare the tests with each other. Conduct this test with your Training Officer.

- a. 30 caliber Remington jacketed soft-point bullet
- b. 30 caliber Remington Accelerator cartridges
- c. Test fire and inter-compare steel jacket bullets vs. Copper jacket bullets from the same barrel

**(Use Training Assignment #45 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

17. Using a .32 S & W caliber Harrington & Richardson revolver, test fire two each of the following cartridges and compare the test bullets with each other. Conduct this test with your Training Officer.

- a. .32 S & W caliber Remington with lead bullet
- b. .32 Auto caliber Remington with full metal case jacketed bullet

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

18. Test fire each of the following pistols. Using two test bullets from each pistol, make microscopic comparisons of the test bullets. Conduct this test with your Training Officer.

- a. 9mm Glock pistol
- b. 9mm H&K, Model P7, pistol
- c. 9mm Steyr, Model GB, pistol

**(Use Training Assignment #45 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

19. 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.

**(Use Training Assignment #43 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

20. 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. Read the article in the April 1985 issue of the Crime Laboratory Digest concerning "*Manufacturing Toolmark Identification on the Base of Jacketed Bullets*."

**(Use Training Assignment #44 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

**(Use Training Assignment #44 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

22. Test fire a .22 caliber firearm. Compare and identify test bullets with each other. Using this same firearm, "slug" the barrel and compare the previously fired test bullets with the bullets used to "slug" the barrel. Cut off approximately 25 percent of the barrel at the muzzle and "slug" this portion of the barrel and compare these tests with the previous test bullets. Conduct this exam with your Training Officer.

**(Use Training Assignment #43 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

23. Obtain a copy of and familiarize yourself with the Firearm Section protocol for the examination of fired bullets.

**(Use Training Assignment #44 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

**REFERENCE MATERIALS**  
**BULLET EXAMINATIONS AND COMPARISONS; SHOTSHELL PROJECTILES**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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I. CARTRIDGE/CARTRIDGE CASE EXAMINATIONS AND COMPARISONS

1. Describe "*class characteristics*" as the phrase applies to markings on a cartridge or a fired cartridge case. Determine the types of marks that may be left on a cartridge case/cartridge during loading/extracting and firing. Review videotape regarding the slow motion of firing sequences using semiautomatic firearms.

**(Use Training Assignment #47 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

- a. 9mm SWD Inc., M11/Nine, submachine gun
- b. 9mm Glock pistol
- c. .45 Auto caliber U.S. Pistol, Model 1911A1
- d. 9mm H&K, P7, pistol
- e. .22 Long Rifle caliber Ruger, MKII, pistol
- f. .22 Long Rifle caliber Ruger, 10/22, rifle

**(Use Training Assignment #48 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

3. Using the test cartridge cases and cartridges from paragraph 2, above, microscopically examine 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 slide drag marks, slide scuff marks, ejection port scuffmarks and magazine lip marks. Photograph the results of your comparisons.

**(Use Training Assignment #48 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date



4. Test fire the following firearms using comparable CCI, Remington, Federal, and Winchester ammunition of the appropriate caliber type for each firearm. Select ammunition with both nickel and brass primers. Test fire each firearm at least twice using each brand of ammunition. Microscopically examine and photograph the markings as in paragraph 3, above.
- a. .38 Special caliber Smith & Wesson, Model 10, revolver
  - b. .357 Magnum caliber Smith & Wesson, Model 19, revolver
  - c. 9mm Smith & Wesson, Model 669, pistol
  - d. .22 Long Rifle caliber Colt, Woodsman, pistol

***(Use Training Assignment #49 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

5. Test fire a .22 Long Rifle caliber Smith and Wesson revolver, fire six .22 Long Rifle caliber cartridges, six .22 Long caliber cartridges, and six .22 Short caliber cartridges of the same manufacturer. Mark each cartridge to note the chamber in which it is fired. Examine and photograph the markings imparted to the fired cartridge cases.

***(Use Training Assignment #50 to complete this exercise.)***

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Training Officer

\_\_\_\_\_  
Date

6. Discuss the possibility of comparing and identifying reloading-type marks on cartridges/cartridge cases. Identify the various types of marks that may be indicative of reloaded ammunition. Become familiar with the reloading equipment in the Section and the procedures used in reloading cartridges. Reload several cartridges and compare reloading-type marks on these cartridges with each other.

***(Use Training Assignment #51 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

7. Discuss the feasibility of comparing and identifying manufacturing toolmarks on a fired cartridge case from the scene of a crime with cartridges that can be associated with the suspect. Identify the various types of manufacturing toolmarks that may be present on cartridges or cartridge cases.

