MNPD Crime Laboratory

Firearms/Toolmark Technical Procedures Manual

Metropolitan Government of Nashville & Davidson County
Police Department

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INTRODUCTION AND SCOPE

This Technical Procedures Manual (TPM) is comprised of procedures obtained from the Association of Firearm and Tool Mark Examiners (AFTE) Procedures Manual and other sources listed in references. The purpose of this TPM is to give the Firearms Examiner and Forensic Technician in the FTIU easy access to the procedures they would encounter in everyday forensic examinations. This manual presents a basic outline of the procedures most routinely used to analyze evidence submitted to the Firearm and Toolmark Identification Unit (FTIU) of the Metropolitan Nashville Police Department Crime Laboratory (MNPD-CL). This manual, in combination with the FTIU Quality Manual and FTIU Technical Training Manual (TTM), provides the basis for effective quality assurance of analysis. The MNPD-CL Quality Manual (QM) provides additional guidelines. It is the purpose of these manuals to provide the basic framework and foundation of examination procedures for the Firearm Examiner and Forensic Technician.

The MNPD-CL FTIU is responsible for conducting Forensic Firearm and Toolmark examinations, which relate to the examination and comparative analysis of firearms, ammunition components, tools and the markings they produce. This service is provided to our customers.

This document encompasses technical procedures for the examination of Firearm and Toolmark examinations, Gunshot Residue Testing pertaining to Distance Determination, Serial Number Restorations, and NIBIN entries and correlations. This document supersedes all previous documents that may exist relating to these examinations and is subject to change according to research, study, and laboratory policy.

The body of knowledge which comprises forensic Firearm and Toolmark Identification within the area of Forensic Science is a compilation of procedures adapted from other disciplines that encompass many of the physical and natural sciences. The Firearm and Toolmark Identification discipline within the Forensic Science community has a very long history and has an enormous amount of data and studies to contribute to the overall validation of this specific discipline. A multitude of individuals have greatly contributed to the protocols, methods and procedures that have become part of these routine examinations. Many procedures referenced have been adapted from standard laboratory practices and, therefore, no specific reference may be available.

This manual is designed to give guidelines that range from how to perform examinations to how to render conclusions from those examinations. Every effort has been made to document the best practices used in this discipline and therefore establish procedures used by this unit, and to provide the appropriate references. Alternative procedures, other than those listed, may be employed with the approval of the Unit Supervisor.

The Metropolitan Nashville Police Department Crime Laboratory (MNPD-CL) Firearms and Toolmark Identification Unit (FTIU) will follow directives, policies, and procedures as set forth by the MNPD-CL Management System documents and the General Orders of the MNPD.

1 BULLET/PROJECTILE CLASSIFICATION AND EXAMINATION

1.1 Scope

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 microscopic comparison examination and in accordance with the MNPD-CL FTIU Quality Manual.

1.2 Instruments

Comparison Microscope

Stereo Microscope

Calipers

Micrometer

Balance

1.3 Examination Procedures

1.3.1 General, Physical and Visual Examination

To accurately classify a bullet, the firearm examiner should record the following data, when possible:

- The number of land and groove impressions present
- The direction of twist
- The measured width of the land and groove impressions
- The bullet weight recorded in grains
- The base diameter
- The bullet design and composition (E.g., FMJ, TMJ, LRN, JHP, etc.)
- The possible manufacturer or marketer of the bullet
- The type and number of cannelures present
- The condition of the fired bullet
- The presence of trace material

As part of the examination process, the firearm examiner shall evaluate the unknown item(s) to identify characteristics suitable for comparison.

