FIREARM AND TOOLMARK SECTION

QUALITY MANUAL

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1 SCOPE

This manual follows the requirements specified by ANSI-ASQ National Accreditation Board (ANAB), which is based on the ISO/IEC 17025:2017 standards and the 2017 ANAB ISO/IEC 17025:2017 — Forensic Science Testing and Calibration Laboratories Accreditation Requirements (AR 3125).

The manual follows the outline of the *ASCL Quality Manual* (ASCL-DOC-01).

1.1 INTERNATIONAL STANDARD: GENERAL REQUIREMENTS

See *ASCL-DOC-01 Quality Manual*.

1.2 INTERNATIONAL STANDARD: SCOPE

See *ASCL-DOC-01 Quality Manual*.

1.2.1 ANAB PROGRAM

See *ASCL-DOC-01 Quality Manual*.

2 NORMATIVE REFERENCES

The Firearm and Toolmark Section follows applicable references listed in *ASCL-DOC-01 Quality Manual*.

3 TERMS AND DEFINITIONS

BARREL LENGTH

The distance between the muzzle end of the barrel and the face of the closed breechblock or bolt for firearms other than revolvers.

OVERALL LENGTH

The dimension measured parallel to the axis of the bore from muzzle to a line at right angles to the axis and tangent at the rearmost point of the butt plate or grip.

Also see *ASCL-DOC-01 Quality Manual*.

4 GENERAL REQUIREMENTS

4.1 IMPARTIALITY

See *ASCL-DOC-01 Quality Manual*.

4.2 CONFIDENTIALITY

The only information that is appropriate to be released about specimens entered into NIBIN is either that no associations have been made at this time or that a NIBIN Hit Letter has been issued containing the NIBIN Lead information. NIBIN cannot be used to conduct a comparison of two specimens; the requesting agency will need to submit the specimens for microscopic examinations/comparisons and verification/review of the results.

Investigative information on a particular item may not be released until after a verification has been completed.

Also see *ASCL-DOC-01 Quality Manual*.

5 STRUCTURAL REQUIREMENTS

5.1 ESTABLISHMENT

See *ASCL-DOC-01 Quality Manual*.

5.2 MANAGEMENT

See *ASCL-DOC-01 Quality Manual*.

5.2.1 OTHER STAFF (FIREARM AND TOOLMARK SECTION)

5.2.1.1 FIREARM AND TOOLMARK EXAMINER

QUALIFICATIONS

The position requires a minimum of a Bachelor's degree with science courses, from an accredited college or university (the educational requirement may be waived for analysts working in the Discipline prior to December 2004, or at the discretion of the Executive Director). In addition, completion of the Association of Firearm and Toolmark Examiners (AFTE) Training Program, the Arkansas State Crime Laboratory Firearm Examiner Training Program, or a comparable program from another forensic laboratory or institution is required.

AUTHORITIES AND REPONSIBILITIES

A Firearm and Toolmark Examiner is responsible for examining firearm and toolmark evidence submitted by law enforcement agencies within the state of Arkansas, as well as federal agencies.

- Notates information regarding evidence submitted.
- Uses a comparison microscope to compare bullets and cartridge cases side-by-side against those test fired in firearms submitted by various law enforcement agencies. This may allow an examiner to determine whether or not a bullet or cartridge case was fired in the firearm in question
- Determines if a firearm is safe to shoot and functions properly.
- Enters cartridge cases into the National Integrated Ballistics Information Network (NIBIN) and reviews the resulting correlations.
- Uses a comparison microscope to compare toolmarks from the crime scene against test marks made with the tool submitted by law enforcement agencies. This may allow an examiner to determine if the tool in question was used to make the markings at the crime scene.
- Conducts range (distance) determination testing.
- Restores serial numbers on firearms.
- Writes a detailed report concerning scientific findings related to the firearm and toolmark analysis.

- Appears in state and federal courts to testify as an expert witness in the area of forensic firearm and toolmark identification and offers opinions based upon scientific analysis in legal criminal proceedings.
- Provides technical assistance, information and instruction to law enforcement agencies in firearm and toolmark techniques and procedures.
- Performs related responsibilities as required or assigned.

5.2.1.2 CHIEF FIREARM AND TOOLMARK EXAMINER

QUALIFICATIONS

The position requires a minimum of a Bachelor's degree with science courses, from an accredited college or university and five years of professional experience as a Firearm and Toolmark Examiner in a forensic laboratory (the educational requirement may be waived for analysts working in the Discipline prior to December 2004, or at the discretion of the Executive Director). The Chief Firearm and Toolmark Examiner will have the appropriate technical training and technical experience in the discipline.

AUTHORITIES AND RESPONSIBILITIES

The Chief Firearm and Toolmark Examiner is under administrative direction and is responsible for directing the activities of the Firearm and Toolmark section. The Chief Firearm and Toolmark Examiner has overall responsibility for the technical operations and the provisions of the resources needed to ensure the required quality of laboratory operations.

Duties of the Chief Firearm and Toolmark Examiner include those of a Firearm and Toolmark Examiner, as well as:

- Supervises a technical staff of Firearm and Toolmark Examiners, technicians, and support personnel. Duties also include interviewing applicants and make recommendations for hiring, approving leave, making work assignments, training employees, and evaluating the performance of employees.
- Assists with developing laboratory policies and procedures, develops short and long-range operational plans for the Firearm and Toolmark section, monitors operational activities by conducting staff meetings to disseminate information and reviewing and approving reports, and compiles and submits statistical reports as needed.
- Performs related responsibilities as required or assigned.
- Ensures compliance with accreditation requirements by implementing the labwide policies and overseeing the section's quality assurance program.
- Oversees the technical operations and provision of resources for the Firearm and Toolmark section.
- Works with the Bureau of Alcohol, Tobacco, Firearms, and Explosive (ATF) as the National Integrated Ballistics Information Network (NIBIN) Program Administrator

5.2.1.3 FIREARM AND TOOLMARK TECHNICIAN/ NIBIN EXAMINER

QUALIFICATIONS

The position requires a minimum of a high school degree. In addition, completion of sections of the *Firearm and Toolmark Section Training Manual (FA-DOC-02)*, as designated by the Chief Firearm and Toolmark Examiner, is required.

AUTHORITIES AND RESPONSIBILITIES

- Notates information regarding evidence submitted.
- Determines if a firearm is safe to shoot and functions properly.
- Examines and test fires firearms submitted for Operation Shutdown.
- Enters cartridge cases into the National Integrated Ballistics Information Network (NIBIN) and review the resulting correlations, when authorized.
- Completes notes related to the evidence that is examined.
- Appears in state and federal courts to testify to the completed analysis in legal criminal proceedings.
- Performs related responsibilities as required or assigned.

5.2.1.4 FIREARM AND TOOLMARK SECTION LABORATORY SUPPORT PERSONNEL

QUALIFICATIONS

The position requirements will be determined by the Chief Firearm and Toolmark Examiner and laboratory administration. Support Personnel may be required to complete designated *the Firearm and Toolmark Section Training Manual (FA-DOC-02)*.

AUTHORITIES AND RESPONSIBILITIES

Duties may include, but are not limited to:

- Notates information regarding evidence submitted.
- Determines if a firearm is safe to shoot and functions properly.
- Examines and test fires firearms submitted for Operation Shutdown.
- Completes notes related to the evidence that is examined.
- Appears in state and federal courts to testify to the completed analysis in legal criminal proceedings.
- Performs related responsibilities as required or assigned.

The following is a list of supplemental job duties held by certain personnel within the Firearm and Toolmark Section.

5.2.1.5 FIREARM AND TOOLMARK SECTION QUALITY MANAGER

The responsibilities of the Firearm and Toolmark Section Quality Manager include:

- Assisting the Chief Firearm and Toolmark Examiner in maintaining and updating the section's manuals and documents.
- Monitoring section practices to verify continuing compliance with policies and procedures.
- Maintaining and evaluating the section's instrument calibration and maintenance records and periodically assessing the adequacy of report review activities.
- Ensuring the validation of new technical procedures.
- Working with the lab-wide Quality Assurance Manager to seek ways to improve the quality system.

5.2.1.6 FIREARM AND TOOLMARK SECTION SAFETY OFFICER

The responsibilities of the Firearm and Toolmark Section Health and Safety Officer include:

- Conducting monthly safety inspections and ensuring that proper practices and procedures are being followed within the section.
- Maintaining records of any safety incidents within the section.
- Maintaining the section's SDSs.
- Working with the lab-wide Health and Safety Manager to seek ways to improve the safety program.
- Communicating safety related information and conducting safety training for the Firearm and Toolmark section.

5.2.1.7 FIREARM AND TOOLMARK SECTION TRAINING OFFICER

The responsibilities of the Firearm and Toolmark Section Training Officer include:

- Overseeing the training of any Firearm and Toolmark trainees or new employees.
- Ensuring the training of Firearm and Toolmark Section employees in any new instrumentation or procedures.
- Assists in finding yearly continuing education/training opportunities for members of the Firearm and Toolmark Section.

5.2.1.8 FIREARM AND TOOLMARK SECTION NIBIN PROGRAM COORDINATOR

The responsibilities of the Firearm and Toolmark Section NIBIN Coordinator include:

- Assist the Chief Firearm and Toolmark Examiner in overseeing the NIBIN program at the ASCL.
- Serve as a liaison between the lab and the ATF and local law enforcement agencies regarding the NIBIN program.
- Monitoring section practices to verify continuing compliance with lab and ATF policies and procedures.
- Maintain the training records of all authorized users for the NIBIN site.
- Will serve as NIBIN Program Administrator in the absence of the Chief Firearm and Toolmark Examiner.

5.3 SCOPE OF LABORATORY ACTIVITIES

See *ASCL-DOC-01 Quality Manual*.

5.4 NORMATIVE DOCUMENTS

See *ASCL-DOC-01 Quality Manual*.

5.5 LABORATORY OPERATIONS

See *ASCL-DOC-01 Quality Manual*.

5.6 QUALITY MANAGEMENT

See *ASCL-DOC-01 Quality Manual*.

5.7 MANAGEMENT SYSTEM COMMUNICATION AND INTEGRITY

See *ASCL-DOC-01 Quality Manual*.

6 RESOURCE REQUIREMENTS

6.1 6.1 PERSONNEL

See *ASCL-DOC-01 Quality Manual*.

6.2 6.2 PERSONNEL

6.2.1 GENERAL

See *ASCL-DOC-01 Quality Manual*.

6.2.2 COMPETENCE REQUIREMENTS

The Chief Firearm and Toolmark Examiner shall ensure the competence of all who operate specific equipment, perform tests, evaluate results and sign test reports. Training will be completed under the supervision of the section's training officer or another competent examiner.

The Chief Firearm and Toolmark Examiner shall document (e.g., by memorandum) that the individual has been properly trained and that their ability to perform the specified testing has been assessed. This record shall be kept in the individual's Training Binder.

Also see *ASCL-DOC-01 Quality Manual*.

6.2.2.1 ANALYST/EXAMINER EDUCATIONAL REQUIREMENTS

See §5.2.1 of the *Firearm and Toolmark Section Quality Manual*.

6.2.2.2 TRAINING PROGRAM

An individual selected as a Firearm and Toolmark Examiner trainee must be able to successfully complete the Association of Firearm and Toolmark Examiners (AFTE) Training Program, the Arkansas State Crime Laboratory Firearm Examiner Training Program, as outlined in *FA-DOC-02 Training Manual*, or a comparable program from another forensic laboratory or institution.

The training program should include the completion of assigned readings, practical assignments, factory tours, courtroom observation, and supervised casework. All training activities should be documented and maintained in the trainee's Training Binder.

If any amount of previous training from a comparable program from another forensic laboratory or institution has been completed and documentation of this training is available, the documentation will be reviewed and the training period shorten as found to be appropriate.

At the conclusion of training, the Chief Firearm and Toolmark Examiner will ensure that analyst trainees have successfully completed a competency test prior to performing independent casework.

Training will be completed under the supervision of the section's training officer or another competent examiner.

Also see *ASCL-DOC-01 Quality Manual*.

6.2.3 COMPETENCE OF STAFF

See *ASCL-DOC-01 Quality Manual*.

6.2.3.1 COMPETENCY TESTING

See *ASCL-DOC-01 Quality Manual*.

6.2.3.2 COMPETENCY-TESTED ACTIVITIES

See *ASCL-DOC-01 Quality Manual*.

6.2.4 DUTIES, RESPONSIBILITIES, AND AUTHORITIES

See *ASCL-DOC-01 Quality Manual*.

6.2.5 PERSONNEL REQUIREMENTS

See *ASCL-DOC-01 Quality Manual*.

6.2.6 AUTHORIZATIONS

See *ASCL-DOC-01 Quality Manual*.

6.3 FACILITIES AND ENVIROMENTAL CONDITIONS

6.3.1 GENERAL

See *ASCL-DOC-01 Quality Manual*.

6.3.2 DOCUMENTATION

There are no conditions (facilities or environmental conditions) that are necessary to ensure the validity of results in the Firearm and Toolmark Section.

6.3.3 MONITORING RECORDS

See *ASCL-DOC-01 Quality Manual*.

6.3.4 CONTROL OF FACILITIES

See *ASCL-DOC-01 Quality Manual*.

6.3.4.1 ACCESS

Access to all of the office areas, microscope examination rooms, tool room, ammunition room, serial number/ GSR processing room, bullet recovery room, indoor firing range and the Evidence room require a key or security fob for access.

A key box, containing cabinet keys and door keys, is located in the ammunition room of the Firearm and Toolmark Section. The key to the key box is kept by the Chief Firearm and Toolmark Examiner and a log is maintained within the section documenting when keys are added or removed from the key box.

The Firearm Reference Collection is accessed by entry through Evidence Receiving where a log is maintained regarding entry and exit.

6.3.4.2 PREVENTION OF ADVERSE INFLUENCES

The Firearm and Toolmark Section has multiple measures in place to prevent contamination, cross-contamination, and adverse influences on laboratory activities. These include, but are not limited to:

- Marking of evidence and test fires, when practicable, with applicable case and item numbers
- Cleaning of evidence that is a possible biohazard
- Wearing of appropriate personal protective equipment as necessary when handling evidence
- Cleaning of work areas, as necessary, between samples and cases.

6.3.4.3 SEPARATION

See *ASCL-DOC-01 Quality Manual*.

6.3.5 EXTERNAL ACTIVITIES

See *ASCL-DOC-01 Quality Manual*.

6.4 EQUIPMENT

6.4.1 ACCESS

Only individuals who have been trained in the proper use of the instrumentation/equipment are authorized to use it.

When new instrumentation or equipment requires a validation, appropriate personnel will be trained, and this training will be documented and kept in Qualtrax.

All instrumentation/equipment will be uniquely identified, if practicable. The identifier will be marked on the instrument/ equipment and will be documented in the Firearm and Toolmark Instrument/Equipment Calibration, Performance Verification and Maintenance Log.

The instrument/ equipment utilized during case work will be documented in the case notes.

All instrumentation/equipment will be maintained in a clean, orderly, and safe condition. Laboratory equipment and instrumentation shall be handled responsibly to ensure optimal performance and to avoid contamination and premature wear and damage. It is the Chief Firearm and Toolmark Examiner's responsibility to ensure that proper planning and care is taken when equipment or instrumentation is initially located or subsequently moved. Due care shall be taken if equipment or instrumentation is to be shipped to a manufacturer or vendor for calibration or maintenance to minimize the possibility of damage in transit. Equipment that is infrequently used shall be stored (covered, powered-down, etc.) per the manufacturer's recommendations.

If an instrument/equipment is not working properly or potential problems are observed, it is the duty of the analyst to immediately take the appropriate steps to repair/correct the problem or inform the appropriate individual of the problem. Any problem and the action to correct the problem must be logged in the Firearm and Toolmark Instrument/ Equipment Calibration, Performance Verification and Maintenance Log.

Instrumentation/Equipment that is not working properly must be clearly marked as being 'OUT OF SERVICE' in order to prevent inadvertent use of the equipment. The instrument/equipment will not be used in casework until appropriate calibration or verification is performed.

When it has been determined that instrumentation/equipment was not working properly, the Section Chief shall take into consideration the effect the problem may have had on previous tests

6.4.2 OUTSIDE EQUIPMENT

See *ASCL-DOC-01 Quality Manual*.

6.4.3 PROPER FUNCTIONING

New employees will be trained on the use of instrumentation/equipment in the Firearm and Toolmark Section, as described in the *FA-DOC-02 Training Manual*.

New instrumentation/equipment used for tests having a significant effect on the accuracy or validity of the result of the test (i.e. rulers), shall either be received with calibration documentation from the provider or an external calibration will be performed prior to use in casework. Documentation of training and related authorizations will be maintained in Qualtrax.

Up-to-date instructions on the use and maintenance of the instrument/equipment shall be readily available for use.

Before instrumentation/equipment is placed into service, a calibration or performance verification with traceable or certified reference standards/materials shall be performed to ensure that it meets the specifications required by the appropriate method and will be documented in the Firearm and Toolmark Instrument/ Equipment Calibration, Performance Verification and Maintenance Log.

If an instrumentation/equipment does not function to the performance standard, it will be taken out of service and either replaced or repaired prior to being placed back into service.

Any adjustments to and maintenance of instrumentation/equipment will be recorded in this Firearm and Toolmark Instrument/ Equipment Calibration, Performance Verification and Maintenance Log, unless otherwise stated..

After significant maintenance has been performed, a calibration or performance verification with traceable or certified reference standards/materials shall be performed and recorded in the Firearm and Toolmark Instrument/ Equipment Calibration, Performance Verification and Maintenance Log.

6.4.3.1 REAGENT RECORDS AND LABELING

See §6.4.3.1 of the *ASCL-DOC-01 Quality Manual* for the minimum requirements for quality control of reagents and chemicals.

Additionally, the following shall be followed for reagents, chemicals and controls:

- Chemicals and solvents used in reagents should be of at least American Chemical Society (ACS) reagent grade.
- Water used in reagent preparation should be reverse osmosis (RO).
- Items with a manufacturer-specified expiration date may not be used after that date without documentation to support continued reliability.
- For items without a manufacturer-specified expiration date, dates will be based on experience, industry standard, or scientific consensus.
- Each analyst must ensure that the reagents and/or chemicals used in their analysis are of satisfactory quality through the use of appropriate reference material, as appropriate.
- Reagents or chemicals which are determined not to be reliable must be removed from use immediately.

After a reagent is made, it will be checked as appropriate with the reference material listed below in Table 1 and the date this is completed will be documented in the appropriate Firearm and Toolmarks Chemical and Reagent Log. Stock solutions of general test reagents will be prepared, as needed, using good laboratory practices.

RELIABILITY TESTING

The reliability testing for all reagents shall occur at the time it is made and will be documented in the Firearm and Toolmarks Section's Chemical and Reagent Logbook. Reagents used in the Firearm and Toolmark Section and their related reference material are listed in Table 1.

Reliability testing for reagents used in Range Determination testing will also occur on the day of use and will be documented in the case notes.

If a reagent does not meet standards, it will not be used; a new reagent will be prepared, checked to determine if it is working properly and documented in the Firearm and Toolmarks Section's Chemical and Reagent Logbook.

Non-routine reagents prepared for one time use may be recorded with the above items in the laboratory case notes and any excess reagent discarded after use.

Table 1: Common Reagents and Related Reference Materials for the Firearm and Toolmark Section

Reagent	**Reference Material**
Modified Griess (Sensitized Blanks)	Nitrites
Dithiooxamide	Copper
Sodium Rhodizonate and Buffer	Lead
Diphenylamine	Nitrates (gunpowder)
Fry's	Ferrous metal
Turner's	Ferrous metal
Chromic Acid	Ferrous metal
Ferric Chloride	Nonferrous metal
Acidic Ferric Chloride	Nonferrous metal
Phosphoric/ Nitric Acid	Nonferrous metal

6.4.3.1.1 REFERENCE MATERIALS

All reference materials, whether prepared in-house or purchased from commercial sources, must be verified prior to use, and where possible, be traceable to SI units of measurement, or to certified reference materials. A Certificate of Analysis will suffice for verification.