***(Use Training Assignment #51 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

8. 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.

***(Use Training Assignment #52 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

9. Read the following two articles in the October 1989 issue of the AFTE journal and discuss them with your Training Officer.
- a. "Firing Pin Impressions - Their Measurement and Significance"
  - b. "Firing Pin Impressions - Their Relation to Hammer Fall Conditions"

***(Use Training Assignment #47 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

10. Obtain a copy of and be familiar with the Firearm Section protocol for the examination of cartridges and cartridge cases.

***(Use Training Assignment #47 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

11. Compare test firings from various firearms before the breech and bore are cleaned and after the breech and bore are cleaned.

***(Use Training Assignment #53 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

12. Use a series of examinations that incorporates bullets, cartridge cases, firearms and the comparison microscope during an "on going investigation."

***(Use Practical Exercises #18 and #19 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

## **REFERENCE MATERIALS**

### **CARTRIDGE AND CARTRIDGE CASE EXAMINATIONS AND COMPARISONS**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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J. SHOTSHELL AND SHOTSHELL COMPONENT EXAMINATIONS AND COMPARISONS

1. Determine what type of examinations may be conducted and what conclusions can be reached from an examination of the following components. Discuss this with your Training Officer.

- a. Shot, deformed and undamaged
- b. Fired card or fiber wads
- c. Fired plastic wads
- d. Fired shotshell casings
- e. Unfired shotshells
- f. Shot buffer material
- g. Shot collar and shot cup

***(Use Training Assignment #55 and Practical Exercise #17 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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 to your Training Officer.

***(Use Training Assignment #54 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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.

***(Use Training Assignment #58 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

4. Test fire the following 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 discuss the significance of identifying any of these types of marks.
- a. Marlin, Model 55, bolt action shotgun
  - b. 12-gauge Remington, Model 1100, shotgun
  - c. 12-gauge Mossberg, Model 500, shotgun
  - d. J.C. Higgins, Model 1011, top-break single shot shotgun
  - e. 12-gauge Beretta, Silver Snipe, shotgun
  - f. Stevens, Model 311, side by side double barrel shotgun

**(Use Training Assignment #56 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

5. Using a 12-gauge Remington, Model 1100, shotgun, obtain at least two test shotshell casings with each of the following types of ammunition. 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 that are recovered and compare them to unfired components of the same type. Discuss the significance of your findings.
- a. 12-gauge Remington, 2 3/4" Magnum, 00 Buck
  - b. 12-gauge Remington, 2 3/4" Shur-Shot, #8 shot
  - c. 12-gauge Federal, 2 3/4" Magnum, 00 Buck
  - d. 12-gauge Federal, 2 3/4" Field load, #9 shot
  - e. 12-gauge Activ, 2 3/4" Field load, #7 shot
  - f. 12-gauge Activ, 2 3/4" Magnum, BB shot
  - g. 12-gauge Winchester, 2 3/4" Xpert, #6 shot
  - h. 12-gauge Winchester, 2 3/4" Super-X, #7 shot

**(Use Training Assignment #57 to complete this exercise.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

6. Discuss in detail the procedures used in reloading shotshells and familiarize yourself with the shotshell reloading equipment in the Firearm Section. 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 section and examine the reloaded shotshells for reloading-type marks.

**(Use Training Assignment #59 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

7. Research the current U.S. shot sizes and weights and obtain a chart reflecting the data. Familiarize yourself with the variations worldwide in shot size and composition. Learn the significance of the "*Rule of 17*" as it applies to shot size.

**(Use *Training Assignment #54* to complete this objective.)**

---

Training Officer

---

Date

## **REFERENCE MATERIALS**

### **SHOTSHELL AND FIRED SHOTSHELL EXAMINATIONS AND COMPARISONS**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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K. GUNSHOT RESIDUE EXAMINATIONS AND DISTANCE DETERMINATIONS

1. Successfully complete the Gunpowder and Primer Residues Course at the FBI Academy, Quantico, Virginia, or equivalent course. Coordinate this with your Training Officer.

**(Use Training Assignment #41 to complete this objective.)**

\_\_\_\_\_  
Instructor

\_\_\_\_\_  
Date

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

2. Demonstrate your proficiency in preparing the chemicals and the test papers used in the modified Griess test and the Sodium Rhodizonate test, including the test media and the photographic paper.