1.3.2 Caliber Determination

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

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

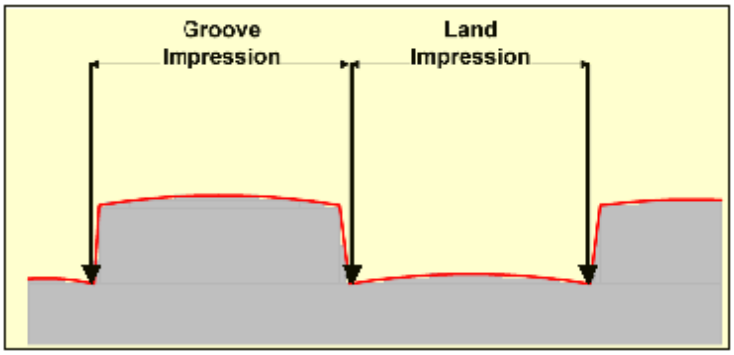
- Measure the base diameter of the evidence bullet using a measuring device and compare this measurement with known measurements published in reference literature.
- Compare the base diameter of the evidence bullet directly with known fired test standards.
- Determine the number and the widths of the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

1.3.2.1 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 can 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.

It may be necessary to measure several of the suitable land and groove impressions in order to obtain a reliable measurement. Each measurement taken will be recorded to the nearest hundredth of an inch and will be recorded in the notes for each bullet. For multiple bullets previously identified as having been fired from the same firearm, the land and groove impression widths of only one bullet need to be measured.

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



1.3.2.1.1 Comparison Microscope using Software

- The fired bullet in question is mounted on one stage of the comparison microscope.
- 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.

1.3.2.1.2 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.

1.3.2.1.3 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.

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.

1.5 Interpretation of Results

Caliber is written as a numerical term. 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.

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 may be included in the report as found appropriate.

1.6 Shotshell Pellets

1.6.1 General, Physical and Visual Examination

Documentation 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:

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

1.6.2 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 weighed together.
  - Consult known pellet weights in Table 1 and Table 2 of Section 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 Section 13 of the AFTE Glossary (6th Edition) and determine shot size, which corresponds to evidence shot.

1.6.3 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.

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

2.1 Scope

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 microscopic comparison examination and in accordance with MNPD-CL Quality Manual.

2.2 Instrumentation

Comparison Microscope

Stereo Microscope

Micrometer

Calipers

2.3 Procedures/Instructions

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 appropriately.

2.4 Cartridge Case/Cartridge Examination and Classification

- To accurately examine a cartridge case the firearm examiner or forensic technician may record the following data:
    - The caliber, commonly found on the headstamp, but may be determined or confirmed through comparison with known standards.
    - Headstamp information and the possible manufacturer.
    - Description of cartridge case and primer composition/finish.
    - Presence and type of sealant if any.
    - Description of the ignition system (E.g., centerfire, rimfire, etc.).
    - Description of the firing pin impression.
    - Description of the breechface marks.
    - Description of the extractor and ejector marks.
    - Cartridge case magnetic or not.
    - Presence and location of any visible trace material.
    - Description of other markings, to include: resizing marks, chamber marks, magazine marks, ejection marks, and any other marks of value.

- Whenever possible, the firearm examiner or forensic technician shall mark the cartridge case away from important markings with the laboratory case number, exhibit number, and initials.
- As part of the examination process, the firearm examiner shall evaluate the unknown item(s) to identify characteristics suitable for comparison.

2.4.1 Shotshell Case Examination and Classification

- To accurately describe a shotshell, the firearm examiner may record the following data on the Shotshell Worksheet or in the case notes:
    - The caliber or gauge, commonly found on the headstamp, but may be determined or confirmed through comparison to known standards.
    - Markings located on the sides of the shotshell indicating load size, length, OZ of shot, and possible dram equivalent
    - Headstamp information and the possible manufacturer of the shotshell.
    - Description of case hull and primer finish.
    - Presence and type of sealant.
    - Note high or low brass.
    - Chamber length.
    - Shotshell crimp type.
    - Description of the firing pin impression.
    - Description of the breechface marks.
    - Description of the extractor and ejector marks.
    - Presence and location of any visible trace material.
    - Description of other markings, to include: resizing marks, chamber marks, magazine marks, ejection marks, and any other marks of value.
- Whenever possible the firearm examiner should mark the shotshell case away from important markings with the laboratory case number, exhibit number, and initials.
- As part of the examination process, the firearm examiner will evaluate the unknown item(s) to identify characteristics suitable for comparison.