Reference materials for the Firearm and Toolmark Section include: Standard Bullet, Standard Cartridge Case, Ferrous and Nonferrous metal standards, Copper and Lead standards and Nitrate standard. Information with regards to these items will be documented in the *Firearm/Toolmark Reference Materials Log (FA-FORM-60).*

Reference standards/materials shall be handled responsibly to prevent contamination or deterioration and in order to protect their integrity. It is the Chief Firearm and Toolmark Examiner or designee's responsibility to ensure that proper planning and care is taken. All reference standards will be stored in the Firearm and Toolmark Section. All weight standards will be handled with gloves.

As appropriate, information and logsheets for Reference Standards and Reference Materials will be maintained in the Firearm and Toolmark Section's Reference Standards and Reference Materials Logbook.

6.4.3.2 REFERENCE COLLECTION RECORDS

The following reference collections are maintained by the Firearm and Toolmark Section:

Ammunition Reference Collection

The Ammunition Reference Collection is established from the current laboratory ammunition inventory. Each sample in the collection will bear a unique identification number and pertinent cartridge information (caliber, manufacturer, bullet style, bullet weight, powder type, and headstamp sketch). To facilitate easy identification of components, both a live and disassembled cartridge (with intact primer) should be included in the package. The propellant from the disassembled cartridge is contained in a smaller package to prevent contamination. Identifying and other related information from each sample will be documented in the Firearm and Toolmark Ammunition Reference Collection database maintained on the S:drive.

Firearm Reference Collection

The Firearm Reference Collection is maintained by the Firearm and Toolmark Section for use in casework and training. The *FA Reference Library Submission Form (FA-FORM-55)* must be completed for all firearms received at the lab to be included in the Firearm Reference Collection.

The following information will be documented in the Firearms Reference Collection database maintained on the S:drive:

- Unique identification number
- Date received at laboratory
- Agency or person transferring control of firearm to laboratory
- Caliber
- Manufacturer
- Model
- Type
- Finish on firearm
- Barrel length
- Serial number
- Any additional, pertinent information.

Firearms reference collection should be displayed and maintained in such a manner as to prevent the firearms deterioration and to facilitate their inventory, safety and control. All firearms placed in the reference library should be tagged in such a manner so as to display that firearm's location within the collection.

6.4.4 PERFORMANCE VERIFICATION

Designated instrumentation/equipment will be subject to a schedule of performance verifications that will be recorded in the Firearm and Toolmark Instrument/ Equipment Calibration, Performance Verification and Maintenance Log.

If an instrumentation/equipment does not function to the performance standard, it will be taken out of service and either replaced or repaired prior to being placed back into service.

Equipment that will undergo performance verifications, and the related schedule, are as follows:

Balances/ Scales

- Performance verifications will be conducted prior to balance/ scale being put into service and on a quarterly basis (± 1 month).
- Performance verifications of the scales will be conducted utilizing the 20 gram and 30 gram NIST traceable weights. The weights should weigh within ± 1.0 grain of their stated weight. If they do not, the balance shall be removed from service until repaired and performance verified.
- If balance is moved to a different location (such as a different room or a countertop) it must be re-verified using the procedure described above.

Comparison Microscope

- Performance verifications will be conducted prior to comparison microscope being put into service and on a quarterly basis (± 1 month).
- Performance verification of the measurement software for the microscopes will be performed using a NIST traceable stage micrometer. If the measurement software disagrees with the stage micrometer by greater than ± 0.003 inch then the measurement software shall be removed from service until repaired and performance verified.
- The comparison microscopes will be cleaned and serviced as needed. Minor repairs may be done by the examiner.

Calipers

- Performance verifications will be conducted prior to calipers being put into service and on a quarterly basis (± 1 month).
- Performance verifications of the calipers will be conducted utilizing NIST traceable rectangular gage blocks of 0.050 inch, 0.200 inch, 0.400 inch and 1.000 inch. The calipers should measure within ± 0.003 inch. If not, the calipers shall be removed from service until repaired and performance verified.

Measuring Rulers

- Performance verifications will be conducted prior to measuring rulers being put into service and on a quarterly basis (± 1 month).
- Performance verifications of the rulers will be conducted utilizing the NIST traceable Certified Master Ruler. If a measuring ruler disagrees with the Certified Master Ruler by greater than ± 1/16 inch then it shall be removed from service and replaced.

Spring Measuring Device

- Performance verifications will be conducted prior to the spring measuring device being put into service and on a quarterly basis (± 1 month).

- Performance verifications of the spring measuring device will be conducted using the 5 pound and 10 pound NIST traceable weights. The device should read within ± ¼ pound of their stated weight to be acceptable. If not, the device shall be removed from service until it has been repaired and performance verified.

Dead Trigger Weights (Free Weights)

- Performance verifications will be conducted prior to dead trigger weights being put into service and on an annual basis (± 3 months).
- Performance verifications of the free weights will be conducted utilizing a NIST traceable balance. The weights should weigh within ± 2% of their stated weight to be acceptable. If not, the weight shall be removed from service until it has been replaced.

IBIS / NIBIN

- Performance verifications will be conducted prior to the IBIS/ NIBIN system being put into service and on a monthly basis.
- Performance verifications of the IBIS/ NIBIN system will be conducted using the certified bullet and cartridge case standards, as appropriate. Correlation scores should be as follows:
  - Bullet standard
    - Maximum phase correlation score should be greater than 3404.
  - Cartridge case standard
    - Breech face correlation score should be greater than 214
    - Firing pin correlation score should be greater than 171
    - Ejector mark correlation score should be greater than 400
- If the correlation scores do not meet requirements then the standard may be recaptured or the instrument shall be removed from service until repaired and performance verified.
- The calibration ring orientation and focus of the IBIS/ NIBIN system will be checked weekly and adjusted as necessary. If any significant changes are noted, the service provider will be contacted and the instrument shall be removed from service until repaired and rechecked.
- All repairs and significant maintenance will be done by the service provider.
- Performance verifications and any maintenance will be documented in the IBIS/ NIBIN System Performance Verification and Maintenance Logbook located with IBIS/ NIBIN instrument.

A performance verification shall be performed on instrumentation and equipment that has gone outside of the direct control of the laboratory (e.g., for repair or preventive maintenance) or has undergone significant maintenance to ensure that its calibration status is satisfactory before being returned to service. The Firearm and Toolmark Instrument/ Equipment Calibration, Performance Verification and Maintenance Log will reflect that the equipment was functioning properly prior to being returned to service.

6.4.5 FITNESS FOR SERVICE

See *ASCL-DOC-01 Quality Manual*.

6.4.6 CALIBRATION REQUIREMENT

See *ASCL-DOC-01 Quality Manual*.

6.4.7 CALIBRATION PROGRAM

Reference standards of the Firearm and Toolmark Section shall be subject to a schedule of calibration checks to be completed by an outside vendor that can provide traceability as described in §6.4.7 of the *ASCL Quality Manual (ASCL-DOC-01)*. Calibration checks will be recorded in the *Firearm/Toolmark Reference Standards Log (FA-FORM-64)*. If the provider does not have this accreditation, the QA Manager shall evaluate the provider utilizing the *Vendor Evaluation Form (ASCL-FORM-61)* to ensure that the provider has sufficient traceability.

Such reference standards of measurement held by the laboratory shall be used for performance verifications and/or adjustments only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

REFERENCE STANDARDS

Certified Master Ruler

Will be recalibrated every 10 years. If ruler is damaged, it will be taken out of service and replaced.

Stage Micrometer

Performance verification of the stage micrometer will be checked against a NIST Traceable ruler every 5 years (± 3 months). If the micrometer disagrees with the NIST Traceable ruler by greater than ± 0.003 inch then it shall be removed from service.

Rectangular Gage Blocks

(0.050 inch, 0.200 inch, 0.400 inch and 1.000 inch)

Performance verification of the rectangular gage blocks will be checked against a NIST Traceable ruler every 5 years (± 3 months). If any of rectangular gage blocks disagrees with the NIST Traceable ruler by greater than ± 0.003 inch then it shall be removed from service.

Troemner Weights

(20 and 30 grams and 5 and 10 pounds)

Performance verification of the Troemner weights will be checked using a NIST Traceable balance every 5 years (± 3 months). The weights should weigh within ± 2% of stated weight to be acceptable. If not, the weight shall be removed from service.

6.4.7.1 COMPONENTS

The Firearm and Toolmark Section does not have equipment requiring calibration.

6.4.8 LABELING

See *ASCL-DOC-01 Quality Manual*.

6.4.9 OUT OF SERVICE

See *ASCL-DOC-01 Quality Manual*.

6.4.10 INTERMEDIATE CHECKS

See *ASCL-DOC-01 Quality Manual*.

6.4.11 CORRECTION FACTORS

See *ASCL-DOC-01 Quality Manual*.

6.4.12 EQUIPMENT ADJUSTMENT

See *ASCL-DOC-01 Quality Manual*.

6.4.13 EQUIPMENT RECORDS

All records related to instrumentation and equipment in the Firearm and Toolmark Section are located in the Instrument/ Equipment Calibration, Performance Verification and Maintenance Logbook.

Instructions on the preparation and reliability testing of specific chemicals and reagents, and the documentations of these preparations and checks, will maintained in the Firearm and Toolmark Section Chemical and Reagent Logbook

Information with regards Reference Material within the Firearm and Toolmark Section will be documented in the *Firearm/Toolmark Reference Materials Log (FA-FORM-60)*.

6.5 METROLOGICAL TRACEABILITY

6.5.1 GENERAL

See *ASCL-DOC-01 Quality Manual*.

6.5.1.1 SUPPLIER RECORDS

See *ASCL-DOC-01 Quality Manual*.

6.5.1.2 ALTERNATE SUPPLIER REQUIREMENTS

See *ASCL-DOC-01 Quality Manual*.

6.5.1.3 INTERNAL CALIBRATION

See *ASCL-DOC-01 Quality Manual*.

6.5.1.4 CERTIFIED REFERENCE MATERIAL ALTERATION

See *ASCL-DOC-01 Quality Manual*.

6.5.2 TRACEABILITY TO THE INTERNATIONAL SYSTEM OF UNITS (SI)

See *ASCL-DOC-01 Quality Manual*.

6.5.3 ALTERNATE TRACEABILITY

See *ASCL-DOC-01 Quality Manual*.

6.6 EXTERNALLY PROVIDED PRODUCTS AND SERVICES

6.6.1 GENERAL

See *ASCL-DOC-01 Quality Manual*.

6.6.2 RECORDS

See *ASCL-DOC-01 Quality Manual*.

6.6.3 COMMUNICATION

See *ASCL-DOC-01 Quality Manual*.

7 PROCESS REQUIREMENTS

7.1 REVIEW OF REQUEST, TENDERS, AND CONTRACTS

7.1.1 GENERAL

The Medical Examiner's Office is considered an internal customer. The Evidence Report generated by the JusticeTrax® system will serve as the submission sheet for all evidence submitted by the Medical Examiner's office.

Unless specifically requested by the investigating agency or by a Medical Examiner, clothing received from the Medical Examiner's office will not be routinely processed by the Firearm and Toolmark Section for gunshot residue/range determination.

See *ASCL-DOC-01 Quality Manual*.

7.1.2 INAPPROPRIATE REQUESTS

See *ASCL-DOC-01 Quality Manual*.

7.1.3 STATEMENT OF CONFORMITY

See *ASCL-DOC-01 Quality Manual*.

7.1.4 RESOLUTION OF DIFFERENCES

See *ASCL-DOC-01 Quality Manual*.

7.1.5 DEVIATION FROM THE CONTRACT

See *ASCL-DOC-01 Quality Manual*.

7.1.6 AMENDMENT OF THE CONTRACT

See *ASCL-DOC-01 Quality Manual*.

7.1.7 COOPERATION WITH CUSTOMERS

See *ASCL-DOC-01 Quality Manual*.

7.1.8 RECORDS OF REVIEW

See *ASCL-DOC-01 Quality Manual*.

7.1.9 DATABASE SEARCH EXTENT

The Firearm and Toolmark Section's National Integrated Ballistics Information Network (NIBIN) database automatically searches at a regional level. Manual correlations can be conducted to search areas outside this regional level.

The extent of any NIBIN database searches will be communicated to the customer via the examiner's report or the case evaluation form.

7.2 SELECTION, VERIFICATION, AND VALIDATION OF METHODS

7.2.1 SELECTION AND VERIFICATION OF METHODS

7.2.1.1 SELECTION OF METHODS

Only appropriate methods and procedures will be used in casework.

If it becomes necessary to deviate from a documented method and/or procedure, the deviation must be technically justified and authorized by the appropriate Chief Firearm and Toolmark Examiner. The deviation will be documented in the case record. The Section Chief will keep a log of method/procedure deviations.

7.2.1.1.1 TEST METHODS

The test methods utilized by the Firearm and Toolmark Section will be located in §9 of the *Firearm and Toolmark Section Quality Manual*.

7.2.1.1.2 COMPARISON OF KNOWNS AND UNKNOWNS

Prior to a comparison examination, the unknown item(s) will be evaluated to identify characteristics suitable for comparison.

7.2.1.1.3 CALIBRATION TEST METHOD SELECTION

See *ASCL-DOC-01 Quality Manual*.

7.2.1.2 METHOD AVAILABILITY

See *ASCL-DOC-01 Quality Manual*.

7.2.1.3 METHOD VERSION

See *ASCL-DOC-01 Quality Manual*.

7.2.1.4 METHOD SELECTION

See *ASCL-DOC-01 Quality Manual*.

7.2.1.5 METHOD VERIFICATION

See *ASCL-DOC-01 Quality Manual*.

7.2.1.6 METHOD DEVELOPMENT

See *ASCL-DOC-01 Quality Manual*.

7.2.1.7 DEVIATION FROM METHOD

See *ASCL-DOC-01 Quality Manual*.

7.2.2 VALIDATION OF METHODS

7.2.2.1 EXTENT OF VALIDATION

See *ASCL-DOC-01 Quality Manual*.

7.2.2.1.1 VALIDATION PRODECURE

See *ASCL-DOC-01 Quality Manual*.

7.2.2.2 CHANGES TO VALIDATED METHODS

See *ASCL-DOC-01 Quality Manual*.

7.2.2.3 RELEVANCE TO NEEDS

See *ASCL-DOC-01 Quality Manual*.

7.2.2.4 VALIDATION RECORDS

See *ASCL-DOC-01 Quality Manual*.

7.3 SAMPLING

7.3.1 GENERAL

See *ASCL-DOC-01 Quality Manual*.

7.3.2 SAMPLING METHOD

The Firearm and Toolmark Section employs non-statistical sampling.

Test fired cartridge cases and evidence cartridge cases from all request types worked by the Firearm and Toolmark Section shall be evaluated for their suitability for entry into NIBIN. One casing from a set of test fires or one casing from a set of evidence items that have either been identified to each other or have similar markings will be entered into the NIBIN database.

If all pellets within a group appear similar, the examiner may select a subset to examine for shot size determination.

In some circumstances, the examiner may use their discretion and only test those evidence items found to be the best suitable. This should be recorded in the case record.

7.3.3 SAMPLING RECORDS

See *ASCL-DOC-01 Quality Manual*.

7.4 HANDLING OF TEST ITEMS

7.4.1 GENERAL

Also see *ASCL-DOC-01 Quality Manual*.

Analyst should be aware of all the sections and testing that involves the evidence and should take the necessary precautions to preserve the integrity of the evidence.

EVIDENCE RETENTION

At the completion of analysis, test fired bullets and cartridge cases and test cuts from toolmark comparison cases will be stored in "FA Short Term TF Storage" until they are transferred to "FA Long Term Storage".

Swabs will be stored temporarily in a secure Firearms Section DNA Storage Area.
The swabs will be transferred as needed to the Physical Evidence Section for long term storage.

INDIVIDUAL CHARACTERISTICS DATABASE

The Firearm and Toolmark Section utilizes the National Integrated Ballistic Information Network (NIBIN) database. Test fired bullet and cartridge case samples are to be treated as evidence. See §9.6 of the *Firearm and Toolmark Section Quality Manual* for more on individual characteristics database procedures.

7.4.1.1 HANDLING PROCEDURES

7.4.1.1.1 STORAGE

Evidence in the Firearm and Toolmark Section may be stored in the Firearm Evidence room as well as lockable cabinets, the tool room, the GSR/Serial number restoration room, and the ammunition storage room. Evidence must be kept in one of these locations for overnight storage. Evidence shall be maintained under appropriate conditions to prevent deterioration, loss or damage to the evidence during storage, handling or the testing process.

Also see *ASCL-DOC-01 Quality Manual*.

7.4.1.1.2 PACKAGING AND SEALING

See *ASCL-DOC-01 Quality Manual*.

7.4.1.1.3 CHAIN OF CUSTODY

In the Firearm and Toolmark Section, evidence is typically transferred from Evidence Receiving to the Firearm Evidence room (FASecureStorage) and is returned to the Firearm Evidence room (FASecureStorage) and back to Evidence Receiving after all analyses are done. The Firearm Evidence room is only available to the members of the Firearm and Toolmark Section and other authorized personnel. Documented evidence transfers between analysts may occur, as deemed necessary.

Evidence items (e.g. expended cartridge cases, bullets) transferred to another examiner for verification purposes shall be recorded on the *Firearms Verification Form (FA-FORM-02)*. Evidence items transferred to another examiner for the purposes of entry into the NIBIN database shall be recorded on the *Evidence Transfer Form (FA-FORM-75)*. The items transferred, the date and time of the transfers, and the initials of the examiners involved in the transfer will be documented.

Also see *ASCL-DOC-01 Quality Manual*.

7.4.1.1.4 CUSTOMER NOTIFICATION

See *ASCL-DOC-01 Quality Manual*.

7.4.2 ITEM IDENTIFICATION

A unique case number is assigned to every case when evidence is initially received by ASCL. Each exterior container must have its unique barcode label affixed to it. Agency evidence numbers will be used to identify the evidence whenever practical and be documented in the examiner's notes.

If testing requires that uniquely identified items be subdivided by the laboratory, appropriate sub-item identifiers shall be assigned and the item(s) labeled by the analyst so that the sub-item may be easily tracked and identified as having originated from a particular item. This will also pertain to items examined for entry into the National Integrate Ballistics Information Network (NIBIN).

All evidence will be marked or identified with the laboratory case number (e.g., YYYY-######) to ensure that it is identifiable and traceable to the corresponding case. When the evidence does not lend itself to marking, then the proximal container must be marked or identified with the laboratory case number.

Individual characteristic database samples will be uniquely identified in accordance with the policies stated above.

7.4.2.1 EXTENT

See *ASCL-DOC-01 Quality Manual*.

7.4.3 DEVIATIONS

See *ASCL-DOC-01 Quality Manual*.

7.4.4 ENVIRONMENTAL CONDITIONS

See *ASCL-DOC-01 Quality Manual*.

7.5 TECHNICAL RECORDS

7.5.1 GENERAL

Each case record will contain enough information to enable reanalysis to be conducted under conditions as close as possible to the original, and to identify factors affecting uncertainty. The identity of all individuals who sampled evidence, conducted testing, or verified results will be specified in the case record.

Observations, data, and calculations shall be recorded at the time they are made and shall be identifiable to the specific task.

Dates shall be recorded to indicate when the work was performed. In the Firearm and Toolmark Section, the date that the case is started will be recorded in the notes or on the case worksheet. Dates of analysis are documented in the notes or on any supporting documentation (i.e. pictures, GRC data, etc.). The ending date for work is considered the date recorded in JusticeTrax® as "Draft Completed".

If it is necessary to record the operating parameters used during analysis, this will be recorded in the examination record.

The unique ASCL case number (e.g., YYYY-######, either handwritten or electronically generated) and the analyst's handwritten initials or signature (or secure electronic equivalent) must be on all examination records in the case file.

When examination records are prepared by an individual other than the issuing examiner, the initials of that individual(s) shall be on each page(s) of examination records representing their work. It shall be clear from the case record who performed each stage of the examination/analysis.

When data from multiple cases are recorded on a single printout, kept in a single file, and referenced for the files for which data was generated, the case number for each case for which data was generated shall be appropriately recorded on the printout. When the printout is placed in each of the appropriate case records, only the individual case number is required.