**(Use Training Assignment #60 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

**(Use Training Assignment #60 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

4. Demonstrate your proficiency in conducting the following techniques, using the techniques set out in the Firearm Section protocol manual:

- a. conventional Modified Griess test
- b. reverse Griess test
- c. sodium rhodizonate test
- d. Bashinsky transfer
- e. blotting transfer

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

5. Using specimens provided to you by your Training Officer, demonstrate your proficiency in conducting "*muzzle-to-garment*" distance tests in cases involving the deposition of gunshot residues. Your examination should include note taking, microscopic and chemical examinations, test firing to produce test patterns and accurately determining "*muzzle-to-garment*" distance.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date



6. Using specimens provided to you by your Training Officer, demonstrate your proficiency in conducting "*muzzle-to-garment*" distance tests in cases involving shot patterns. Your examination should include note taking; microscopic; and chemical examinations; test firing of shot patterns; gunshot residue patterns; and accurately determining "*muzzle-to-garment*" distance; orientation of the firearm; sources and patterns of gunshot residues (e.g., muzzle orthogonal vs. muzzle oblique; GSR patterns from flash suppressors; sound suppressors; and revolver cylinder gap); and geometric aspects of powder and GSR patterns.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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 with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

8. Attend an autopsy of a shooting victim at the Medical Examiner's facilities. Document any indications of gunshot residue deposits photographically. Also, document the physical effects of the projectile on the body. Prepare a report on your observations and include any information obtained by medical examiner personnel concerning their opinions on distance determination and bullet effects, cause of death, direction of bullet travel and other information pertinent to firearm identification.

\_\_\_\_\_  
Medical Examiner

\_\_\_\_\_  
Date

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

9. Visit the facilities of the Armed Forces Institute of Pathology (*AFIP if feasible or any other such facility in your area*). Become familiar with their mission, capabilities, casework and research efforts. Generate a report on your visit emphasizing your understanding of their capabilities concerning gunshot wound analysis.

\_\_\_\_\_  
Agency Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

## **REFERENCE MATERIALS**

### **TERMINAL BALLISTICS: GUNSHOT RESIDUES, SHOT TERMINAL BALLISTICS: GUNSHOT RESIDUES, SHOT PATTERNS, DISTANCE DETERMINATIONS, BULLET PATH ANALYSES AND WOUND EFFECTS ANALYSES AND WOUND EFFECTS**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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#### L. TOOLMARK EXAMINATIONS AND COMPARISONS

1. 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 firearm identification. However, it should be noted that in the broad definition of toolmarks identification, certain other related types of examinations are also performed. Discuss your review with your Training Officer.

**(Use Training Assignment #64 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

2. Define the word "*tool*" and "*toolmarks identification*" in the narrow sense of the expression. Also define toolmark identification in its broadest sense, and determine the kinds of conclusions that may be reached in toolmark identification. Set these out in detail and discuss these with your Training Officer.

**(Use Training Assignment #64 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

**(Use Training Assignment #64 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

4. In a case involving a toolmark examination wherein no tool is submitted, determine the types of conclusions which can be reached. Consider such things as the type of tool, size of the tool, action employed by tool, value of toolmark for comparison purposes, and unusual tool features. Discuss the "*no tool*" case with your Training Officer.

**(Use Training Assignment #64 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

- a. Shearing
- b. Pinching
- c. Fracture
- d. Scrape mark
- e. Impression
- f. Slicing

**(Use Training Assignment #65 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

6. Define the term "*class characteristics*" as it applies to toolmark identification. Using the tools or methods selected as examples in the above, describe their respective class characteristics in detail.

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

**(Use Training Assignment #65 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

7. Using soft copper wire of approximately 1/4-inch diameter, make cuts through it with the tools that employ a shearing, pinching and slicing action. Make test cuts in lead using the same tools. Attempt to identify the cuts in the copper wire as having been made by the same tool as that which cut the test lead. Support your results with photographs and note any lighting considerations made necessary by the color difference between copper and lead.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

8. 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.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

9. Using a drive pin punch, produce an impression in a piece of brass sheeting. Produce a set of test marks in lead and examine these two marks. Attempt to identify these as having been made by the same tool. Support your results by photographs.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

10. Using a junked doorknob and a serrated-jawed tool, have your Training Officer produce impressions and scrape marks like those produced by an attempt at an entry. Devise a method of obtaining test marks in lead like those produced by the serrated-jawed tool on the doorknob. Microscopically examine 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.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

11. Learn the technique of reverse lighting. Obtain a piece of brittle material such as Plexiglass or pot metal and fracture it into two fragments. Attempt to identify the two fragments as having once been a single object. Take notes and support your results by photographs.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

12. Obtain an ax blade that contains numerous defects. Cut a piece of seasoned wood such as dowel rod with the ax blade and attempt to identify the blade with the cut. Insure that your test cuts are consistent with your "*unknown*" with respect to the orientation of the ax to the wood and the direction of the grain. Support your results with sketches and photographs.