2.4.2 Shotgun Wadding Examination and Classification

- Directly compare the evidence shot wad to known laboratory standards of similar composition, type and design to determine manufacture and type of wadding (E.g., Winchester AA, Remington Power Piston, etc.). For gauge determination, directly compare the base of the evidence shot wad to the bases of the standards until a similar size is found.
- Measure the base diameter of the wad and compare these measurements to known measurements listed in manufacturer's indexes.
- Weigh the shot wad.
- Microscopic examination may reveal striations suitable for comparison.
- Microscopic examination may reveal manufacturers data stamped into the wad.
- If evidence shotshells are submitted, it may be necessary to disassemble one for the determination of gauge size or similarity of manufacture.

3 PHYSICAL EXAMINATION AND CLASSIFICATION OF FIREARMS PROCEDURE

3.1 Scope

This procedure is used for the initial examination and classification of a firearm.

3.2 Precautions/Limitations

The firearm examiner shall visually inspect the firearm to ensure that it is not loaded. If loaded, care must be taken to unload the firearm chamber and source of ammunition from the firearm (magazine, tube, etc.) If unsure of how to unload safely, seek technical assistance.

3.3 Procedures/Instructions

Remove the firearm from the packaging and ensure the firearm is unloaded. If a magazine is received in a loaded condition, it must first be unloaded prior to conducting any examinations when using it with a firearm.

Follow safe firearm handling procedures at all times.

- It is the examiners discretion as to which worksheet will work best for the documentation of the evidence. Documentation should include the following information when applicable:
- Laboratory Number and Exhibit Number assigned to the firearm
- Initials of the examiner/technician
- Date of examination
- Manufacturer and Model
    - On revolvers, determine which direction the cylinder rotates.
    - Determine if the revolver will fire in the single/double-action mode for which it was designed for.
    - When the hammer is cocked on firearms that fire in the single-action mode, determine if the hammer can be pushed off the sear.
    - Determine if there are any missing or broken parts.
- Caliber/Gauge
- Type
- Serial Number
- General Rifling Characteristics
- Safeties
    - If any safety or other component/system of the firearm is found to be defective, this defect shall be described, investigated, and accounted for, to the extent possible. Any misfires or operational problems encountered during test firing shall be noted on the firearm worksheet or in the examiner's notes.
- Operating Condition
    - Before test firing, the examiner shall test all semi-automatic firearms to ensure that they have not been altered intentionally, environmentally or have a mechanical malfunction and/or designed to fire as automatic firearms.

- Bore Condition
- Trigger Pull
    - Trigger pull is defined as the amount of force which must be applied to the trigger of a firearm to cause sear release. Trigger pull may be recorded as a descriptor but not reported unless a 282 request is received in which case the UoM procedure will be followed.
        - Single Action Trigger Pull
            - Ensure that the firearm is unloaded.
            - Use the dead weight method with the barrel of the firearm perpendicular to the ground/floor.
            - Rest the trigger hook of the standard trigger weight hanger on the trigger where the average finger would normally rest, making sure it is not touching any other part of the firearm.
            - The firearm will be cocked in the single action mode, with the safeties disengaged.
            - Record in pounds the least amount of weight the trigger can carry that releases the hammer/striker from sear engagement.
        - Double Action Trigger Pull
            - Ensure that the firearm is unloaded.
            - Use the dead weight method with the barrel of the firearm perpendicular to the ground/floor.
            - Rest the trigger hook of the standard trigger weight hanger on the trigger where the average finger would normally rest, making sure it is not touching any other part of the firearm.
            - The firearm should be in the double action mode with the hammer at rest and the safeties disengaged.
            - Record in pounds the least amount of weight the trigger can carry that releases the hammer/striker from sear engagement.
- Firing Pin
    - Examine the firing pin and note its shape (E.g., hemispherical, rectangular, elliptical, etc.).
    - Firing pin type (E.g., striker, inertia, fixed, etc.).
- Finish
- Capacity
    - On revolvers, enter the number of chambers in the cylinder.
    - For other guns, determine the maximum number of cartridges that can be loaded in the firearm, which may include chamber(s), internal magazine, or submitted detachable magazine(s).
    - Always use dummy rounds when determining capacity, except in those instances where no dummy rounds are available. Live ammunition may be used in a safe area (shoot tank/range). If live ammo is used, these cartridges must not be returned to the reference ammunition collection.
- Magazine(s)
    - Determine the capacity of magazine(s) submitted with the evidence firearm.