When examination records are recorded on both sides of a page, each side shall include both the case number and analyst's initials.

7.5.1.1 TECHNICAL RECORD RETENTION

Examination records are any records generated by the analyst/examiner for a case file (e.g., notes, worksheets, photographs, spectra, printouts, charts, and other data). Examination records that are essential for the evaluation and interpretation of the data must be stored in the appropriate folder within the "Request" folder in the LIMS case file. When it is not feasible to incorporate the examination records in the LIMS case file, these records may be stored external to the LIMS case file. The location of these records must be specified in the case file.

All other records contained in the case file will be considered administrative records and will normally be stored in the "Case Images" folder in the LIMS case file. It is acceptable to place an administrative memorandum in a "Request" folder after the draft complete milestone if (and only if) it does not serve as an examination record (i.e., it solely helps explain the administrative information contained within the examination record).

7.5.1.2 ABBREVIATIONS

Abbreviations found in the Firearm and Toolmark Section's Abbreviations List, in the AFTE Glossary, and those common to the firearm and ammunition industries may be used in examination records. The Firearm and Toolmark section's Abbreviations List (FA-DOC-04) is located on Qualtrax, the most recent addition of the AFTE Glossary is located on the S:drive, and firearm and ammunition manufacturer references may be located in the main Firearm and Toolmark section examination room or on related websites.

7.5.1.3 TECHNICAL RECORD SUFFICIENCY

Technical records to support a report[1] shall be such that, in the absence of the analyst, another competent reviewer could evaluate what was done and interpret the data. See §9 of the *Firearm and Toolmark Section Quality Manual* for documentation requirements for the Firearm and Toolmark Section.

7.5.1.4 TECHNICAL RECORD PERMANENCY

See *ASCL-DOC-01 Quality Manual*.

7.5.1.5 REJECTION

See *ASCL-DOC-01 Quality Manual*.

7.5.1.6 CALIBRATION DATA

See *ASCL-DOC-01 Quality Manual*.

7.5.2 AMENDMENTS TO TECHNICAL RECORDS

See *ASCL-DOC-01 Quality Manual*.

[1] Including results, opinions, and interpretations

7.6 EVALUATION OF MEASUREMENT UNCERTAINTY

Measurement of uncertainty has been studied for length measurements and for distance determination. The estimation of uncertainty will be calculated for both barrel length measurements and overall length measurements.

The analytical protocols for estimation of the measurement uncertainty are located in §10 of the *Firearm and Toolmark Section Quality Manual*.

7.6.1 UNCERTAINTY COMPONENTS

See *ASCL-DOC-01 Quality Manual*.

7.6.1.1 METHOD REQUIREMENTS

The estimation of uncertainty will be recalculated when significant changes in the budget occur (i.e. increase or decrease in number of examiners, new standard ruler). A documented review of the estimation of uncertainty will be conducted annually as well as within three months of an analyst starting or ceasing independent casework.

See *ASCL-DOC-01 Quality Manual*.

7.6.2 CALIBRATION

See *ASCL-DOC-01 Quality Manual*.

7.6.3 ESTIMATION PROCEDURE

See *ASCL-DOC-01 Quality Manual*.

7.6.4 REQUIRED RECORDS

See *ASCL-DOC-01 Quality Manual*.

7.7 ENSURING THE VALIDITY OF RESULTS

7.7.1 GENERAL

See *ASCL-DOC-01 Quality Manual*.

7.7.1.1 VERIFICATION

Verification is an independent examination of the evidence by another competent analyst to confirm the primary analyst's conclusions. Verifications shall be performed by another analyst qualified in the same discipline/sub-discipline.

Verifications must be documented in the case file. If the confirming analyst draws the same conclusion as the primary analyst, documentation shall be clear as to what was verified, who performed the verification and the date the verification was performed.

If the individual draws a different conclusion from the primary analyst, both analysts shall attempt to come to a resolution. If a resolution cannot be achieved, the issue shall be brought to the attention of the Chief Firearm and Toolmark Examiner. The Chief Firearm and Toolmark Examiner shall consult with the involved parties and resolve the issue. In the case of an off-site confirmation, the same requirement for documentation applies. The resolution of any such discrepancy shall be recorded.

All analytical conclusions reached in firearm or Toolmark comparisons will be verified by a second examiner and will be documented on the *Firearms Verification Form (FA-FORM-02)*.

All analytical conclusions reached during a serial number restoration will be verified by a second examiner and will be documented on the *Serial Number Restoration Worksheet (FA-FORM-10)*.

All conclusions reached during gunshot residue and distance determination testing will be verified by a second examiner and will be documented on the *Firearms Verification Form (FA-FORM-02)*.

All analytical conclusions regarding an item of evidence being of no value will be verified by a second examiner and will be documented on the *Firearms Verification Form (FA-FORM-02)*.

7.7.1.2 CASE REVIEW

All cases will be technically and administratively reviewed prior to the release of the report. The review process must confirm that electronic versions of all necessary documentation are in the imaging module of LIMS. If a reviewer discovers an error in the case record, the reviewer must document the error on the *Firearms Case Review Form (FA-FORM-01)* and inform the analyst.

If the analyst and the reviewer cannot reach consensus, then both the analyst and reviewer must meet with the Section Chief (or designee) for resolution.

All non-conforming work identified during review will be handled according to § 8.7 (Corrective Action) of the *ASCL-DOC-01 Quality Manual*.

The successful completion of technical and administrative review is recorded by the setting of the appropriate milestone(s) in JusticeTrax.

7.7.1.2.1 TECHNICAL REVIEW

See *ASCL-DOC-01 Quality Manual*.

7.7.1.2.2 TESTIMONY REVIEW

A testimony review of all testifying personnel from the Firearm and Toolmark Section will be conducted in accordance with the policies outlines in § 7.7.1.2.3 of the *ASCL-DOC-01 Quality Manual*.

Testimony of testifying personnel from the Firearm and Toolmark Section will be conducted, at a minimum, once per accreditation cycle.

The first testimony of testifying personnel will be reviewed.

7.7.2 INTERLABORATORY COMPARISONS

See *ASCL-DOC-01 Quality Manual*.

7.7.2.1 EXTERNAL PROFICIENCY TESTING

For each location and calendar year[2], the ASCL participates in at least one external proficiency test for each discipline in which accredited services are provided. The providers of these tests are authorized to release the test results to ANAB.

7.7.3 MONITORING ACTIVITY ANALYSIS

See *ASCL-DOC-01 Quality Manual*.

7.7.4 INDIVIDUAL PROFICIENCY TESTING

Each analyst and technical support personnel engaged in testing activities, verifications, case review, or the authorization of results shall successfully complete at least one internal or external proficiency test per calendar year[3] in each discipline in which they perform that work.

The areas of proficiency testing for the Firearm and Toolmark discipline include:

- Firearms
- Toolmarks
- Individual Characteristic Database
- Serial Number Restoration
- Distance Determination

The Firearm and Toolmark discipline will successfully complete at least one external proficiency test annually. ASCLD/LAB approved test providers shall be used where available. If there is not an ASCLD/LAB approved test provider available, the ASCL will locate and use another source of an external test in the discipline.

7.7.5 PROFICIENCY TESTING REQUIREMENTS

Analysis, verification, technical review, and administrative review policies are employed during proficiency testing as they are normally applied to casework. All parts of a proficiency test provided by an approved test provider shall be examined as completely as the discipline's procedures allow.

A case will be created in JusticeTrax® LIMS-plus for all proficiency tests. Under the "Offense" tab, "Proficiency Test" shall be selected. For external proficiency tests, the analyst shall complete the test and submit the results by the due date.

[2] For proficiency tests conducted at the end of the calendar year, the evaluation may take place in the next calendar year

[3] For proficiency tests conducted at the end of the calendar year, the evaluation may take place in the next calendar year

Some external proficiency tests (e.g., Firearm and Toolmarks, Latent Prints) may be taken independently by multiple analysts in succession. The first analyst taking the test will submit the results to the external provider before any of the succeeding analysts receive the test. This will be considered an External Proficiency Test. The remaining analysts will independently take the exam by the proficiency due date. These tests will be considered Internal Proficiency Tests. Precautions are taken to prevent the initial results from influencing subsequent examiners (e.g., each proficiency case record is restricted in JusticeTrax® so that the other analysts taking the test cannot access it).

Successfully completing a proficiency test means either obtaining the satisfactory response or successfully completing a corrective action(s) resulting from an incorrect response (see § 8.7 of the *ASCL-DOC-01 Quality Manual*).

- All tests are graded as satisfactory or unsatisfactory
  - A satisfactory grade is attained when the experimental results match the expected results.
- If there is a discrepancy between the expected results and the experimental results, the Chief Firearm and Toolmark Examiner must notify the lab-wide Quality Assurance Manager
- Minor discrepancies may be deemed satisfactory based on the following factors with approval of the Quality Assurance Manager:
  - Discipline interpretation guidelines
  - Consensus results

When an inconclusive result is given as a proficiency test conclusion, and this is not the expected result, the conclusion will be evaluated by the supervisor of the analyst to determine if it is supported by Discipline Interpretation Guidelines or consensus results.

- Discipline Interpretation Guidelines will be as follows:
  - Another qualified examiner, preferably of more experience than the test taker, will conduct an examination of the test samples to determine if an association of proper strength has been made.
    - If the association is determined to have been proper, the test will be graded as a pass.
    - If the association is determined to have been improper, the test will be graded as a fail and a CAR will be initiated.
- Consensus results will be as follows:
  - Determined based on the statistics given by the test provider
    - The proportion of labs reporting an inconclusive result will be evaluated.
    - If an insufficient proportion of labs report an inconclusive result for the same sample, the Discipline interpretation guidelines will be followed.

If the results are deemed to be unsatisfactory, a Quality Assurance Concern workflow in Qualtrax will be initiated.

The laboratory's overall performance in proficiency testing is reviewed annually as part of management review, as well as upon the evaluation of individual testing events.

For intralaboratory monitoring events (i.e., internal proficiency tests), the quality of the comparison will be evaluated prior to the monitoring activity. This is typically achieved by predistribution testing, but other methods may be detailed in the discipline Quality Manuals or proficiency test workflow. Documentation of this evaluation will be maintained.

Nonconformities identified at any point in the testing will be handled in accordance with § 4.9 (Control of Nonconforming Testing) and § 4.11 (Corrective Action) of the *ASCL-DOC-01 Quality Manual*.

The Chief Firearm and Toolmark Examiner is responsible for comparing the analytical results to the expected results, determining if the analytical results are acceptable, and reviewing these results with the analyst.

7.7.6 PROFICIENCY TEST SCHEDULE

Each individual engaged in testing activities (both analysts and technical support personnel) shall be proficiency tested annually in each discipline in which they perform testing.

Each analyst and technical support personnel engaged in testing activities shall be proficiency tested in each area of testing appearing on the ASCL's Scope of Accreditation at least once during each accreditation cycle.

See *ASCL-DOC-01 Quality Manual*.

7.7.7 PROFICIENCY TEST SOURCING

See *ASCL-DOC-01 Quality Manual*.

7.7.8 PROFICIENCY TEST RECORDS

See *ASCL-DOC-01 Quality Manual*.

7.8 REPORTING OF RESULTS

7.8.1 GENERAL

7.8.1.1 REVIEW AND AUTHORIZATION OF REQUESTS

See *ASCL-DOC-01 Quality Manual*.

7.8.1.1.1 DOCUMENTATION

See *ASCL-DOC-01 Quality Manual*.

7.8.1.2 REPORTS

See *ASCL-DOC-01 Quality Manual*.

7.8.1.2.1 REPORT DISTRIBUTION

See *ASCL-DOC-01 Quality Manual*.

7.8.1.2.2 REPORTING PROCEDURE

Each item received will be addressed on the report, either singly or as part of a group.

When associations are made, the significance of the association shall be communicated clearly and qualified properly in the report.

When comparative examinations result in the elimination of an individual or object, the report shall clearly communicate the elimination.

When results are inconclusive, the reason shall be documented in the laboratory report.

If an initial database entry[4] is made, this shall be communicated on the report.

7.8.1.2.3 CALIBRATION

See *ASCL-DOC-01 Quality Manual*.

7.8.1.3 SIMPLIFIED REPORTING

See *ASCL-DOC-01 Quality Manual*.

7.8.2 COMMON REQUIREMENTS FOR REPORTS

See *ASCL-DOC-01 Quality Manual*.

7.8.3 SPECIFIC REQUIREMENTS FOR TEST REPORTS

See *ASCL-DOC-01 Quality Manual*.

7.8.4 SPECIFIC REQUIREMENTS FOR CALIBRATION CERTIFICATES

See *ASCL-DOC-01 Quality Manual*.

7.8.5 REPORTING SAMPLING – SPECIFIC REQUIREMENTS

See *ASCL-DOC-01 Quality Manual*.

7.8.6 REPORTING STATEMENTS OF CONFORMITY

See *ASCL-DOC-01 Quality Manual*.

7.8.7 REPORTING OPINIONS AND INTERPRETATIONS

See *ASCL-DOC-01 Quality Manual*.

[4] For example: DNA profiles, friction ridge, ballistics, biometrics

7.8.8 AMENDMENTS TO REPORTS

See *ASCL-DOC-01 Quality Manual*.

7.8.9 REPORTING GUIDELINES

The following are guidelines regarding report wording for the Firearm and Toolmark Section.

7.8.9.1 COMPARATIVE EXAMINATIONS

ASSOCIATION/ IDENTIFICATION

When associations are made, the significance of the association shall be communicated clearly and qualified properly in the report.

Criteria:

Agreement of a combination of individual characteristics and all discernable class characteristics where the extent of agreement exceeds that which can occur in the comparison of Toolmarks made by different tools and is consistent with the agreement demonstrated by Toolmarks known to have been produced by the same tool.

Range of Conclusions:

- The fired evidence in question was fired with the suspect firearm.
- The fired evidence in question was fired from the same firearm, firearm not received.
- The Toolmark evidence in question was made with the suspect tool.
- The Toolmark evidence in question was made with the same tool, tool not received.
- The evidence in question was cycled through the action of the suspect firearm.

Suggested Reporting Format:

The (item number) cartridge case was microscopically compared to cartridge cases test fired in the (item number) pistol with **POSITIVE RESULTS**. The (item number) cartridge case was fired in the (item number) pistol.

The (item numbers) bullets were microscopically compared to each other with **POSITIVE RESULTS**. The (item numbers) bullets were fired through the barrel of the same firearm.

The Toolmarks on the (item number) padlock were microscopically compared to test cuts made with the (item number) bolt cutters with **POSITIVE RESULTS**. The Toolmarks on the (item number) padlock were made by the (item number) bolt cutters.

The (item number) cartridge case was microscopically compared to cartridges cycled through the action of the (item number) pistol with **POSITIVE RESULTS**. The (item number) cartridge case was cycled through the action of the (item number) pistol.

The (item number) cartridge was microscopically compared to cartridges cycled through the action of the (item number) pistol with **POSITIVE RESULTS**. The (item number) cartridge was cycled through the action of the (item number) pistol.

ELIMINATION

When comparative examinations result in the elimination of an individual or object, the report shall clearly communicate the elimination.

Criteria:

Significant disagreement of discernable class characteristics and/or individual characteristics.

Range of Conclusions:

- The fired evidence in question was not fired with the suspect firearm.
- The fired evidence in question was not fired from the same firearm, firearm not received.
- The Toolmark evidence in question was not made with the suspect tool.
- The Toolmark evidence in question was not made with the same tool, tool not received.
- The evidence in question was not cycled through the action of the suspect firearm.

Suggested Reporting Format:

The (item number) cartridge case was **ELIMINATED** as having been fired in the (item number) pistol based on differences in class characteristics.

The (item number) cartridge case was microscopically compared to cartridge cases test fired in the (item number) pistol with **NEGATIVE RESULTS**. The (item number) cartridge case was not fired in the (item number) pistol.

The (item numbers) bullets were microscopically compared to each other with **NEGATIVE RESULTS**. The (item numbers) bullets were not fired through the barrel of the same firearm.

The Toolmarks on the (item number) padlock were microscopically compared to test cuts made with the (item number) bolt cutters with **NEGATIVE RESULTS**. The Toolmarks on the (item number) padlock were not made by the (item number) bolt cutters.

The (item number) cartridge case was microscopically compared to cartridges cycled through the action of the (item number) pistol with **NEGATIVE RESULTS**. The (item number) cartridge case was not cycled through the action of the (item number) pistol.

The (item number) cartridge was microscopically compared to cartridges cycled through the action of the (item number) pistol with **NEGATIVE RESULTS**. The (item number) cartridge was not cycled through the action of the (item number) pistol.

INCONCLUSIVE

When results are inconclusive, the reason shall be documented in the laboratory report.

Criteria:

1) Some agreement of individual characteristics and all discernable class characteristics, but insufficient for an identification.

2) Agreement of all discernable class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility.
3) Agreement of all discernable class characteristics and disagreement of individual characteristics, but insufficient for an elimination.

Range of Conclusions:

- The fired evidence in question cannot be identified or eliminated as having been fired with the suspect firearm.
- The fired evidence in question cannot be identified or eliminated as having been fired with the same firearm, firearm not submitted.
- The Toolmark evidence in question cannot be identified or eliminated as having been made with the suspect tool.
- The Toolmark evidence in question cannot be identified or eliminated as having been made with the same tool, tool not submitted.
- The evidence in question cannot be identified or eliminated as having been cycled through the action of the suspect firearm.

Suggested Reporting Format:

The (item number) cartridge case was microscopically compared to cartridge cases test fired in the (item number) pistol with **INCONCLUSIVE RESULTS**. Due to the insufficient agreement or disagreement of individual markings, the (item number) cartridge case could neither be identified nor eliminated as having been fired in the (item number) pistol.

The (item numbers) bullets were microscopically compared to each other with **INCONCLUSIVE RESULTS**. Due to limited individual characteristics, the (item numbers) bullets could neither be identified nor eliminated as having been fired through the barrel of the same firearm.

The Toolmarks on the (item number) padlock were microscopically compared to test cuts made with the (item number) bolt cutters with **INCONCLUSIVE RESULTS**. Due to the insufficient presence of individual characteristics, the Toolmarks on the (item number) padlock could neither be identified nor eliminated as having been made by the (item number) bolt cutters.

The (item number) cartridge case was microscopically compared to cartridges cycled through the action of the (item number) pistol with **INCONCLUSIVE RESULTS**. Due to the insufficient agreement or disagreement of individual markings, the (item number) cartridge case could neither be identified nor eliminated as having been cycled through the action of the (item number) pistol.

The (item number) cartridge was microscopically compared to cartridges cycled through the action of the (item number) pistol with **INCONCLUSIVE RESULTS**. Due to the insufficient agreement or disagreement of individual markings, the (item number) cartridge could neither be identified nor eliminated as having been cycled through the action of the (item number) pistol.

7.8.9.2 RANGE DETERMINATION

DETERMINED TO BE A BULLET HOLE, NO OTHER RESIDUE FOUND

Suggested Reporting Format:

The hole in the (item number) shirt was microscopically examined and chemically processed for the presence of gunshot residues. The hole in the (item number) shirt is consistent with the passage of a bullet. A pattern of gunshot residues was not found on the shirt.

PATTERN OF RESIDUES FOUND

Suggested Reporting Format:

The hole in the (item number) shirt was microscopically examined and chemically processed for the presence of gunshot residues, and a pattern of residues was found. The (item number) pistol deposits a pattern of gunshot residue consistent with that on the (item number) shirt at a distance greater than contact and less than 3 feet.

NO RESIDUES FOUND

Suggested Reporting Format:

The hole in the (item number) shirt was microscopically examined and chemically processed for the presence of gunshot residues. No residues were visualized or developed.

7.8.9.3 SERIAL NUMBER RESTORATION

COMPLETE RESTORATION

Criteria: All characters of the serial number are visible after restoration attempt.

Suggested Reporting Format:

The acid etch method was used to completely restore the serial number of the (item number) pistol to read: P123456.

PARTIAL RESTORATION

Criteria: Not all characters of the serial number are visible after restoration attempt. Unrestored characters will be represented clearly by a "?" or similar symbol.