\_\_\_\_\_  
Training Officer

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Date

13. Obtain a section of large-diameter telephone cable and cut it with the ax used above and study the effects of a slicing 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 sliced end of the cable.

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Training Officer

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Date

14. Discuss the fact that generally saws, files and abrasive tools are not identifiable with the marks they produce. Cite any exceptions to this rule.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

15. 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. Discuss 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.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

16. Investigate pressure/contact examinations in regard to objects that 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.

***(Use Training Assignment #64 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

17. Discuss and demonstrate the making of casts of toolmarks. Also, discuss the potential of such casts and of photographs alone in making toolmarks identifications.

***(Use Training Assignment #64 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date



**REFERENCE MATERIALS**  
**TOOLMARK EXAMINATIONS, COMPARISONS AND IDENTIFICATIONS**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

**Criteria for the Identification of Toolmarks**  
**(Including Those Found on Fired Ammunition Components)**

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M. SERIAL NUMBER RESTORATION

1. Read the Handbook of Methods for the Restoration of Obliterated Serial Numbers, by Tretow. Be prepared to discuss the theory of number restoration.

**(Use Training Assignment #61 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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.

**(Use Training Assignment #61 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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, embossing, debossing, coining, vibratory pencil, laser and electrical discharge machining.

- a. Discuss with the Training Officer the effect each of these marking techniques has on the subsurface of the marked area.
- b. Discuss with the Training Officer the marking methods used that can directly affect the ability of the examiner to restore any obliterated markings and why.

**(Use Training Assignment #61 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

4. Define in your notebook the term "*plastic deformation*" of metal.

**(Use Training Assignment #61 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

5. Briefly discuss in your notebook and with your Training Officer the difference between cold rolled steel and cast iron metal.

**(Use Training Assignment #61 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

6. Discuss with your Training Officer 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.
- a. grinding
  - b. over stamping
  - c. pinging
  - d. gouging
  - e. heating
  - f. puddling
  - g. welding
  - h. removal
  - i. combinations of the above

**(Use Training Assignment #61 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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.

**(Use Training Assignment #62 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

8. Discuss with your Training Officer the different types of lighting (*e.g., incandescent, infrared, UV, and fluorescent*) and how they can improve or enhance the restoration results. Be prepared to explain how the angle of incidence of these lighting techniques might vary the results.

**(Use Training Assignment #62 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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

**(Use Training Assignment #62 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

10. Determine the chemical reaction that takes place when etching is conducted and document in your notebook the appropriate chemical formulations for the general reactions of acid with steel and aluminum.

**(Use Training Assignment #62 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

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.

***(Use Training Assignment #62 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

12. Determine the specialized equipment that might be used in number restoration and discuss these your Training Officer.

***(Use Training Assignment #62 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

13. Discuss with your Training Officer the appropriate photography techniques and procedures to be used before, during, and after restoring obliterated serial numbers.

***(Use Training Assignment #62 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

14. Determine the various types of film utilized for number restoration photography. Be prepared to discuss with your Training Officer under what circumstances each would be used.

***(Use Training Assignment #62 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

15. Research the various kinds of magnifying and enhancing equipment used for number restoration and explain when and why each would be used.

***(Use Training Assignment #62 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date



16. Become familiar with the following chemicals:

- a.  $\text{CuNH}_4\text{Cl}_2$
- b.  $\text{CuCl}_2$
- c.  $\text{NaOH}$
- d.  $\text{HCl}$
- e.  $\text{HNO}_3$
- f.  $\text{KCN}$
- g.  $\text{K}_2\text{SO}_4$
- h. Aqua Regia
- i.  $\text{H}_2\text{SO}_4$
- j.  $\text{FeCl}_3$
- k.  $\text{H}_2\text{O}_2$
- l. Tartaric acid
- m. Ammonium Persulfate

**(Use Training Assignment #62 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

17. 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.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

18. Define and place in your notebook these common chemical terms:

- a. Fries Reagent
- b. Arais Reagent
- c. Hydrofluoric acid
- d. Turner's Reagent
- e. Davis' Reagent

**(Use Training Assignment #63 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

19. Become knowledgeable of the numbering systems and methods used by various firearm manufacturers including but not limited to Colt, Ruger, Smith & Wesson, US Repeating Arms (Winchester) and Remington.