Suggested Reporting Format:

The acid etch method was used to partially restore the serial number of the (item number) pistol to read: P1234??. (? = characters that were not raised)

UNSUCCESSFUL RESTORATION

Criteria: No characters are visible after restoration attempt.

Suggested Reporting Format:

An attempt to restore the serial number on the (item number) pistol was unsuccessful.

7.8.9.4 LENGTH EXAMINATIONS

BARREL LENGTH

Criteria:

A firearm received with a barrel length measured to be shorter than the legal length (16 inches for a rifle and 18 inches for a shotgun).

Suggested Reporting Format:

- The barrel length of the 02-AA rifle was found to be 15 1/16 inches +/- 3/16 of an inch at a coverage probability of 99.73%.

OVERALL LENGTH

Criteria:

A long gun received with an overall length measured to be shorter than the legal length (26 inches for rifles and shotguns).

Suggested Reporting Format:

The overall length of the 01-AA shotgun was found to be 25 1/16 inches +/- 4/16 of an inch at a coverage probability of 99.73%.

7.8.10 TESTIMONY GUIDELINES

The following is from Section IV of the Department of Justice's *Uniform Language for Testimony and Reports (ULTR) for the Forensic Firearms/ Toolmarks Discipline – Pattern Match Examination*[5].

- An examiner shall not assert that two toolmarks originated from the same source to the exclusion of all other sources. This may wrongly imply that a 'source identification' conclusion is based upon a statistically-derived or verified measurement or an actual comparison to all other toolmarks in the world, rather than an examiner's expert opinion.
- An examiner shall not assert that examinations conducted in the forensic firearms/toolmarks discipline are infallible or have a zero error rate.
- An examiner shall not provide a conclusion that includes a statistic or numerical degree of probability except when based on relevant and appropriate data.
- An examiner shall not cite the number of examinations conducted in the forensic firearms/toolmarks discipline performed in his or her career as a direct measure for the accuracy of a proffered conclusion. An examiner may cite the number of examinations conducted in the forensic firearms/toolmarks discipline performed in his or her career for the purpose of establishing, defending, or describing his or her qualifications or experience.
- An examiner shall not use the expressions 'reasonable degree of scientific certainty,' 'reasonable scientific certainty,' or similar assertions of reasonable certainty in either reports or testimony unless required to do so by a judge or applicable law.

[5] Reference: Department of Justice. *Uniform Language for Testimony and Reports for the Forensic Firearms/ Toolmarks Discipline – Pattern Match Examination*. Effective Date: 01/24/2019

7.9 COMPLAINTS

See *ASCL-DOC-01 Quality Manual*.

7.10 NONCONFORMING WORK

See *ASCL-DOC-01 Quality Manual*.

7.11 CONTROL OF DATA AND INFORMATION MANAGEMENT

See *ASCL-DOC-01 Quality Manual*.

8 MANAGEMENT SYSTEM REQUIREMENTS

8.1 OPTIONS

See *ASCL-DOC-01 Quality Manual*.

8.2 MANAGEMENT SYSTEM DOCUMENTATION (OPTION A)

The Firearm and Toolmark Quality Manual is located on Qualtrax.

The Firearm and Toolmark Quality Manual will be reviewed annually by the Chief Firearm and Toolmark Examiner and the Firearm and Toolmark Quality Manager. This annual review will be documented in Qualtrax.

See *ASCL-DOC-01 Quality Manual*.

8.3 CONTROL OF MANAGEMENT SYSTEM DOCUMENTS (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

8.3.1 CONTROLLED DOCUMENTS

See *ASCL-DOC-01 Quality Manual*.

8.3.2 CONTROLLED DOCUMENT POLICIES AND PROCEDURES

See *ASCL-DOC-01 Quality Manual*.

CONTROL OF EXTERNAL DOCUMENTS

Any external documents (i.e. reference material, computer software) will be available in the main room of the Firearm and Toolmark Section or on the S:drive.

8.4 CONTROL OF RECORDS (OPTION A)

8.4.1 RECORDS

The Firearm and Toolmark Section's quality records, such as the Chemicals and Reagents Log, will be stored in the discipline and accessible to employees in the discipline.

The unique identifier for the instruments/equipment used during analysis shall be recorded in the case record.

See *ASCL-DOC-01 Quality Manual*.

8.4.2 RECORD POLICIES AND PROCEDURES

8.4.2.1 RECORD RETENTION

See *ASCL-DOC-01 Quality Manual*.

8.4.2.2 CONFIDENTIALITY

Investigative information on a particular item may not be released until after a verification has been completed.

See *ASCL-DOC-01 Quality Manual*.

8.5 ACTIONS TO ADDRESS RISKS AND OPORTUNITIES (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

8.6 IMPROVEMENT (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

8.7 CORRECTIVE ACTIONS (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

8.8 INTERNAL AUDITS (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

8.9 MANAGEMENT REVIEW (OPTION A)

See *ASCL-DOC-01 Quality Manual*.

9 TEST METHODS

9.1 GENERAL

This section provides standard procedures for tests and examinations performed by the Firearm and Toolmark Examiner. These procedures may involve hazardous materials, operations and equipment. These procedures do not purport to address all of the safety problems associated with their use. It is the responsibility of the user of these procedures to establish appropriate safety and health practices and determine the applicability and normal limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered (see *ASCL-DOC-08 Health and Safety Manual* for safety requirements). Personal protective equipment includes, but is not limited to: lab coats, latex or nitrile gloves, safety glasses, and hearing protection devices. Proper caution should include strict adherence to the *ASCL-DOC-08 Health and Safety Manual*.

The ASCL shall use test methods that meet the needs of the customer and are appropriate for the tests undertaken. The most current version of the method must be documented and readily available to the analyst for reference unless it is not appropriate or possible to do so. See the *ASCL-DOC-01 Quality Manual* for information on validation of methods.

9.1.1 SAFETY CONSIDERATIONS

Examinations performed in the Firearm and Toolmark Section are inherently dangerous. These procedures may also involve hazardous materials, including evidence that may be contaminated with a biohazard. These procedures do not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

- Proper caution to include strict adherence to the Biological Hygiene Plan in the *ASCL-DOC-08 Health and Safety Manual* must be exercised.
- The use of personal protective equipment must be considered to avoid exposure to any potential hazards.
- If needed, consult the appropriate Material Safety Data Sheet (MSDS) for each chemical.

9.1.2 EXAMINATION DOCUMENTATION

Examination documentation must adhere to the requirements described in the *ASCL-DOC-01 Quality Manual*. Appropriate notes should be taken that would allow another examiner to review and interpret the data and come to the same conclusions as well as to be to repeat analysis in conditions as close to the original as possible. Notes should be documented on the appropriate worksheet found either in Qualtrax or JusticeTrax®.

9.1.3 TRACE MATERIAL EXAMINATION

Firearms, tools and other firearm and Toolmark related evidence items recovered during an investigation may contain trace material transferred from the crime scene. This trace material may be in the form of blood, tissue, plaster, paint, hairs, fibers, glass, etc. The examiner should:

- Examine the submitted evidence visually and microscopically for any trace material. Any trace material observed should be recorded in the notes.
- When appropriate, the examiner should consider contacting the Physical Evidence Section to determine if further examination of trace material is necessary.
- The trace material can be collected by the firearm examiner or personnel from the Physical Evidence Section. The following steps should be followed when the firearm examiner is removing the trace evidence:
  - Remove material with care not to damage the evidence.
  - Place the removed trace material in a suitable container/packaging.
  - Transfer the trace material to the appropriate section or storage location.
- If the trace material is not going to be retained for further examination, proceed with the following steps as applicable:
  - For evidence containing blood, tissue or other biohazards, soak the evidence for at least one (1) minute in a 10% bleach solution.
  - Remove loose material by rinsing the fired evidence with methanol or water.
  - Remove plaster by rinsing the fired evidence with methanol or water.
  - Remove paint by soaking the fired evidence in methanol or acetone. Use CAUTION with plastics.

9.1.4 COLLECTION OF DNA SWABS

Collection of transfer DNA swabs from evidence items will be conducted as requested or as deemed necessary by the firearm examiner. When appropriate, the examiner should consider contacting the Physical Evidence Section to determine if further examination of the DNA is necessary.

- Wear gloves and a mask, if necessary, to prevent contamination of the evidence item.
- After swabs have been obtained, evidence may be handled according to labwide personal protective equipment requirements (see Appendix D of the *ASCL-DOC-08 Health and Safety Manual*).
- Clean the work area with 10% bleach solution.
- Alternatively, the evidence item may be kept in its container, rather than placed on the countertop, during the swabbing process.
- Lay down clean paper.
- Lightly moisten a swab with distilled water.
- Swab surfaces of the evidence item that are likely to have DNA.
- Use as few swabs as possible to concentrate the DNA obtained.
- Dry the swabs, and then package the swabs in an envelope.

In JusticeTrax®, itemize and de-containerize an envelope under the parent item to hold the swab envelopes. Then, individually itemize the swab envelopes under the evidence item and show their location as being in the de-containerized envelope.

Swabs will be stored temporarily in the secure Firearm and Toolmark Section DNA Storage Area. The swabs will be transferred as needed to the Physical Evidence Section for long term storage.

The item number of the evidence and a description of areas swabbed should be included on the inner packaging for that swab. Any swabs taken from an item of evidence will be documented in the examination notes for that item as well as on the report.

9.1.5 TEST FIRING AND THE RECOVERY OF TEST FIRES

In order to perform a microscopic comparison of a submitted firearm, a minimum of two (2) test shots should be fired and recovered. If the firearm is capable of firing both single and double action modes, a minimum of one (1) shot per mode should be obtained. The examiner should consider indexing and sequencing each shot and perform these functions if necessary. The examiner should consider the number of cartridges being loaded into the firearm during the initial testing of the firearm.

Proper hearing and eye protection must be worn during all test firing. Proper safe firearm practices will be conducted during all test firing. All exhaust fans should be turned on and all warning systems activated prior to test firing.

Test fired bullet and cartridge case samples are to be treated as evidence. The test fired bullet and cartridge case samples will be itemized separate from the firearm and decontainerized so as to have their own chain of custody. At the completion of a case, the test fired bullet and cartridge case samples will be transferred in "FA Short Term TF Storage" and stored in a sealed condition.

Archived material will be stored in a secure area in the ASCL Annex. These archived test fired bullet and cartridge case samples will be transferred into "FA Long Term TF Storage" at this time.

A test fire information card will be filled out to include the ASCL case #, item # and identifying information (if available) for the test firearm. The test fire information card will be stored with the test fired bullets and cartridge cases.

The examiner should consider marking the bullet and cartridge case of each test shot with the:

- Full or abbreviated laboratory case number and
- Full or abbreviated item number and/or
- Examiner's initials

Discharged bullets and ejected discharged cartridge cases **must** be retrieved before the next firearm can be fired into the water tank.

Test firing can take place in the water tank, indoor range, and with the use of the cotton waste recover box. The type of firearm and ammunition tested will usually dictate the type of recovery method used.

9.1.5.1 WATER TANK RECOVERY

The water recovery tank is used to recover bullets from handguns, rifles and slugs fired from shotguns. One should be aware of the maximum velocity of the projectile that can be fired into a

particular water tank, as well as the proper water depth needed for firing. The subsequent steps should be followed when using the water tank:

- Ensure that the water level is appropriate.
- Ensure that all lids or doors of the water recovery tank are closed and properly secured.
- Fire the firearm through the shooting port.
- Recover the bullets using the vacuum tube.

9.1.5.2 COTTON WASTE RECOVERY BOX

The cotton waste recovery box is usually used to recover bullets from handguns, rifles and slugs fired from shotguns. One should be aware of the maximum velocity of the projectile that can be fired into a particular cotton waste recovery box.

- The examiner should consider wetting the first section of cotton in the box.
- The examiner should consider the placement of paper partitions at various points in box to ensure tracking of the test shot, as well as insuring that the cotton is packed down so as not to retain previous bullet paths.
- Ensure that the lids of the boxes are closed and properly secured.
- Bullets should be recovered by searching through cotton, using partitions as guides.

9.1.5.3 INDOOR FIRING RANGE

The indoor firing range is usually used to test fire firearms when the recovery of the fired projectile(s) is not necessary.

The examiner should check the range to make sure no materials are left behind.

9.1.5.4 DOWNLOADING

Due to the limitations of the Firearm and Toolmark Section's bullet recovery devices, it may be necessary to reduce or change the powder load of the cartridge in order to obtain a velocity suitable for safely collecting test standards for comparison purposes. Even with a reduced load, it may be necessary to fire the firearm remotely. The following steps should be followed when downloading:

- Pull the bullet of the cartridge using an inertia bullet puller or a reloading press.
- Remove existing powder.
- Weigh the pulled bullet.
- Consult a reloading manual, such as Lyman, and obtain the powder charge for the weight of the pulled bullet and the new velocity needed.
- Weigh out the appropriate powder charge and place in existing cartridge case.
- Loosely pack a small piece of tissue or other similar material into the case to fill the gap between the bullet and powder.
- Seat the bullet back into the cartridge case using a rubber mallet or a reloading press.

- If appropriate powder is not available, a reduced load using 50% of the original powder can be used. It should be noted that great care must be taken when performing this type of downloading. 50% downloading CANNOT be used with slow burning powders. 50% downloading CANNOT be used with many non-canister powders.
- When utilizing downloaded ammunition it is imperative that the examiner checks the barrel for obstructions between each firing. The bullet, cartridge case, or shotshell of each test shot should be marked appropriately.

9.1.5.5 PRIMED CARTRIDGE CASE/SHOTSHELL

During the course of examining a firearm, it may be determined that it would be unsafe for the examiner to fire the firearm as designed. If it is not necessary to obtain test standards for comparison purposes, the firing condition of the firearm can be tested using a primed empty cartridge case or shotshell.

The following steps should be followed to obtain a primed round:

- Obtain a primed empty cartridge case in the desired caliber or pull the bullet of a live cartridge using an inertia bullet puller or reloading press, retaining only the primed cartridge case.
  - For shotguns, obtain a primed empty shotshell in the desired gauge or cut open a live shotshell removing all components, retaining only the primed shotshell. Commercial firing pin testing devices are available for shotguns and may be used.

Testing will occur in the water tank room or the indoor firing range and the test firing procedures from § 9.1.5 of the *Firearm and Toolmark Quality Manual* will be followed. The following additional steps should be considered:

- Load the primed empty cartridge case, primed empty shotshell or commercial firing pin testing device into the chamber of the firearm and test fire in front of the bullet trap.
- When utilizing a primed empty it is imperative that the examiner check the barrel for obstructions between each firing.
- Repeat if the firearm has more than one action.
- Obtain all tests.

9.2 PHYSICAL EXAMINATION AND CLASSIFICATION OF FIREARMS

9.2.1 INTRODUCTION

This section describes the general guidelines for the examination and classification of firearms received as evidence in the Firearm and Toolmark Section. Firearms evidence in the laboratory environment must be handled correctly and treated with respect. Occasionally, loaded firearms are received in evidence for a particular examination. These, of course, need very special handling. <u>All firearms must be treated as though they are loaded</u>. This rule cannot be over stressed and must be followed at all times, whether it's in the evidence receiving area, Firearm and Toolmark Section, test

firing area, or in court. Safe firearm handling within the laboratory environment corresponds with safe firearm handling in general. The only way to prevent accidents is to practice safety at all times.

9.2.2 INSTRUMENTATION/ EQUIPMENT

- As appropriate for length measurements: Ruler (and/or) Tape Measurer (and/or) Non-Marring dowel
- Balance/ Scale
- Stereo Microscope
- Mallet

9.2.3 PREPARATION

- 10% Bleach Solution
  - Prepare the bleach solution by combining 10 milliliters of bleach to 90 milliliters of water.

9.2.4 CASE MANAGEMENT GUIDELINES

- Trigger pull measurements are not conducted.

9.2.5 PROCEDURE OR ANALYSIS

A systematic approach should be used for the physical examination and classification of any firearm. All observations and findings should be documented in the appropriate worksheet.

Test fires will be marked in such a way as to protect characteristics which may be used for comparison microscopic examination (chamber marks) and in accordance with the *ASCL-DOC-01 Quality Manual*.

9.2.5.1 SAFE FIREARM HANDLING

- The muzzle of the firearm must always be pointed in a safe direction.
- Prior to any examination, regardless of which section is receiving the firearm, a competent individual must ascertain the loaded or unloaded condition of the firearm. This process must be accomplished before the firearm is received by the laboratory.
- Test firing or any examination of the firearm that utilizes live ammunition, or a live ammunition component, will only be performed in designated test firing areas.
- A firearm will not be placed in the evidence vault or returned to any agency in either a loaded condition or prior to its loaded or unloaded condition being checked.

9.2.5.2 GENERAL, VISUAL, AND PHYSICAL EXAMINATION

The initial examination of any firearm will include the completion of the Firearm worksheet. This worksheet will include a physical description, the manufacture data, if available, of the firearm and will serve as a source to document the condition of the firearm as received and any tests or

comparisons performed. All observations and findings should be documented in the firearms worksheet.

The firearms worksheet may also include determining the following when appropriate:

- If any trace material present
- Location and type of trace evidence
- Caliber/gauge
- Make/model
- Serial number
- Firing mechanics
- Type of action
- Safeties
- Operating condition
- Rifling characteristics
- Barrel length
- Overall length

9.2.5.3 PRE-FIRING SAFETY EXAMINATION

It is the responsibility of the firearm examiner to ensure that all appropriate safety checks are performed on a firearm or item of ammunition prior to test firing. The following is a list of safety checks, which shall be considered during the initial visual examination. The examiner must be mindful that individual case situations may require a more extensive evaluation process than that which is listed here.

- Decide whether or not a firearm can be safely test fired from the normal hand held position:
  - Is the chamber/bore clear?
  - Are there any signs of cracks or weaknesses in major parts of the firearm; such as the frame, slide or barrel?
  - Does the firearm function, lock-up or dry fire as you would expect it to?
  - Is the <u>correct</u> ammunition being utilized?
- Decide whether it is appropriate to utilize the evidence ammunition:
  - Are there signs of reloading? If so, reconsider the need to test fire the evidence ammunition.
  - Are there splits in the cartridge case neck and/or other significant damage to the cartridge case?
  - Is the ammunition of the <u>correct</u> caliber? This assessment of caliber cannot be based only on the headstamp.
  - Are there existing Toolmarks on pertinent surfaces of the ammunition?
  - Is the ammunition needed for other tests; i.e., range determinations?
- Decide whether or not a Muzzle Loading firearm can be safely test fired from the normal hand held position:
  - Does the chamber/barrel appear sound?

- Do the percussion nipples have oversized flash holes?
- If a black powder firearm is received in the loaded condition, it must have the bullet and charge removed. It may then be properly loaded prior to test firing.
- Is this an "original" muzzleloader or a modern reproduction? "Originals" must always be remote fired.

9.2.5.3.1 INTERPRETATION OF RESULTS

If any of the above considerations cannot be answered with a clear "yes" or otherwise rectified and test firing is necessary, that firearm must be remote fired.

9.2.5.4 BARREL AND OVERALL LENGTH MEASUREMENT OF A FIREARM

Barrel length is defined as the distance between the muzzle end of the barrel and the face of the closed breechblock or bolt for firearms other than revolvers. For revolvers, it is the overall length of the barrel including the threaded portion within the frame. Barrel length normally should include compensators, flash hiders, etc., if permanently affixed.

Overall length of a firearm is defined as the dimension measured parallel to the axis of the bore from muzzle to a line at right angles to the axis and tangent at the rearmost point of the butt plate or grip. Removable barrel extensions, poly chokes, flash hiders, etc., are not part of the measured barrel length or overall length.

Care must be taken if any object is placed down the barrel to help expedite the measurement. Only a non-marring item may be placed down the barrel.

9.2.5.4.1 PROCEDURE

REVOLVERS

Measure the distance from the breech end of the barrel to the muzzle, excluding the cylinder. This measurement can be done directly or by placing a non-marring item down the barrel, marking the distance from the breech end of the barrel to the muzzle and measuring this item.

FIREARMS OTHER THAN REVOLVERS

Measure the distance from the breech face in a closed and locked position to the muzzle. This measurement can be done directly or by placing a non-marring item down the barrel, marking the distance from the breech end of the barrel to the muzzle and measuring this item.

OVERALL LENGTH

Measure the distance from the butt to the muzzle if the firearm. Measurement shall be made parallel to the bore.

9.2.5.4.2 INTERPRETATION OF RESULTS

When a firearm is received with its barrel cut-off or length shortened in any manner, it will be measured and recorded on the firearm's worksheet. If the barrel is shorter than the legal length (16 inches for a rifle and 18 inches for a shotgun) the barrel length will be documented on the report.

When a long gun is received with its barrel and/or stock cut-off or overall length shortened in any manner, the overall length will be measured and recorded on the firearm's worksheet. If the overall length of the firearm is shorter than the legal length (less than 26 inches for rifles and shotguns) the overall length will be documented on the report.

If the barrel or stock of a firearm has not been altered in any way it is the examiner's discretion whether or not to record the barrel or overall lengths.

Measurements will be recorded in inches and will be reported to the nearest 1/16th of an inch. If the measurement is between two hash marks on the ruler, the measurement will be rounded up.

The ruler used will be documented in the notes.

9.2.5.4.3 REPORTING THE UNCERTAINTY OF MEASUREMENT – FIREARM LENGTH MEASUREMENTS

The estimation of uncertainty will be reported when a barrel or overall length is reported and will be expressed as an expanded uncertainty and include the coverage factor.

All lengths will be reported in 1/16th of an inch. The units of the measurement result and the estimated uncertainty must be the same. All lengths will also be reported at the 99.73% coverage probability.

REPORTING EXAMPLE

The overall length of the 01-AA shotgun was found to be 25 1/16 inches +/- 5/16 of an inch at a coverage probability of 99.73%.

The barrel length of the 02-AA rifle was found to be 15 1/16 inches +/- 4/16 of an inch at a coverage probability of 99.73%.

9.2.5.5 MALFUNCTIONING FIREARM/ OPERABILITY TESTING

A firearms examiner may be called upon to examine a firearm to determine if the firearm will malfunction. Many of these cases will deal with the question: "Will the firearm fire without pulling the trigger?" The examiner should attempt to conduct his/her examinations in a manner so as not to alter the firearm. However, there may be occasions when damage may occur and any change to the firearm must be specifically documented in the examiner's notes.

Malfunctioning Firearm/ Operability Testing should include the following, when appropriate, and be documented in the examiners notes and the results included on the report:

- Visual and physical examination of the firearm. Any observations should be noted, including the functionality of the safeties.
- If possible and safe, test firing of the firearm and any malfunctions should be noted.
- Impact Test
- Push Off Test

9.2.5.5.1 VISUAL AND PHYSICAL EXAMINATION OF FIREARM

No one procedure can sufficiently outline the steps necessary to examine all firearms for any malfunction. However, the following list of examinations should serve as a guideline for the examiner. Any damage, abnormalities, or other issues observed during the examiner's examination should be documented.

- Condition as Received:
  - Cocked/uncocked
  - Safety position
  - Loaded/unloaded
  - Cartridge position
  - Stuck cartridges/discharged cartridge cases
  - Presence and/or location of flare marks
- Visual Abnormalities:
  - Barrel (loose, bulges etc.)
  - Receiver (condition)
  - Slide (condition)
  - Parts broken or missing, in particular:
    - the firing pin
    - the ejector
    - the extractor
  - Screws (loose or missing)
  - Alterations or adaptations
  - Sights (loose or missing)
- Action (External):
  - Relationships of the action parts
  - Correct assembly
  - The proper locking of the action on closing
    - For revolvers:
      - Cylinder rotation (securely locks)
      - Hand relationship to the ratchet (worn)
  - Trigger pull type (single action, double action) and striking of hammer.
- Action (Internal):
  - Hammer notch condition (worn, burrs, dirt, etc.)
  - Sear condition (worn, burrs, dirt, etc.)
- Safeties (relationships and general parts relationship)
  - Condition (any signs of alteration, tampering, or faulty assembly, etc.)
  - Evaluate the functionality of the firearm's safety or safeties
    - Drop hammer several times to check the following safeties
    - ¼ , ½ , Full Cock, Seating check (any false seating positions, pull off/push off, etc.)
    - Grip, magazine, disconnector
    - Thumb/Finger – note positions when firearm will fire

    - Rebound hammer or inertia firing pin
    - Position of the slide or bolt in order to fire
- Action Check:
  - Check feeding (Magazine, carrier or lifter, feed ramp, magazine lips, etc.)
  - Check for possibilities of slam fire
  - Check for unusual marks exhibited on the cartridges/discharged cartridge cases.
  - Check for any inherent "quirks" known about the particular firearm based on literature or case data
- Test Fire Firearm (also see § 9.1.5 of the Firearm and Toolmark Section Manual):
  - Note any operational problems

9.2.5.5.1.1 INTERPRETATION OF RESULTS

The operation of the firearm during test firing and the functionality of the safeties should be documented. Any abnormalities or damage observed should also be documented when appropriate.

9.2.5.5.2 IMPACT TEST

A mallet is used to strike the firearm in various locations (ex: frame, slide, back strap area) while in a cocked position in an attempt to determine if impact will cause the firearm to discharge. The impact test is normally conducted after the firearm has been successfully test fired. The cocked external hammer should not be directly struck. There is a remote possibility that the firearm may be damaged during this examination.

9.2.5.5.2.1 INTERPRETATION OF RESULTS

Whether or not the firearm could be discharged by striking various surfaces of the firearm should be documented.

9.2.5.5.3 PUSH-OFF TEST

This test is to be performed on single action firearms. Hand pressure is applied to the hammer or hammer area of a cocked firearm in order to determine if the hammer will fall. The push-off test is normally conducted after the firearm has been successfully test fired. There is a remote possibility that the firearm may be damaged during this examination.

9.2.5.5.3.1 INTERPRETATION OF RESULTS

Whether or not the hammer of the firearm could be made to fall by pushing on the hammer area should be documented.

9.2.5.6 RUSTY FIREARM EXAMINATION

Rusty firearms or those found in water, etc. may be submitted for examination. Immediate attention must be given to these firearms to prevent further damage to the firearm.

For firearms found in water, the examiner should instruct the submitting agency to submit the firearm in a container of the fluid in which the firearm was recovered. If this is not practical, the

agency can be instructed to immediately and thoroughly spray the firearm with a water-displacing product such as WD-40® or other similar product to prevent further deterioration.

It should be noted that the firearm might be too rusted to be functional. An examiner must take all necessary steps to ensure that the firearm is unloaded. Any firearm that cannot be unloaded upon submission to the laboratory should be examined further in the Firearm and Toolmark Section and, if necessary, in an area designated for the firing of firearms. Determining whether or not a firearm is unloaded may necessitate a complete disassembly or in some cases, destruction (i.e., cutting).

The examiner must determine to what extent restoring the firearm is necessary (i.e., for test firing, for recovering manufacturer information, serial number, etc.). The following guidelines should be considered when restoring a rusted firearm:

- Soak the firearm in penetrating oil, de-rusting solvents or similar material.
- Periodically check the firearm until the firearm functions, or the desired information is recovered.
- Clean the firearm with gun cleaning solvent, cleaning patches and cloth. Care must be taken if any object is placed down the barrel. Only a non-marring item should be placed down the barrel.
- Record findings and/or observations on the firearms worksheet.

9.2.5.7 SOUND SUPPRESSOR EXAMINATION

A silencer or sound suppressor is any device attached to the barrel of a firearm designed to reduce the noise of discharge. Silencers can be commercially produced or homemade. They are typically tubular metal devices, but may vary in shape or form. The following guidelines should be considered when examining a silencer or sound suppressor:

- Examine device to determine if it is, or is characteristic of, a silencer or sound suppression device.
- Examiner will document and record his/her findings.
- After an initial examination, a report can be issued that the device is, or is characteristic of, a silencer or sound suppression device.
- Testing of a firearm and firearm/silencer combination must be conducted in an appropriate setting, usually a range.

In many instances the noticeable reduction in sound between the firing of the firearm with the device attached versus the firing of the firearm without the device is sufficient to determine that the device is a sound suppressor.

9.2.6 REFERENCES

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9.3 PHYSICAL EXAMINATION AND CLASSIFICATION OF FIRED PROJECTILES

9.3.1 INTRODUCTION

This section describes the general guidelines for the examination and classification of fired bullets, slugs and shotshell pellets. The evidence will be marked in such a way as to protect characteristics which may be used for comparison microscopic examination and in accordance with the *ASCL-DOC-01 Quality Manual*.

9.3.2 INSTRUMENTATION/ EQUIPMENT

- Comparison Microscope
- Stereo Microscope
- Caliper
- Scale/Balance
- Micrometer

9.3.3 PREPARATION

- 10% Bleach Solution
  - Prepare the bleach solution by combining 10 milliliters of bleach to 90 milliliters of water.

9.3.4 CASE MANAGEMENT GUIDELINES

None

9.3.5 PROCEDURE OR ANALYSIS

A systematic approach should be used for the physical examination and classification of fired projectile evidence. All observations and findings should be documented in the appropriate worksheet.

9.3.5.1 FIRED BULLET AND SLUG EVIDENCE

9.3.5.1.1 GENERAL, PHYSICAL, AND VISUAL EXAMINATION

The initial examination of any fired bullet/slug evidence will include the completion of a Bullet or Shotshell Component worksheet. These worksheets will include the physical description of the fired evidence and will serve as a source to document the condition of the evidence as received and any tests or comparisons performed.

All observations and findings should be documented in the appropriate worksheet and may also include determining the following when appropriate:

- If any trace material is present
- The caliber
- The bullet/slug weight should be measured in grains
- The number of lands and grooves on a fired bullet
- The direction of twist
- The measured width of the land impressions
- The measured width of the groove impressions
- The composition of the bullet/slug
- The bullet style
- The possible manufacturer/marketer of the bullet/slug/projectile
- A description of the base of the bullet
- The type and position of cannelures
- Any extraneous markings to include:
  - Skid marks
  - Shave marks
  - Flared base
  - Other marks
- The presence of gunpowder and/or powder imprints adhering to the base
- The condition of the fired evidence as received
- The suitability of the fired evidence for comparison purposes

9.3.5.1.2 CALIBER DETERMINATION

Caliber, or the base diameter, is one of the class characteristics of a fired bullet. The determination of caliber will aid the examiner during the identification or elimination of a suspect firearm. If no firearm is submitted, the bullet's caliber may be used in determining the general rifling characteristics of the firearm involved.

The following may be utilized to determine the caliber of any fired bullet. The condition of the bullet will determine which steps can be used.

- Measure the base diameter of the evidence bullet using a measuring device and compare this measurement with known measurements published in reference literature.
- Compare the base diameter of the evidence bullet directly with known fired test standards.

Determine the number and the widths of the land and groove impressions (see § 9.3.5.1.3 of the *Firearm and Toolmark Quality Manual*) and compare to Table 8 in §13 of the Association of Firearm and Toolmark Examiners (AFTE) Glossary (6th Edition) to find the corresponding diameter.

- Physical characteristics of the evidence bullet, such as weight, bullet shape, composition, nose configuration, and number and placement of cannelures, may aid in caliber determination.

9.3.5.1.2.1 INTERPRETATION OF RESULTS

Caliber is written as a numerical term and will be depicted with the decimal point when applicable. If the base is mutilated, the examiner may only be able to determine that the evidence is consistent with a range of calibers or that the caliber cannot be determined.

9.3.5.1.3 MEASURING LAND IMPRESSION AND GROOVE IMPRESSION WIDTHS

Another class characteristics used in the discipline of firearms identification is the width of the land impressions and groove impressions. These measurements aid the examiner during the identification or elimination of a suspect firearm. If no firearm is submitted, these measurements will be used in determining the General Rifling Characteristics of the firearm involved. The comparison microscopes have specific software for measurements. The air gap method utilizes a comparison microscope and a micrometer.

In measuring a fired bullet to determine the width of the land impression or the groove impression, it is paramount that the points used for beginning and ending a measurement comply with the discipline-wide practice. This practice utilizes the anchor points shown below in Figure 1.

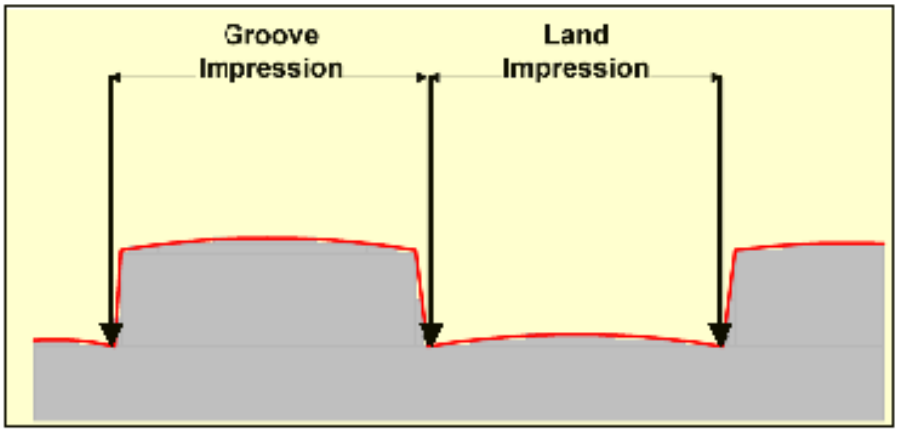

Figure 1: Anchor points of Land and Groove Impressions

The following techniques can be used to measure land and groove impression widths:

- Comparison Microscope using Software
  - The fired bullet in question is mounted using the microscope bullet holder.
  - The operating instructions for the microscope being used to measure land and groove impression widths should be followed.
  - Measure the distance between both anchor points of a land impression using the comparison microscope's software and record the measurement to the nearest hundredth or thousandth of an inch.
  - Repeat the above utilizing the groove impression.
- Air Gap Method
  - The fired bullet in question is mounted on one stage of the comparison microscope. The micrometer is mounted on the other stage.
  - Both stages must be using the same magnification level (objective setting) and be in focus.
  - Align the image of the measurement gap (opening) of the micrometer with the image of the appropriate land impression being measured and record the measurement to the nearest hundredth or thousandth of an inch.
  - Repeat the above utilizing the groove impression.
- Stereo Microscope with a caliper
  - The fired bullet in question is either held or mounted on a steady surface beneath the stereo microscope.
  - Measure the distance between both anchor points of a land impression using calipers and record the measurement to the nearest hundredth or thousandth of an inch.
  - Repeat the above utilizing the groove impression.

9.3.5.1.3.1 INTERPRETATION OF RESULTS

It may be necessary to measure several of the suitable land and groove impressions in order to obtain a reliable measurement. At a minimum, one land impression measurement and one groove

impression measurement, recorded to the nearest hundredth or thousandth of an inch, should be recorded in the notes for the examined bullet.

For multiple bullets previously identified as having been fired from the same firearm, or found to have the same class characteristics, the land and groove impression widths of only one bullet need to be measured.

9.3.5.1.4 GRC DATABASE UTILIZATION

The caliber and rifling characteristics of an evidence bullet can be utilized in an attempt to generate a list of possible firearms that could have fired the evidence bullet. This can be used when no firearm has been submitted for comparison to the evidence bullet(s). Various databases can be used to obtain this list and should be referenced appropriately in the examination notes.

9.3.5.1.4.1 INTERPRETATION OF RESULTS

This list of possible firearms is an investigative aid and should not be construed as an all-inclusive list of firearms available with those particular rifling characteristics. Information obtained from a GRC database will be included in the report as found appropriate.

9.3.5.2 SHOTSHELL PELLETS

9.3.5.2.1 GENERAL, PHYSICAL, AND VISUAL EXAMINATION

The initial examination of any shotshell pellet evidence will include the completion of a Shotshell Component worksheet. This worksheet will include the physical description of the fired evidence and will serve as a source to document the condition of the evidence as received and any tests or comparisons performed.

All observations and findings should be documented in the appropriate worksheet and may also include determining the following when appropriate:

- Determine the total number of pellets received.
- Determine the composition of the pellets.
- The condition in which the pellets were received.
- The weight and diameter of the pellets.

9.3.5.2.2 SHOT SIZE DETERMINATION

By examining recovered shotshell pellets, the examiner may be able to determine the actual shot size. The determined size can then be compared to the shot size loaded in submitted live shotshells or to the size that the submitted discharged shotshell was marked to have contained.

The examiner may use one or all of the below techniques to determine shot size:

- Visual/Microscopic Comparison

- Determine the number of pellets suitable for comparison purposes. Make note if pellet sizes all appear to be similar in size. If several different sizes are present, determine each specific size.
- Compare laboratory standards of known shot sizes side by side with the evidence pellets until a known shot size is determined. A stereo microscope may aid in this determination.
- Record findings on worksheet.

- Comparison by Weight
  - Determine the number of pellets suitable for weighing. Make note if pellet sizes all appear similar. If several sizes present, determine each specific size.
  - Weigh the pellets in grains.
  - Divide weight of pellets by total number weighed if multiple pellets are weighted together.
  - Consult known pellet weights in Table 1 and Table 2 of §13 of the AFTE Glossary (6th Edition) and determine shot size, which corresponds to evidence shot.
  - The weight of the evidence pellets can also be directly compared to weight of standards using the same number of pellets until a similar known weight is obtained.
- Measuring Pellet Size
  - Determine the number of pellets suitable for comparison purposes. Make note if pellet sizes all appear similar. If several sizes present, determine each specific size.
  - Choose the best specimen and measure diameter using a caliper and record in hundredths or thousandths of an inch or the appropriate measurement.
  - Consult known pellet sizes in Table 1 and Table 2 of §13 of the AFTE Glossary (6th Edition) and determine shot size, which corresponds to evidence shot.

9.3.5.2.3 INTERPRETATION OF RESULTS

It may be possible to determine the shot size and composition of the pellets. Record results on worksheet. If the pellets are mutilated, the examiner may only be able to determine that the evidence is consistent with a range of shot sizes or that the shot size cannot be determined.

9.3.6 REFERENCES

- Association of Firearm and Toolmark Examiners Glossary, 6th Edition, 2013.
- Barnes, Frank C., Cartridges of the World, 12th Edition, 2009.
- Howe, Walter, J., “Laboratory Work Sheets” AFTE Newsletter, 1969, Vol. 1, No. NL02, p. 12.
- Leica FSC Operating Manual.
- Leica UFM-4 Operating Manual.
- Leica Application Suite Software.
- Lutz, Monty C. and Ward, John G., "Determination of Bullet Caliber From an X-ray," AFTE Journal, 1989, Vol. 21, No. 2, p. 168.
- Mathews, J. Howard, Firearms Identification, Vol. I, 1962.
- Molnar, S., “A Simplified Technique for L&G Measurement – Twist Rate”, AFTE Newsletter, 1969, Vol. 1, No. NL04, p. 28.
- SPOT Operating Manual by Diagnostic Instruments.

- U.S. Department of Justice, Federal Bureau of Investigation, NCIC, Criminalistics Laboratory Information System (CLIS) Operating Manual, 1978.
- Walsh, J. F., "Accuracy, Speed and Conversion in Rifling Measurements", AFTE Journal, 1977, Vol. 9, No. 1, p. 50.

9.4 PHYSICAL EXAMINATION AND CLASSIFICATION OF FIRED CARTRIDGE CASES AND LOADED CARTRIDGES

9.4.1 INTRODUCTION

This section covers the general guidelines for examination and classification of fired cartridge case and loaded cartridge evidence. The evidence will be marked in such a way as to protect characteristics which may be used for comparison microscopic examination (chamber marks) and in accordance with the *ASCL-DOC-01 Quality Manual*.

9.4.2 INSTRUMENTATION/ EQUIPMENT

- Comparison Microscope
- Stereo Microscope

9.4.3 PREPARATION

- 10% Bleach Solution
  - Prepare the bleach solution by combining 10 milliliters of bleach to 90 milliliters of water.

9.4.4 CASE MANAGEMENT GUIDELINES

- The possible make or model of firearm that may have fired an expended cartridge case will not be reported.