**(Use Training Assignment #63 to complete this objective.)**

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

20. Determine the best chemicals and techniques to use in number restoration of the following firearms:

- a. Colt pistol
- b. Smith & Wesson revolver
- c. RG Industries revolver
- d. Ruger stainless steel revolver
- e. chrome/nickel 25 caliber autoloading pistol
- f. shotgun alloy receiver
- g. shotgun casehardened receiver
- h. Winchester rifle

***(Use Training Assignment #63 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

21. Obtain several firearms from your Training Officer, alter the serial numbers using different methods and then attempt to restore them. Prepare notes and photographs to substantiate your conclusions and results.

***(Use Training Assignment #63 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

22. Be prepared to discuss with your Training Officer the methods used and lessons learned during the restoration process.

***(Use Training Assignment #63 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

23. 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.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

24. Discuss with your Training Officer how the combination of brief application of  $\text{CuNH}_4\text{Cl}_2$  followed by normal NaOH application can shorten the processing time on aluminum.

***(Use Training Assignment #63 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

25. Discuss with your Training Officer why alternating  $\text{HNO}_3$  and  $\text{HCl}$  can work so well on chrome or nickel plated firearms.

***(Use Training Assignment #63 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

26. Research the effect of D. C. electricity (Include the proper polarity and voltage for enhance etching/development of obliterated numbers and letters) on the reaction time of the different chemical techniques you have learned. Conduct restorations using this method.

***(Use Training Assignment #63 to complete this objective.)***

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

## **REFERENCE MATERIALS**

### **RESTORATION OF OBLITERATED MARKINGS**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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N. RESEARCH PROJECT, REPORT WRITING, EXPERT TESTIMONY  
AND EXTERNAL LABORATORY REVIEW AND TOURS

1. Formulate a method of taking notes in your cases, that is, how to note essential data on which you base your conclusions, to document chain of custody, to identify a case with a particular contributor and with a particular file. Develop a system for the administration of your cases. Discuss the above areas with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

2. Read through copies of reports generated by at least two examiners for the purpose of familiarization with report format and phraseology. Compile a reference file which reflects correct phraseology divided into appropriate categories, i.e., bullet examination, bullet "*no conclusion*," bullet identification, cartridge case identification, firearms function, accidental discharge, gunshot residues, etc. Discuss this with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

3. Attend moot courts of other trainees during your training period and evaluate the demeanor and professionalism of the trainee. Discuss this with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

4. Review several transcripts of at least two examiners regarding their "*expert*" testimony in the field of firearms/toolmark identification. Discuss these transcripts with each examiner.

\_\_\_\_\_  
Examiner

\_\_\_\_\_  
Date

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Examiner

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Date

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Training Officer

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Date

5. Discuss the meaning and/or definition of the following terms or phrases, as they apply to testimony in the field of firearms/toolmark identification, with your Training Officer.

- a. expert witness
- b. reasonable degree of scientific certainty
- c. hearsay
- d. opinion
- e. voir dire

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

6. 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. Discuss this with your Training Officer.

\_\_\_\_\_  
Training Officer

\_\_\_\_\_  
Date

7. Observe at least two examiners testifying as an "*expert witness*." Discuss their testimonies with each examiner. Coordinate this with your Training Officer.

\_\_\_\_\_  
Examiner

\_\_\_\_\_  
Date

\_\_\_\_\_  
Examiner

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Date

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Training Officer

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Date

8. Confer with other examiners regarding personal hints and recommendations in regard to courtroom testimony. This discussion should be lengthy and cover all aspects of the topic.

\_\_\_\_\_  
Examiner

\_\_\_\_\_  
Date

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Examiner

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Date

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Examiner

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Examiner

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Training Officer

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Date



## **REFERENCE MATERIALS**

### **RESEARCH PROJECT**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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## **REFERENCE MATERIALS**

### **ORAL PRESENTATIONS AND COURT TESTIMONY**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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## **REFERENCE MATERIALS**

### **EXTERNAL LABORATORY REVIEW AND TOURS**

The following reference materials serve several purposes:

- to provide a wider range of additional resources should you have a particular interest in a given topic.
- to provide reference materials for your future professional use.
- to allow you to gain additional depth in particular subject areas.

Should you encounter other references in this category, you are encouraged to make additional notes about them at the end of this listing.

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