9.4.5 PROCEDURE OR ANALYSIS

A systematic approach should be used for the physical examination and classification of fired cartridge case and loaded cartridge evidence. All observations and findings should be documented in the appropriate worksheet

9.4.5.1 FIRED CARTRIDGE CASES

The initial examination of any expended cartridge case evidence will include the completion of an Expended Cartridge Case worksheet. These worksheets will include the physical description of the fired evidence and will serve as a source to document the condition of the evidence as received and any tests or comparisons performed

9.4.5.1.1 GENERAL, PHYSICAL, AND VISUAL EXAMINATION

The following should be considered:

- If any trace material present
- Caliber
- The possible manufacturer/marketer of the item
- Ignition System
  - Centerfire
  - Rimfire
- Other
- Shape of cartridge case
- Description of cartridge case and primer
- Description of head stamp
- Description of firing pin impression
- Description of other markings, to include:
  - Breech face markings
  - Extractor
  - Ejector
  - Resizing marks
  - Chamber or cycling marks
  - Anvil marks
  - Magazine marks
  - Ejection port markings
  - Other marks

9.4.5.1.1.1 INTERPRETATION OF RESULTS

Markings on the fired cartridge case should be examined and, as appropriate, compared to tests from a firearm or with other cartridge cases.

9.4.5.2 LOADED CARTRIDGES

The initial examination of any loaded cartridge evidence can include the completion of an Ammunition worksheet. These worksheets will include the physical description of the evidence and will serve as a source to document the condition of the evidence as received and any tests or comparisons performed.

9.4.5.2.1 GENERAL, PHYSICAL, AND VISUAL EXAMINATION

The following should be considered:

- If any trace material present
- Caliber
- The possible manufacturer/marketer of the item
- Ignition System
  - Centerfire
  - Rimfire
  - Other

- Description of head stamp
- Shape of cartridge case
- Description of the loaded bullet
- Description of any other markings present, which may include loading marks, cycling marks, and firing pin impressions.

9.4.5.2.1.1 INTERPRETATION OF RESULTS

Any markings on the loaded cartridges should be examined and, as appropriate, compared to tests from a firearm or with another cartridge or cartridge case.

Possible use of loaded cartridges for test firing purposes should also be considered and any such use will be documented in the notes. The use of any loaded cartridges for test firing purposes will also be included in the report and it will be indicated that these items were retained at the laboratory.

9.4.6 REFERENCES

- Association of Firearm and Toolmark Examiners Glossary, 6th Edition, 2013.
- Howe, Walter, J., "Laboratory Work Sheets" AFTE Newsletter, 1969, Vol. 1, No. NL02, p. 12.

9.5 PHYSICAL EXAMINATION AND CLASSIFICATION OF FIRED SHOTSHELL, WADDING, AND LOADED SHOTSHELL EVIDENCE

9.5.1 INTRODUCTION

This section covers the general guidelines for examination and classification of fired shotshell, wadding and loaded shotshell evidence. The evidence will be marked in such a way as to protect characteristics which may be used for comparison microscopic examination and in accordance with the *ASCL-DOC-01 Quality Manual*.

9.5.2 INSTRUMENTATION/ EQUIPMENT

- Comparison Microscope
- Stereo Microscope
- Digital Calipers

9.5.3 PREPARATION

- 10% Bleach Solution
  - Prepare the bleach solution by combining 10 milliliters of bleach to 90 milliliters of water.

9.5.4 CASE MANAGEMENT GUIDELINES

None

9.5.5 PROCEDURE OR ANALYSIS

A systematic approach should be used for the physical examination and classification of fired shotshell, wadding and loaded shotshell evidence. All observations and findings should be documented in the appropriate worksheet.

9.5.5.1 FIRED SHOTSHELLS

The initial examination of any fired shotshell evidence will include the completion of an Expended Shotshell worksheet. These worksheets will include the physical description of the fired evidence and will serve as a source to document the condition of the evidence as received and any tests or comparisons performed.

9.5.5.1.1 GENERAL, PHYSICAL, AND VISUAL EXAMINATION

The following should be considered:

- If any trace material is present
- Gauge/bore/caliber
- The possible manufacturer/marketer of the item
- Ignition system
  - Centerfire
  - Rimfire
  - Other
- Shape of the shotshell
- Description of the shotshell and primer
- Description of the head stamp
- Description of the firing pin impression
- Description of other markings, to include:
  - Breech face markings
  - Extractor
  - Ejector
  - Resizing marks
  - Chamber marks
  - Anvil marks
  - Magazine marks
  - Ejection port markings
  - Other marks

9.5.5.1.1.1 INTERPRETATION OF RESULTS

Markings on the fired shotshell should be examined and, as appropriate, compared to tests from a firearm or with other fired shotshells.

9.5.5.2 WADDING

The initial examination of any wadding evidence will include the completion of a Shotshell Component worksheet. This worksheet will include the physical description of the evidence and will serve as a source to document the condition of the evidence as received and any tests or comparisons performed.

9.5.5.2.1 GENERAL, PHYSICAL, AND VISUAL EXAMINATION

The following should be considered:

- If any trace material is present
- Shape of wad
- Gauge
- Possible manufacturer/marketer of the wad using reference materials (i.e., ammunition database) and indicate in notes the number assigned to this reference
- Description of wad composition
- Microscopic examination of any striations suitable for identification of the wad back to the shotgun that fired it

9.5.5.2.2 WAD GAUGE DETERMINATION

By examining wadding, the examiner may be able to determine the gauge size, manufacture, and if the wad contains markings suitable for comparison to the firearm that discharged it.

Determine gauge size by:

- Directly comparing the evidence to known laboratory standards of similar manufacture or composition by comparing the base of evidence to the bases of the standards until a similar size is found.
- If evidence shotshells are submitted, it may be necessary to disassemble one for the determination of gauge size or manufacturer.
- Gauge size can also be determined by measuring the base diameter of the wad and comparing these measurements to known measurements.

Measurements may be obtained by utilizing a:

- Caliper
- The air gap method
- The stereo microscope with ruler/micrometer/caliper
- Record all information on the appropriate worksheet.

9.5.5.2.2.1 INTERPRETATION OF RESULTS

It may be possible to determine gauge and possible manufacturer of the wadding. Record results on worksheet. If the wad is mutilated or soaked with blood or other body fluids, the examiner may not be able to specifically determine gauge size and may only be able to determine that the evidence is

consistent with a range of gauges or that the gauge cannot be determined. The examiner should also recognize that some manufacturers might duplicate the design of another manufacturer.

9.5.5.3 LOADED SHOTSHELLS

The initial examination of any loaded shotshell evidence will include the completion of an Loaded Shotshell worksheet. These worksheets will include the physical description of the evidence and will serve as a source to document the condition of the evidence as received and any tests or comparisons performed.

9.5.5.3.1 GENERAL, PHYSICAL, AND VISUAL EXAMINATION

The following should be considered:

- If any trace material present
- Gauge
- The possible manufacturer/marketer of the item
- Ignition system
  - Centerfire
  - Rimfire
  - Other
- Description of head stamp
- Description of case material, case length and base brass
- Description of the loaded projectile(s)
- Description of any other markings present, which may include loading marks, chamber or cycling marks, and firing pin impressions.

9.5.5.3.1.1 INTERPRETATION OF RESULTS

Any markings on the loaded shotshells should be examined and, as appropriate, compared to tests from a firearm or with another shotshell or fired shotshell.

Possible use of shotshells for test firing purposes should also be considered and any such use will be documented in the notes. The use of any loaded shotshells for test firing purposes will also be included in the report and it will be indicated that these items were retained at the ASCL.

9.5.6 REFERENCES

- Association of Firearm and Toolmark Examiners Glossary, 6th Edition, 2013.
- Howe, Walter, J., “Laboratory Work sheets” AFTE Newsletter, 1969, Vol. 1, No. NL02, p. 12.

9.6 MICROSCOPIC EXAMINATION

9.6.1 INTRODUCTION

In order for an examiner to identify an item of fired evidence back to the firearm that produced it, a comparison utilizing a comparison microscope must be performed. The comparison microscope allows the examiner to place the evidence on one side of the microscope and the known standard on the other side. This procedure may also be used to compare two unknown pieces of fired evidence together to determine if they were fired in the same firearm.

9.6.2 INSTRUMENTATION/ EQUIPMENT

- Comparison Microscope
- Stereo Microscope

9.6.3 PREPARATION

- 10% Bleach Solution
  - Prepare the bleach solution by combining 10 milliliters of bleach to 90 milliliters of water.

9.6.4 CASE MANAGEMENT GUIDELINES

In order to provide quality, timely services for the criminal justice system, the following case management guidelines have been established. Exceptions may be made on a case by case basis, if needed.

- Bullets will not be compared to cartridge cases.
- Manufacturing mark comparison (e.g., bunter marks) to determine if ammunition components come from the same lot will not be routinely conducted.
- Cartridge cases recovered from the cylinder or chamber of a firearm will not routinely be compared back to that firearm.
- Cases in which the submitted evidence consists primarily of cartridge cases without an appropriate firearm for comparison will be examined for entry into the National Integrated Ballistics Information Network (NIBIN) only. Comparison examination will be conducted for the purposes of confirming a NIBIN Lead, testimony in court, or if a firearm is recovered at a later date.
  - Cases of this type will be worked under the request type of "Operation Shutdown – CC".

9.6.5 PROCEDURE OR ANALYSIS

All observations and findings should be documented in the appropriate firearm or fired evidence worksheets. Findings can also be documented on the *Summary of Findings Form (FA-FORM-74)*.

9.6.5.1 MICROSCOPIC COMPARISON

Microscopic comparisons can be utilized in determining if an item, such as a fired bullet, expended cartridge case, or expended shotshell, has been fired in a particular firearm. This process can also be used to determine if an expended cartridge case/ shotshell or a loaded cartridge/ shotshell has been cycled through the action of a particular firearm. Finally, microscopic comparisons can be utilized in the examination of a toolmark and a tool (see §9.9 of the *Firearm and Toolmark Section Quality Manual*).

The procedure steps below do not have to be performed in the order listed; however, all steps must be considered and/or addressed:

- Select the correct objective (magnification) setting and ensure that the objectives are locked in place.
- Select the correct set of oculars (eyepieces).
- The illumination (lights) used must be properly adjusted. Oblique lighting is usually preferred.
- If a firearm is included as part of the evidence, compare the test fires produced from this firearm to determine what microscopic characteristics are reproducing.
- Compare unknown fired evidence to another piece of unknown fired evidence or to a known standard by placing the unknown fired evidence on one stage and the other piece of unknown fired evidence or known standard on the other stage.
- The entire unknown should be considered.

9.6.5.1.1 SUBCLASS CHARACTERISTICS

When examining an item of fired evidence it is important for the examiner to evaluate the markings observed for potential subclass characteristics. Caution should be exercised in distinguishing subclass characteristics from individual characteristics. Subclass characteristics are discernible features of an object which are more restrictive than class characteristics in that they are:

- Produced incidental to the manufacturing process.
- Are significant in that they relate to a smaller group source (a subset of the class to which they belong).
- Can arise from a source which changes over time.
- Examples may include: bunter marks, broach cut marks, concentric circled breech face marks, etc.

9.6.5.1.2 FACTORS TO CONSIDER DURING COMPARISON EXAMINATION

During the microscopic comparison process, the examiner should consider the following factors:

- Adjusting the angle and/or type of lights
- The need for additional known standards
  - Possibility of cleaning the firearm or tool and producing new tests
- Position of the evidence, the tests, or both
- Possibility that the firearm or tool has changed

- Possibility that a different firearm or tool was used
- The entire unknown should be considered
- The use of magnesium to reduce glare.

9.6.5.1.3 INTERPRETATION OF RESULTS

9.6.5.1.3.1 IDENTIFICATION

For an identification, or positive result, there should be agreement of a combination of individual characteristics and all discernible class characteristics where the extent of agreement exceeds that which can occur in the comparison of Toolmarks made by different tools and is consistent with the agreement demonstrated by Toolmarks known to have been produced by the same tool.

This will lead the examiner to the conclusion that both items (evidence and tests) originated from the same source.

The areas of agreement observed during the comparison examination that lead the examiner to this conclusion should be documented in the case record.

9.6.5.1.3.2 INCONCLUSIVE

For an inconclusive result, one of the following should be observed:

1) Some agreement of individual characteristics and all discernible class characteristics, but insufficient for an identification.
2) Agreement of all discernible class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility.
3) Agreement of all discernible class characteristics and disagreement of individual characteristics, but insufficient for an elimination.

This will lead the examiner to the conclusion that no identification or elimination could be made with respect to the items examined.

When results are inconclusive, the reason shall be documented in the case record as well as on the laboratory report.

9.6.5.1.3.3 ELIMINATION

For an elimination, or negative result, significant disagreement of discernible class characteristics and/or individual characteristics should be observed.

This will lead the examiner to the conclusion that both items (evidence and tests) did not originate from the same source.

Documentation supporting this conclusion should be included in the case record.

9.6.5.1.3.4 UNSUITABLE

An item of evidence found to be unsuitable will exhibit a lack of suitable microscopic characteristics.

This will lead the examiner to the conclusion that the items are not suitable for comparison.

Documentation supporting this conclusion should be included in the case record when appropriate.

9.6.5.1.4 VERIFICATIONS

All analytical conclusions reached during this testing will be verified by a second examiner and will be documented on the *Firearms Verification Form (FA-FORM-02)*. This will include identification, elimination, inconclusive, and item of no value conclusions.

9.6.5.1.5 ADDITIONAL DOCUMENTATION

Additional types of documentation that may be considered are as follows:

- Photographs depicting comparison or characteristics observed
- Sufficient notes
- Diagrams
- Sketches

9.6.6 REFERENCES

- Association of Firearm and Toolmark Examiners Glossary, 6th Edition, 2013.
- Howe, Walter, J., "Laboratory Work sheets" AFTE Newsletter, 1969, Vol. 1, No. NL02, p. 12.

9.7 NATIONAL INTEGRATED BALLISTICS INFORMATION NETWORK (NIBIN), OPERATION SHUTDOWN, AND OPERATION SHUTDOWN – CC

9.7.1 INTRODUCTION

This section covers the general guidelines related to the National Integrated Ballistics Information Network (NIBIN) and to the Firearm and Toolmark subsection Operation Shutdown.

<u>National Integrated Ballistics Information Network (NIBIN)</u>

NIBIN is a computerized system for acquiring, storing and searching the images of cartridge cases with the purpose of linking cases involving the same firearm. NIBIN images portions of the surface of the headstamp and primer areas of fired cartridge cases using optical and electronic technology. These images are then stored in databases and sophisticated algorithms are used to correlate the images against each other using filters such as caliber, date of crime and date of entry. For each correlation a list of possible matches is generated and will be reviewed by an examiner or an appropriately trained technician. If a possible association, or NIBIN Lead, is found during the review of a correlation, a NIBIN Hit Letter will be issued with the NIBIN Lead information. A

comparative examination of the physical items will need to be conducted by an examiner in order to confirm the NIBIN Lead.

Personnel utilizing the NIBIN database must receive proper training and/or clearance through the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF).

9.7.2 INSTRUMENTATION/ EQUIPMENT

- IBIS BrassTrax-3D
- IBIS MatchPoint+
- Stereoscope

9.7.3 PREPARATION

None

9.7.4 CASE MANAGEMENT GUIDELINES

In order to provide quality, timely services for the criminal justice system, the following case management guidelines have been established. Exceptions may be made on a case by case basis, if needed.

- Cartridge cases from all calibers of semiautomatic pistols will be routinely entered into NIBIN.
- Cartridge cases from certain rifle calibers will be routinely entered into NIBIN. This will include cartridge cases from .223 Rem, 5.56mm, and 7.62 x 39mm caliber rifles.
- Shotshells from certain gauge shotguns will be routinely entered into NIBIN. This will include 12 gauge shotguns.
- Cartridge cases from all other caliber pistols and rifles as well as all revolvers, shotguns and derringers will not routinely be entered into NIBIN.
  - For Operation Shutdown requests, firearms of this type will not be test fired.
- Cartridge cases from firearms used to commit suicide and cartridge cases from a Law Enforcement Officer's firearm will not routinely be entered into NIBIN.
- NIBIN instrumentation at the ASCL currently does not support bullet entry.
- Cases in which the submitted evidence consists primarily of cartridge cases without an appropriate firearm for comparison will be examined for entry into NIBIN only. These will be worked under the "Operation Shutdown – CC" request type. Comparison examination will be conducted for the purposes of confirming a NIBIN Lead, testimony in court, or if a firearm is recovered at a later date.

9.7.5 PROCEDURE OR ANALYSIS

Test fired cartridge cases and evidence cartridge cases from all request types worked by the Firearm and Toolmark Section shall be evaluated for their suitability for entry into NIBIN.

9.7.5.1 EXAMINATION OF EVIDENCE FOR NIBIN ENTRY

- Any cartridge cases selected for entry into NIBIN should have sufficient individual characteristics within the firing pin impression and/or breech face marks to affect a match.
- It may be necessary for more than one cartridge case to be entered into NIBIN if different individual characteristics reproduce better on different tests or evidence items.
- The examiner should consider marking the sides of the cartridge case to indicate the location of the extractor and/or ejector markings or the 3 o'clock position for proper alignment in the cartridge case holder.
- Information on the date of entry and by whom the entry was completed should be documented in the case record.
- Specimens will be entered into NIBIN as outlined in the operators' manual or the IBIS Training Course student handbook.

9.7.5.2 OPERATION SHUTDOWN

By Arkansas Statute 12-12-324, a firearm used in the commission of a crime, that meets the caliber and type determined by the Executive Director, may be submitted to the Arkansas State Crime Laboratory. Firearms that do not need immediate comparison work will be submitted to the Operation Shutdown subsection. When suitable, test fired cartridge cases are entered into NIBIN. The appropriate worksheet will be completed and a NIBIN Firearm Evaluation Form will be completed and available on iResults.

Firearms will be examined and the appropriate documentation will be completed in accordance with the requirements outlined in §9.2 of the *Firearm and Toolmark Quality Manual*.

Firearms of a caliber and/or type that are not routinely entered into NIBIN will not be routinely test fired.

A test fire information card will be filled out as described in "Test Firing and Recovery of Test Fires" in §9.1.5 of the *Firearm and Toolmark Quality Manual*.

Test fired bullet and cartridge case samples are to be treated as evidence. The test fired bullet and cartridge case samples will be itemized separate from the firearm and decontainerize so as to have their own chain of custody. At the completion of a case, the test fired bullet and cartridge case samples will be transferred to "FA Short Term TF Storage".

All test fired bullet and cartridge case samples will be stored in a sealed condition.

Test fired bullet and cartridge case test fire samples will be stored in a secure area accessible by Firearm and Toolmark Section personnel as outlined in §9.1.5 of the *Firearm and Toolmark Quality Manual*.

9.7.5.3 OPERATION SHUTDOWN – CC REQUESTS

Evidence cartridge cases that are submitted without a firearm for comparison will be submitted to the Operation Shutdown-CC subsection. These cartridge cases will be triaged and when suitable, the

best representative of the group(s) will be entered into NIBIN. The item(s)entered into NIBIN will be documented in the case record and on the Evaluation Form

Evidence cartridge cases will be examined and the appropriate documentation will be completed in accordance with the requirements outlined in § 9.4 of the *Firearm and Toolmark Section Quality Manual*.

9.7.5.3.1 TRIAGE PROCESS

Evidence cartridge cases processed under the Operation Shutdown – CC request will be triaged to determine the best representative sample(s) that are suitable for NIBIN entry. This is not a comparison examination to determine the number of firearms involved in the firing of the evaluated items.

9.7.5.4 INTERPRETATION OF RESULTS

For Firearm and Toolmark Section requests, a notification of entry into the NIBIN system, as well as the extent of the database search will be included in the examiner's report or the case's evaluation form.

For Operation Shutdown subsection requests, a NIBIN Firearm Evaluation Form will be completed and will be available on iResults.

For Operation Shutdown – CC subsection requests, an Evaluation Form will be completed and will be available on iResults.

A microscopic examination shall be conducted in order for a NIBIN Lead to be confirmed. A report of findings will be issued stating the results of this examination.

The only information that is appropriate to be released about specimens entered into NIBIN is either that no associations have been made at this time or that a NIBIN Hit Letter has been issued containing the NIBIN Lead information. NIBIN cannot be used to conduct a comparison of two specimens; the requesting agency will need to submit the specimens for microscopic examinations/comparisons and verification/review of the results.

9.7.5.4.1 CORRELATION REVIEW

Correlations will be reviewed by either a trained Firearm and Toolmark Examiner or an appropriately trained technician.

The date, name of reviewer, and results of the review should be documented in the case record.

At a minimum, the images of the top 30 results from the rank sort list will be reviewed.

All NIBIN Leads will be reviewed by a second trained Firearm and Toolmark Examiner or an appropriately trained technician and documented using the *NIBIN Lead Worksheet (FA-FORM-76).*

9.7.5.4.2 NIBIN HIT LETTER (ISSUING OF NIBIN LEADS)

If any potential matches or NIBIN Leads are found, a NIBIN Hit Letter will be generated via JusticeTrax® with the NIBIN Lead information from all involved cases and will be available on iResults. Confirmation of a NIBIN Lead will not be routinely conducted without proper notification from the related agencies that confirmation is needed. Proper notification can include the resubmission of evidence by the agency after receipt of the NIBIN Hit Letter.

9.7.6 REFERENCES

- IBIS BrassTrx-3D and MatchPoint+ Operation manuals
- IBIS Training Course Student Handbook

9.8 DISTANCE DETERMINATION

9.8.1 INTRODUCTION

When a firearm is fired, gunshot residues are discharged from the firearm. These residues can be in the form of burnt gunpowder particles, partially burnt gunpowder particles, unburnt gunpowder particles, vaporous lead, and particulate metals. Muzzle-to-target distance determination is based on gunshot residue examinations and/or shot pattern examinations. Gunshot residues along with the morphology of the bullet hole or the size of the pellet pattern can effectively be used in determining the possible muzzle-to-target distance.

With exception of contact or near contact shots, valid conclusions in muzzle-to-target distance examinations must be reached through tests which are conducted to reproduce the physical parameters related to the incident.

If no pattern of gunshot residue suitable for comparison is developed on a piece of evidence, distance testing using the suspected firearm is not required.

Unless specifically requested by the investigating agency or a Medical Examiner, clothing received from the Medical Examiner's office will not be routinely processed by the Firearms and Toolmark Section for gunshot residue/range determination.

All analytical conclusions made during range determination testing will be verified by a second examiner and documented using the *Firearms Verification Form (FA-FORM-02).*

9.8.2 INSTRUMENTATION/ EQUIPMENT

- Stereo Microscope
- Sony DSCF828 Digital camera
- Hoya R-72 Infrared filter
- Incandescent light source
- Scale/Balance

9.8.3 PREPARATION

9.8.3.1 HAEMO-SOL CLEANING TECHNIQUE

The Haemo-sol cleaning is used independently and/or in conjunction with other tests in range determinations. The Haemo-sol cleaning technique is a method of removing blood deposit from bloodstained clothing in an effort to make visible the underlying gunshot residue deposits. With careful treatment, the blood should be removed and the underlying residues should be visible.

- Prepare a 2% weight/volume Haemo-Sol solution.
- Place the bloodstained clothing in a shallow tray covering the affected area with the Haemo-sol solution.
- Let soak, undisturbed for 8-12 hours. Carefully pour off Haemo-sol solution and air dry. Filter solution if necessary.

9.8.3.2 CHEMICAL PREPARATION

Refer to the Firearm and Toolmark Section's Chemical and Reagent Logbook for instructions on the preparation and verification of specific chemicals and reagents and for the documentations of these preparations.

- Diphenylamine (DPA)solution
- Sensitized photo paper
- 15% Acetic Acid
- Nitrite Test Strips
- Saturated Sodium Rhodizonate solution
- 5% Hydrochloric Acid
- Tartaric Buffer solution
- 0.2% Dithiooximide (DTO) solution
- Ammonia Hydroxide solution

9.8.3.2.1 MINIMUM ANALYTICAL STANDARDS AND CONTROLS

Reagents will be checked prior to use in case work, as appropriate, and documented in the case notes. Methods for verifying the reagent's reliability are located in the Firearm and Toolmark Section Chemical and Reagent Logbook.

9.8.3.3 TEST PANEL PREPARATION

- Attach appropriate sized pieces of cotton twill material or a piece of the evidence material to a nitrite free cardboard backing board for non-shot pellet test patterns.
- The test media for shot pellet test patterns is an appropriate sized piece of poster board, cardboard or heavy paper.

9.8.4 CASE MANAGEMENT GUIDELINES

In order to provide quality, timely services for the criminal justice system, the following case management guidelines have been established. Exceptions may be made on a case by case basis, if needed.

- Distance determination testing will only be conducted if the firearm is submitted. Submission of the appropriate ammunition is preferred.
- Distance determination testing will not be routinely conducted if there is a video of the shooting incident.
- Distance determination testing will typically only be performed on clothing, with the exception of shot patterns. Distance determination testing will not be conducted on skin.
- Distance determination testing will not be conducted in cases where a black powder firearm was used.

9.8.5 PROCEDURE OR ANALYSIS

A systematic approach should be used for the visual and microscopic examination of an item for gunshot residues. Evidence will be marked in accordance with the *ASCL-DOC-01 ASCL Quality Manual*.

9.8.5.1 VISUAL AND MICROSCOPIC EXAMINATION

All observations and findings should be documented in the appropriate Gunshot Residue worksheet. These worksheets will include a physical description of the evidence and will serve as a source to document the condition of the evidence as received and any tests performed.

The visual and microscopic examination of an item for gunshot residue will include the examination and/or consideration of the following:

- The presence of vaporous lead (smoke)
- The presence of particulate metals (shavings of lead, copper, brass)
- The presence of partially burnt and/or unburnt gunpowder
- The presence of melted adhering gunpowder
- A hole in the item
- The presence of a visible ring around the perimeter of holes
- The location of all holes, tears, missing buttons, etc.
- The presence of burning or singeing or melting
- The presence of any possible masking effects
- The direction of artifacts surrounding the hole

Data regarding these physical effects and visible residues must be included in the examiners notes.

9.8.5.1.1 INFRARED (IR) PHOTOGRAPHIC EXAMINATION

The Infrared (IR) Photographic examination is used independently and/or in conjunction with other tests in range determinations. The IR examination utilizes filtered color photography to help

distinguish obscure or faint gunpowder patterns. This test detects residue patterns, a product of the incomplete burning of gunpowder, by unmasking the dark colored background to produce a visualization of available residues or patterns.

Place the object to be photographed on to a suitable stand (copy) or table and illuminate with a good source of bright incandescent light (200w). Screw the IR filter onto the end of the camera lens, set the camera to "NIGHTSHOT" and photograph with automatic camera settings. It is recommended that you also take standard black and white or color photographs to document your work.

9.8.5.1.2 POSSIBLE MASKING EFFECTS

Masking effects of gunshot residue to consider, include:

- Dark background color
- Blood staining
- Intervening object

9.8.5.1.3 INTERPRETATION OF RESULTS

Indicative of/or consistent with the discharge of a firearm

- Vaporous lead (smoke)
- Particulate metals (shavings of lead, copper, brass)
- Unburned gunpowder (morphology)
- Melted adhering gunpowder

Indicative of/ consistent with the passage of a bullet

- A hole in the item
- Visible ring around the perimeter of holes
- Location of all holes, tears, missing buttons, etc.

Indicative of/ consistent with a contact shot

- Ripping or tearing
- Burning or singeing
- Melted artificial fibers
- Heavy vaporous lead residues

The above conclusions will be verified by a second examiner and documented on the *Firearms Verification Form (FA-FORM-02)*.

If the above observations support the findings of a "contact shot", comparison of the evidence to test patterns is not necessary.

If the observations do not support a "contact shot" finding, the examiner should consider chemically processing the clothing.

9.8.5.2 CHEMICAL PROCESSING

It should be noted that if multiple chemical examinations are going to be performed on an item then a specific order must be followed:

- First - Diphenylamine
- Second - Modified Griess
- Third – Dithiooxamide
- Fourth - Sodium Rhodizonate

9.8.5.2.1 DIPHENYLAMINE TEST

The Diphenylamine (DPA) test is used independently and/or in conjunction with other tests in range determination. The DPA test utilizes a morphological and color chemistry reaction to indicate the presence of cellulose and nitrates. The DPA test reacts with cellulose to produce a morphological change resulting in a significant swelling to the granule and to produce a dark greenish-blue to nearly black color reaction. This test can effectively be used in determining the physical presence of discharged gunpowder particles including the determination of entrance versus exit holes and the presence of gunshot residues.

- Place one granule of gunpowder into a clean spot plate.
- Place one to two drops of acetone onto the granule; observe the swelling of the granule from one to two times its original size and becoming semi-translucent.
- Place one to two drops of Diphenylamine solution onto the swollen particle; observe the color reaction.

9.8.5.2.1.1 INTERPRETATION OF RESULTS – DPA TEST

A swelling of the granule is a positive reaction of acetone with cellulose.

A dark greenish-blue color reaction, corresponding to the swollen area tested, constitutes a positive reaction for nitrates.

9.8.5.2.2 MODIFIED GRIESS TEST

The Modified Griess test is used independently and/or in conjunction with other tests in range determinations. It utilizes a color chemistry reaction to help distinguish obscure or faint gunpowder patterns. This test detects nitrites, a product of the incomplete burning of gunpowder, by reacting with acetic acid to form nitrous acid. This acid combines with alpha-naphthol and produces an orange-red color reaction.

DIRECT APPLICATION TECHNIQUE (DAT)

- Place the sensitized blank (photo paper - emulsion side down or sensitized filter paper) over the area to be tested.
- Soak a piece of nitrite free cheesecloth or filter paper with the acetic acid solution, and place this over the reverse side of the evidence.
- Apply heat and pressure with an iron until the acetic acid solution treated paper is dry.

REVERSE APPLICATION TECHNIQUE (RAT)

- Wipe the side of the sensitized blank that will be in contact with the questioned area with the acetic acid solution.
- Place the sensitized blank (photo paper - emulsion side down or filter paper) over the area to be tested.
- Place a piece of filter paper or nitrite free cheese cloth over either the sensitized blank or evidence depending on what is being used for a blank.
- Apply heat and pressure with an iron until the acetic acid solution treated paper is dry.

9.8.5.2.2.1 INTERPRETATION OF RESULTS – MODIFIED GRIESS TEST

An orange or orange-red color reaction on the paper, corresponding to the area tested, constitutes a positive reaction for nitrites.

9.8.5.2.3 DITHIOOXAMIDE TEST

The Dithiooxamide (DTO) test is used independently and/or in conjunction with other tests in range determination. The DTO test utilizes a color chemistry reaction to indicate the presence of copper. The DTO test reacts with copper to produce a dark greenish-gray to nearly black color reaction. It should be noted that the DTO test will also react with cobalt, leaving an amber color reaction, and nickel, leaving a violet color reaction. This test can effectively be used in determining the physical characteristics of bullet holes including the determination of entrance versus exit holes. Fired bullets passing through clothing and/or other objects often leave traces of copper around the bullet hole. This copper transfer comes from the surfaces of a copper containing bullet and/or the barrel of the firearm. This copper transfer can be in the form of minute particles, a fine coating of powder particles or a fine cloud of vaporized copper. At times this copper transfer is an obvious ring or wipe around the hole but is more often invisible.

- Place three drops of the ammonia solution on a piece of filter paper.
- Place the ammonia treated filter paper over the hole to be tested.
- Place a second piece of filter paper over the first and apply moderate pressure for approximately 5 seconds.
- Remove both pieces of filter paper and place 3 drops of the Dithiooxamide Solution to the tested area of the filter paper.
- Repeat this process on all holes to be tested. Both sides of a hole should be tested if there is a question of entrance versus exit.

9.8.5.2.3.1 INTERPRETATION OF RESULTS – DTO TEST

A dark greenish-gray color reaction, corresponding to the area tested, constitutes a positive reaction for copper.

9.8.5.2.4 SODIUM RHODIZATE TEST

The Sodium Rhodizonate test is used independently and/or in conjunction with other tests in range determinations. The Sodium Rhodizonate test utilizes a color chemistry reaction that is specific for lead and can effectively be used in determining the physical characteristics of bullet holes including the determination of entrance versus exit holes. Fired bullets passing through clothing and/or other objects often leave traces of lead around the bullet hole. This lead transfer comes from the surfaces of the bullet, the barrel and/or the primer residue. This lead transfer can be in the form of minute particles, a fine coating of powder particles or a fine cloud of vaporized lead. At times this lead transfer is an obvious ring or wipe around the hole but is more often invisible.

DIRECT APPLICATION TECHNIQUE (DAT)

- Spray the Sodium Rhodizonate Solution on to the questioned area.
- Spray the tested area with the Buffer Solution.
- Spray the tested area with the Hydrochloric Acid Solution.

BASHINSKY TRANSFER TECHNIQUE (BTT)

- Uniformly dampen a piece of filter paper with the Acetic Acid Solution.
- Place the treated filter paper over the hole/area to be tested.
- Place a second piece of filter paper over the first and apply moderate pressure or apply a hot iron for approximately 5 seconds.
- Remove both pieces of filter paper and perform the treatment steps as outlined above in the Direct Application Technique.
- Repeat this process on all holes/areas to be tested. Both sides of a hole should be tested if there is a question of entrance versus exit.
- Remove both pieces of filter paper and perform the treatment steps as outlined above in the Direct Application Technique.
- Repeat this process on all holes/areas to be tested. Both sides of a hole should be tested if there is a question of entrance versus exit.

9.8.5.2.4.1 INTERPRETATION OF RESULTS – SODIUM RHODIZONATE TEST

A violet or purple colored ring, corresponding to the margin of the hole, or a violet or purple colored stain, corresponding to the area tested constitutes a positive reaction for lead.

9.8.5.2.5 INTERPRETATION OF RESULTS – CHEMICAL PROCESSING

If a pattern of gunshot residue is developed during the chemical processing of the evidence and the suspected firearm has been submitted in the case, distance determination testing can be conducted.

If no pattern of gunshot residue suitable for comparison is developed on a piece of evidence, distance determination testing using the suspected firearm is not required.

All analytical conclusions reached during the chemical processing of the evidence will be verified by a second examiner and will be documented on the *Firearms Verification Form (FA-FORM-02)*.

9.8.5.3 DISTANCE DETERMINATION TESTING

In order to properly perform a muzzle-to-target range determination examination, it is necessary to attempt to reproduce the gunshot residue patterns or the shot patterns present on the suspect item. This reproduction is accomplished by shooting test targets at varying distances until the gunshot residue pattern or shot pattern present on the suspect item is reproduced. It is essential that the suspect firearm and ammunition consistent with that used in the crime are utilized to produce muzzle-to-target range determination test patterns.

NON-PELLET PATTERN PRODUCTION

- Wound location information can be obtained from associated laboratory case files and/or Medical Examiner's Office files.

Prepare test target media as outlined in § 9.8.3.3 of the *Firearm and Toolmark Section Quality Manual*.

- Tests should be shot one per piece of target media.
- Tests should be shot in increasing or decreasing range increments until a range of distance is established that reproduces the gunshot residue or shot patterns on the suspect item.
- Test distance should be recorded in the case notes.
- The tests should then be processed chemically as per the appropriate Modified Griess and Sodium Rhodizonate procedures to develop a gunshot residue pattern to compare to the evidence.

SHOT PELLET PATTERN PRODUCTION

- Wound location information can be obtained from associated laboratory case files and/or Medical Examiner's Office files.

Prepare test target media as outlined in § 9.8.3.3 of the *Firearm and Toolmark Section Quality Manual*.

- Tests should be shot one per piece of target media.
- Tests should be shot in increasing or decreasing range increments until a range of distance is established that reproduces the gunshot residue or shot patterns on the suspect item.
- Test distance should be recorded in the case notes.
- If appropriate, the tests can then be processed chemically as per the appropriate Modified Griess and Sodium Rhodizonate procedures to develop a gunshot residue pattern to compare to the evidence.

9.8.5.3.1 INTERPRETATION OF RESULTS

By utilizing the suspect firearm and appropriate ammunition it is possible to obtain a reproduction of a gunshot residue pattern or shot pellet pattern present on a suspect item. Therefore one can ascertain the approximate bracketed distance that particular firearm's muzzle was from the suspect item when it was shot.

All analytical conclusions reached during distance determination testing will be verified by a second examiner and will be documented on the *Firearms Verification Form (FA-FORM-02)*.

9.8.6 REFERENCES

- Dillon, John, H., "A Protocol for Gunshot Residue Examinations in Muzzle-To-Target Distance Determinations", 1990, AFTE Journal, Vol. 22, No. 3, p. 257.
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- Dillon, John, H. "The Sodium Rhodizonate Test: A Chemically Specific Chromophoric Test for Lead in Gunshot Residues", AFTE Journal, 1990, Vol. 22, No. 3, p. 251.
- Dillon, John, H. "A Protocol for Shot Pattern Examinations in Muzzle-to-Target Distance Determinations", AFTE Journal, 1991, Vol. 23, No. 1, p. 511.
- Di Maio, Vincent, Gunshot Wounds, 2nd Edition, CRC Press, 1999.
- Hueski, E., "Gunshot Residue Testing of Blood Stained Garments", AFTE Journal, 1994, Vol. 26, No. 1, p. 26.

9.9 PHYSICAL EXAMINATION AND CLASSIFICATION OF TOOLMARKS

9.9.1 INTRODUCTION

The basic objective in evaluating a questioned Toolmark is to determine the suitability and classification of the Toolmark. In order to compare a questioned Toolmark with a suspect tool or another Toolmark, it is necessary to conduct a physical examination and classification of the Toolmark and the tool, which will help determine what course the rest of the examination should follow.

In order to compare a questioned Toolmark with a suspect tool, test standards or marks are usually made with the suspect tool. The basic objective in preparing test standards is to attempt to duplicate the manner in which the tool was used to reproduce the evidence or questioned Toolmark.

9.9.2 INSTRUMENTATION/ EQUIPMENT

- Stereo Microscope
- Scale/Balance
- Comparison Microscope
- Ruler

9.9.3 PREPARATION

- 10% Bleach Solution
  - Prepare the bleach solution by combining 10 milliliters of bleach to 90 milliliters of water.

MAGNESIUM SMOKING

Magnesium smoking is a non-destructive, non-invasive technique of reducing the glare of a shiny object by lightly coating the surface with fine magnesium smoke. This smoking is traditionally done manually, however a diode sputtering system used for coating Scanning Electron Microscopy (SEM) specimens might also be used.

- Manual Smoking
  - The short pieces of magnesium ribbon are lit.
  - The object to be smoked is passed over the smoke generated by the burning magnesium.
  - If the object collects too much smoke, wipe the smoke off and repeat the process.
  - The coating should be light enough to see the color of the item smoked through the coating of smoke.
- Automated Smoking
  - The appropriate instructions for the particular instrument should be followed.

CASTING

If an item received for a Toolmark examination is too large to be conveniently placed on the microscope's stages a silicon rubber cast can be made of the Toolmarks in question. There are also occasions when a cast of a Toolmark might be received as evidence. In either case, any test standards made will also have to be cast in order to perform a comparison. Mikrosil®, Duplicast® or other types of silicon rubber casting material are similar products and procedurally are equivalent as long as the manufacturer's instructions are followed.

- Prepare the casting material as per manufacturer's specifications.
- Cascade the casting material over the Toolmark to be cast.
- Allow the cast the appropriate amount of time to cure.
- Gently lift the cast off the Toolmark.
- Consideration must be given to placing identifying marks as well as orientation marks on the back of the cast.

Casts will be retained with the test standards in the test reference collections.

9.9.4 CASE MANGAMENT GUIDELINES

In order to provide quality, timely services for the criminal justice system, the following case management guidelines have been established. Exceptions may be made on a case by case basis, if needed.

Due to the considerable length of time required to analyze Toolmark cases, only cases where the tool can be connected to a suspect (e.g., recovered from a suspect, or associated through other forensic testing, such as latent prints or DNA) will be processed.

9.9.5 PROCEDURE OR ANALYSIS

A systematic approach should be used for the physical examination and classification of tool and Toolmark evidence. All observations and findings should be documented in the Toolmark worksheet. These worksheets will include a physical description of the evidence and will serve as a source to document the condition of the evidence as received and any tests or comparisons performed.

Evidence will be marked in such a way as to protect characteristics which may be used for comparison microscopic examination and in accordance with the *ASCL-DOC-01 ASCL Quality Manual*.

9.9.5.1 EXAMINATION AND PHYSICAL CLASSIFICATION – TOOLMARK

The following should be considered:

- The suitability of the Toolmark for comparison purposes
- Class of tool that made the Toolmark
- Major and minor classes of Toolmarks
- Physical characteristics of Toolmarks
- Direction of Toolmark

9.9.5.1.1 INTERPRETATION OF RESULTS

If the Toolmark is suitable for comparison, then the examination may continue.

If the Toolmark has the same class characteristics as the suspect tool, then the examination may continue.

9.9.5.2 EXAMINATION AND PHYSICAL CLASSIFICATION - TOOL

The following should be considered:

- If any trace material is present
- The class characteristics of the tool
- The type of tool
- The brand name of tool
- The size of the tool
- The condition of the tool
- Type of tests conducted (if any)
- The medium used for testing

9.9.5.2.1 TEST STANDARDS

In order to compare a questioned Toolmark with a suspect tool, test standards or marks are usually made with the suspect tool. The basic objective in preparing test standards is to attempt to duplicate the manner in which the tool was used to produce the evidence or questioned Toolmark.

Test standards will be treated as evidence. The test standards will be itemized separate from the firearm and decontainerized so as to have their own chain of custody. At the completion of a case, the test standards will be transferred in "FA Short Term TF Storage" and stored in a secure area accessible by Firearm and Toolmark Section personnel.

All test standards will be stored in a sealed condition with a test fire information card. A test fire information card will be filled out to include the ASCL case number, item number and identifying information (if available).

Archived material will be stored in a secure area in the ASCL Annex. These archived test standards will be transferred into "FA Long Term TF Storage" at this time.

The examiner should consider marking the Toolmark test standards with the:

- Full or abbreviated laboratory case number and
- Full or abbreviated item number and/or
- Examiner's initials.

A systematic approach should be used for the production of test marks or standards. Consideration should be given to the following:

- Areas of recent use on the tool in question.
- Direction of use and angle of the tool in relation to the surface being marked.
- Indexing of test standards/marks.
- Test Media
  - The initial test media should be soft enough to prevent alterations of the tool's working surface. Lead is usually the material utilized.
  - Subsequent tests might require the use of a harder test media to better reproduce the Toolmarks.

9.9.5.3 MICROSCOPIC COMPARISON

In order for an examiner to identify a Toolmark back to the tool that produced it, a microscopic comparison utilizing a comparison microscope must be performed. The comparison microscope allows the examiner to place the evidence on one side of the microscope and the test standard on the other side. This procedure may also be used to compare two unknown Toolmarks together to determine if they were made by a single tool.

The procedure steps below do not have to be performed in the order listed; however, all steps should be considered and/or addressed:

- Select the correct objective (magnification) setting and ensure that the objectives are locked in place.
- Select the correct set of oculars (eyepieces).
- The illumination (lights) used must be properly adjusted. Oblique lighting is usually preferred.

- Compare unknown Toolmark to either another unknown Toolmark or a test standard by placing the unknown Toolmark on the left hand stage and the other unknown Toolmark or test standard on the right hand stage.
- The entire Toolmark must be considered.

9.9.5.3.1 SUBCLASS CHARACTERISTICS

When examining a Toolmark it is important for the examiner to evaluate the markings observed for potential subclass characteristics. See § 9.6.5.1.1 of the *Firearm and Toolmark Section Quality Manual* for more information on the evaluation of subclass characteristics.

9.9.5.3.2 FACTORS TO CONSIDER DURING COMPARISON EXAMINATION

See § 9.6.5.1.2 of the *Firearm and Toolmark Section Quality Manual*.

9.9.5.3.3 INTERPRETATION OF RESULTS

All analytical conclusions reached during this testing will be verified by a second examiner and will be documented on the *Firearms Verification Form (FA-FORM-02)*. This will include identification, elimination, inconclusive, and item of no value conclusions.

9.9.5.3.3.1 IDENTIFICATION

For an identification, or positive result, there should be agreement of a combination of individual characteristics and all discernible class characteristics where the extent of agreement exceeds that which can occur in the comparison of Toolmarks made by different tools and is consistent with the agreement demonstrated by Toolmarks known to have been produced by the same tool.

This will lead the examiner to the conclusion that both items (evidence and tests) originated from the same source.

9.9.5.3.3.2 INCONCLUSIVE

For an inconclusive result, one of the following should be observed:

4) Some agreement of individual characteristics and all discernible class characteristics, but insufficient for an identification.
5) Agreement of all discernible class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility.
6) Agreement of all discernible class characteristics and disagreement of individual characteristics, but insufficient for an elimination.

This will lead the examiner to the conclusion that no identification or elimination could be made with respect to the items examined.

When results are inconclusive, the reason shall be documented in the laboratory report.

9.9.5.3.3.3 ELIMINATION

For an elimination, or negative result, significant disagreement of discernible class characteristics and/or individual characteristics should be observed.

This will lead the examiner to the conclusion that both items (evidence and tests) did not originate from the same source.

9.9.5.3.3.4 UNSUITABLE

An item of evidence found to be unsuitable will exhibit a lack of suitable microscopic characteristics.

This will lead the examiner to the conclusion that the items are not suitable for comparison.

9.9.5.3.4 ADDITIONAL DOCUMENTATION

Additional types of documentation that may be considered are as follows:

- Photomicrograph depicting comparison or characteristics
- Sufficient notes
- Diagrams
- Sketches

9.9.6 REFERENCES

Additional types of documentation that may be considered are as follows:

- Photomicrograph depicting comparison or characteristics
- Sufficient notes
- Diagrams
- Sketches

9.10 SERIAL NUMBER RESTORATION

9.10.1 INTRODUCTION

Serial Numbers are applied to firearms for identification purposes. The process of applying a serial number produces a compression of the metal of the firearm, or plastic deformation, in the area immediately surrounding and a short distance below the applied serial number. Firearms can be received with serial numbers that have been removed and/or obliterated in a variety of ways. The serial number may possibly be restored if the removal/obliteration is not taken past the previously mentioned compression zone.

9.10.2 INSTRUMENTATION/ EQUIPMENT

- Scale/Balance
- Dremel type tool with a sanding/polishing disc

- Fine grit sand paper
- Hand magnets
- Electromagnetic yoke
- Ultra-Violet (UV) light source
- UV protective glasses

9.10.3 PREPARATION

Refer to the Firearm and Toolmark Section's Chemical and Reagent Logbook for instructions on preparing of specific chemicals and reagents and for the documentations of these preparations.

- Fry's Reagent
- Turner's Reagent
- 25% Nitric Acid
- 50% Hydrochloric Acid
- Chromic Acid
- Ferric Chloride
- Acidic Ferric Chloride
- 10% Sodium Hydroxide
- Phosphoric/ Nitric Acid

9.10.4 CASE MANGEMENT GUIDELINES

In order to provide quality, timely services for the criminal justice system, the following case management guidelines have been established. Exceptions may be made on a case by case basis, if needed.

Serial number restorations will only be conducted on firearms.

9.10.5 PROCEDURE OR ANALYSIS

The evidence will be marked in accordance with the *ASCL-DOC-01 ASCL Quality Manual*. Examination and results are to be recorded on the Serial Number Restoration worksheet. Initial inspection of the serial number area should include observations of coating, trace material, character remnants, and the method of obliteration. Observations should be recorded in the notes by documenting and/or photographing the serial number area.

Serial numbers are removed and/or obliterated in a variety of ways and may be restored if the removal/obliteration is not taken past the previously mentioned compression zone, by using methods such as polishing, chemical or electrochemical restoration.

9.10.5.1 POLISHING

It is desirable to remove (polish) the grinding and filing scratches introduced during obliteration. The polishing procedure can be effective independently but is more often used in conjunction with various chemical or heat restoration procedures.

Perform an initial inspection of the serial number area for coatings, trace material or any character remnants as well as possibly determining the method of obliteration. Note and record any visible characters prior to polishing.

Polish the area of the obliteration using either a:

- Dremel type tool with a sanding/polishing disc
- Fine grit sand paper

Depending on the extent of the obliteration, continue polishing until the surface is mirror-like removing all scratches. If the obliteration is severe it may not be possible or desirable to remove all the scratches.

9.10.5.1.1 INTERPRETATION OF RESULTS

Note any characters that become visible.

If all characters do not become visible, proceed to the appropriate chemical or heat restoration procedure.

9.10.5.2 MAGNETIC PARTICAL RESTORATION

Magnetic particle restoration is a test that "uses magnetic fields and small magnetic particles (iron filings) to detect defects or flaws in components" (AFTE Glossary, p. 152). This nondestructive technique can assist in the restoration of defaced serial numbers because the process of applying a serial number to a firearm will cold-work the affected area and result in plastic deformation. The application of a magnetic field and magnetic fillings to the defaced area can result in the accumulation of these fillings at the areas of plastic deformation, revealing the characters of the defaced serial number. The magnetic particle restoration technique is nondestructive and can be utilized with other serial number restoration techniques such as the acid-etch method.

MATERIALS

- Hand magnets of different strengths
- Electromagnetic Yoke
- 7HF Oil-based Visible Magnetic Particle Suspension
- 14AM Oil-based Fluorescent Magnetic Particle Suspension
- UV light source

9.10.5.2.1 PROCEDURE

- Determine the serial number medium's physical properties, i.e. magnetic or non-magnetic. If the area is found to be magnetic, it is suitable for magnetic particle restoration.
- Prepare the area by using the polishing procedure if necessary.
- It is suggested that molding clay be utilized to form a barrier, "well", around the area of defacement.
- Select a magnetic particle suspension.

- For prepared baths, or aerosols, spray into a beaker and let settle at bottom.
- Apply magnetic particle suspension to the area of defacement.
- Place a magnet or the yoke behind the defaced area, with the poles on either side of the defacement.
  - This placement can be adjusted to reveal more or different areas of obliteration.
  - The UV light source should be used when the 14AM suspension is utilized.

9.10.5.2.2 INTERPRETATION OF RESULTS

Note any characters that become visible. Only characters that are fully restored and have been verified will be reported.

9.10.5.2.2.1 COMPLETE RESTORATION

All characters of the serial number are visible after restoration attempt

9.10.5.2.2.2 PARTIAL RESTORATION

Not all characters of the serial number are visible after restoration attempt. Unrestored characters will be represented clearly by a "?" or similar symbol.

9.10.5.2.2.3 UNSUCCESSFUL RESTORATION

No characters are visible after restoration attempt.

9.10.5.3 CHEMICAL RESTORATION

The chemical restoration procedure or sometimes referred to as the chemical or acid etching procedure is suitable for restoration of serial numbers in metal. The die stamping process is a form of "cold-working" metal. A side effect of cold-working is the decrease of that item's ability to resist chemical attack. Therefore the utilization of chemical etching will affect the compressed area of the obliterated number faster and to a greater degree than the non cold-worked area surrounding it.

MATERIALS

Note: reagents below are listed in order of increasing strength, with the weakest listed first.

- Magnetic/ Ferrous media
  - Fry's Reagent
  - Turner's Reagent
  - 25% Nitric Acid
  - 50% Hydrochloric Acid
  - Chromic Acid
- Non-magnetic/ Non-ferrous media
  - Ferric Chloride
  - Acidic Ferric Chloride
  - 25% Nitric Acid
  - 10% Sodium Hydroxide

- Phosphoric/ Nitric Acid
- 50% Hydrochloric Acid

9.10.5.3.1 PROCEDURES

- Prep the area by using the polishing procedure if necessary.
- Determine the serial number medium's physical properties, i.e. magnetic or non-magnetic.
- Utilize appropriate chemical reagent.
- Apply the chemical solution to the area of obliteration utilizing cotton tip applicators or swabs that have been moistened with the chemical solution.

9.10.5.3.2 INTERPRETATION OF RESULTS

Note any characters that become visible. Only characters that are fully restored and have been verified will be reported.

9.10.5.3.2.1 COMPLETE RESTORATION

All characters of the serial number are visible after restoration attempt.

9.10.5.3.2.2 PARTIAL RESTORATION

Not all characters of the serial number are visible after restoration attempt. Unrestored characters will be represented clearly by a "?" or similar symbol.

9.10.5.3.2.3 UNSUCCESSFUL RESTORATION

No characters are visible after restoration attempt.

9.10.5.3.3 VERIFICATIONS

All analytical conclusions reached during a serial number restoration will be verified by a second examiner and will be documented on the *Serial Number Restoration Worksheet (FA-FORM-10)*.

9.10.5.3.4 ADDITIONAL DOCUMENTATION

Additional types of documentation that may be considered are as follows:

- Photographs depicting comparison or characteristics
- Sufficient notes

9.10.6 REFERENCES

- Association of Firearm and Toolmark Examiners (AFTE) Technical Procedures Manual, 2015, p. 81-84.
- Bureau of Alcohol, Tobacco and Firearms Laboratory, Serial Number Restoration Handbook, 2007.
- Deats, Marcellus, "Serial Number Restoration Information", AFTE Journal, 1980, Vol. 12, No. 3, p. 82.
- Mathews, J. Howard, Firearms Identification, Vol. I, 1962.

- Miller, Ken E., "Current Assist for Die Stamp Impression Restoration", AFTE Journal, 1972, Vol. 4, No. 3, p. 38.
- Polk, Donald, E. and Giessen, Bill, C. "Metallurgical Aspects of Serial Number Recovery", AFTE Journal, 1989, Vol. 21, No. 2, p. 174.
- Treptow, Richard, S., Handbook of Methods for the Restoration of Obliterated Serial Numbers, NASA, 1978.
- Turley, Dennis M., "Restoration of Stamp Marks on Steel Components by Etching and Magnetic Techniques", Journal of Forensic Science, 1987, Vol. 32, No. 3, p. 640.

10 MEASUREMENT UNCERTAINTY ESTIMATION PROCEDURE

10.1 INTRODUCTION

The following are the procedures that will be used for the measurement uncertainty calculations conducted for firearm barrel and overall length measurements and distance determination testing test panel creation. An uncertainty budget will be created for each using all appropriate measurement data and will be maintained on *Firearm and Toolmark Uncertainty Budget Form (FA-FORM-63)*.

Traceability is established for measurements through the performance verification of the applicable measuring devices. Performance verifications will be completed using a NIST certified standard ruler with a calibration certificate.

10.2 EQUIPMENT

Equipment used in each method includes:

FIREARM BARREL AND OVERALL LENGTH

- Multiple steel rulers with 1/16 inch scale markings of the same type
- Wooden dowel when applicable.

DISTANCE DETERMINATION TEST PANEL CREATION

- Laser measuring device
- Remote firing platform
- Test panel stand

10.3 CALCULATION OF THE ESTIMATION OF UNCERTAINTY

The following uncertainty components were considered:

- Temperature
- Measuring ruler uncertainty (for firearm length measurements)
- Laser measuring device uncertainty (for Distance Determination test panel creation)
- Multiple analysts
- Technique used
- Standard ruler uncertainty
- Length scale readability (for firearm length measurements)
- Training and experience level of analysts

The effect of temperature on the stainless steel rulers and the laser measuring device was evaluated and determined to have an insignificant effect as an uncertainty component and will not be included in the calculations.

The following is a list of the remaining uncertainty components that will be included in the uncertainty calculations and how each will be evaluated:

Uncertainty Component	Method of Evaluation
Standard ruler uncertainty	Type B
Measuring ruler uncertainty	Type B
Laser measuring device uncertainty	Type B
Length scale readability	Type B
Multiple analysts	Type A (covered in reproducibility data)
Training and experience level of analyst	Type A (covered in reproducibility data)
Technique used	Type A (covered in reproducibility data)

10.3.1 TYPE A UNCERTAINTY

Type A uncertainty is determined through the documentation of repeatable data.

FIREARM LENGTH MEASUREMENTS

- Data for the calculation of the Type A uncertainty will be attained with each examiner measuring the barrel length and overall length of a rifle or shotgun from the Firearm Reference Collection.
- The amount of data collected should be greater than 30 measurements. It is recommended that three measurements per day are taken for a total of five days by each examiner in the section.
- The ruler used by the examiner in case work will be used by that examiner for these measurements.
- Data will be collected for overall length measurement and for barrel length measurements both using a dowel inside the barrel and by measuring the exterior of the barrel.
- Measurements will be available on the S:drive.
- The mean and standard deviation of the data will be calculated.
- Reproducibility data will be expressed in inches and converted to a decimal. The data is considered to have a normal distribution and the standard deviation of the data will be divided by 1.

DISTANCE DETERMINATION TEST PANEL CREATION

- Data for the calculation of the Type A uncertainty will be attained with each examiner measuring the distance of the muzzle of a firearm from the Firearm Reference Collection mounted on the firing platform to a test panel mounted on the panel stand.
- The amount of data collected should be greater than 30 measurements. It is recommended that three measurements per day are taken for a total of five days by each examiner in the section.
- The laser measuring device will be used by each examiner for these measurements.

- Measurements will be available on the S:drive.
- The mean and standard deviation of the data will be calculated.
- Reproducibility data will be expressed in inches and converted to a decimal. The data is considered to have a normal distribution and the standard deviation of the data will be divided by 1.

10.3.2 TYPE B UNCERTAINTY

Type B uncertainties arise from characteristic biases present in the measuring system that cannot be completely eliminated. The standard uncertainties for Type B uncertainties will be evaluated as follows:

- The certificate of calibration for the standard ruler, the measuring rulers, and the laser measuring device will be reviewed. It can be assumed that a normal distribution with a coverage factor of 2 and a coverage probability of approximately 95% was used.
  - The reported uncertainty on the certificate will be divided by 2 to determine the standard uncertainty.
- Length scale readability is the smallest increment that can be detected by the ruler being used for the measurement. The uncertainty budget will have an entry at the "zero" and the 36 inch mark using the appropriate length scale readability.
  - The length scale readability will be expressed in inches, evaluated as a rectangular distribution and divided by $\sqrt{3}$ to determine its standard uncertainty.

10.3.3 COMBINED UNCERTAINTY

The Combined Uncertainty ($U_{combined}$) is determined using the formula:

$U_{combined} = \sqrt{(U^2_{process} + U^2_{readabilty} + U^2_{readabilty} + U^2_{calibration})}$, (U = Type A and Type B uncertainties)

10.3.4 EXPANDED UNCERTAINTY

The Expanded Uncertainty ($U_{expanded}$) is determined using the formula:

$U_{expanded} = U_{combined} \times k$ (k = coverage factor)

- For a large amount of data (n>30)
  - 95.45% confidence, k = 2
  - 99.73% confidence, k = 3

After calculation, the Expanded Uncertainty will be evaluated to determine if it is acceptable. If it is found not to be acceptable, possible changes or improvements to areas of the method should be considered. If any changes are made, the estimation of uncertainty should be re-evaluated.

The calculated Expanded Uncertainty will be used in the estimated uncertainty of measurement.

10.4 REPORTING THE UNCERTAINTY

Reporting of uncertainty measurements will be as follows:

- Firearm Length Measurements
  - See §9.2.5.4.3 of the *Firearm and Toolmark Section Quality Manual*.
- Distance Determination Test Panel Creation
  - The estimation of uncertainty only needs to be recorded in the case notes and will be expressed as an expanded uncertainty and include the coverage factor.
  - The measured distance of each panel will be recorded to the nearest one-hundredth of an inch.
  - The uncertainty for the measured distance will be documented at the 99.73% coverage probability.
  - Documentation Example
    - The test panels were made at the following distances: 6.00 in., 12.00 in., 18.00 in., and 24 in. +/- 0.31 in. at a coverage probability of 99.73%.