    - If magazine submitted with the firearm does not fit the firearm, this shall be noted. If the examiner can determine the type/manufacturer of the firearm that the magazine does fit, it should be noted.
- Barrel length/Overall length
- Ammunition Used for Test Firing
    - Submitted evidence cartridges may be used for test firing.
    - Record manufacturer, caliber, cartridge type, and bullet weight.
    - If submitted evidence ammunition is used for test firing, it must be clearly reflected in the case notes and report.
- Location of Identifying Marks

4 TEST FIRING PROCEDURE

4.1 Scope

To further test the operability of a firearm and to collect ammunition components for microscopic comparisons, a minimum of two (2) test shots should be fired and recovered. Recovery methods include the bullet recovery water tank, and the test firing range. The type of firearm, ammunition used, and the experience of the firearm examiner/technician shall dictate the type of recovery method used. This procedure describes test firing practices.

4.2 Precautions/Limitations

The firearm examiner/technician shall visually inspect the firearm to ensure the firearm is not loaded and that the barrel and chamber are free of any obstructions. If loaded, care must be taken to unload the source of ammunition (magazine, tube, etc.) and any ammunition from the chamber area and/or action.

4.3 Procedures/Instructions

4.3.1 General Procedures

The following general procedures should be followed for all test firing. The appropriate recovery system will be determined by the firearm examiner or technician.

- Ensure that the firearm is SAFE to fire. Examine to ensure the bore is unobstructed.
- ALWAYS wear appropriate eye and ear protection.
- Ensure that the door to the range is closed securely and that the exhaust fans are turned on during firing.
- A second person, “spotter”, may be present during all test-firing, if possible. At a minimum, a second person must be notified and observe on camera or be connected by phone when an examiner/technician is test firing. If the spotter is physically present, they must wear the appropriate hearing protection.
- Use ammunition designed for the firearm.
    - There will be exceptions to the above when the suspect may have fired ammunition components in a firearm that was not designed to fire them. (E.g., 16

gauge shotshell in a 12 gauge shotgun, or a 357 Magnum cartridge fired in a 30-30 rifle.)
    - On those occasions where ammunition not designed for a firearm must be fired in that firearm, extreme caution shall be maintained. Firing the firearm remotely may be the best option.
- Treat every barrel of multiple barreled firearms separately.
- Fire at least two (2) rounds for all firearms (barrels), although three or more (3+) rounds are recommended when a bullet comparison is necessary. These will be fired into a bullet recovery system. The examiner may need to fire additional rounds if multiple ammunition types are received as evidence, the tests are not reproducing consistently, the exact type of ammunition is not available, or any other reason necessitating additional test fires.
- A maximum of one cartridge at a time may be loaded in a magazine for semi-automatic/automatic firearms when firing in the bullet recovery water tank.
- In certain cases it may be necessary to clean the bore after the first test shots, and before firing any additional test shots. The firearm should be fired as received except when the bore is rusted, corroded, or blocked by mud/dirt.
- The examiner may choose to pre-mark the test cartridges with marks to assist in phasing during microscopic examination or marks indicating the sequence of fire. This may be done by placing a phase mark on the ogive of the bullet extending down on to the casing, and chambering the round with the mark at the 12 o'clock position.
- After test firing, if evidence cartridges were used, the examiner should mark the bullet and cartridge case with the laboratory number and/or the exhibit number, and the examiner's initials.
- A small container should be used to hold test fired bullets and cartridge cases. One side of the container should be marked with the following information:
    - Make, Model, Serial Number, Caliber, Laboratory Case Number, Exhibit Number, Agency Case Number, Occurrence Type, and Occurrence Date
        - If the firearm is manufactured without a serial number, "N/A" or "None" should be designated.
        - If the serial number had been obliterated and restored, the recovered serial number should be listed.
        - If the serial number had been obliterated, and restoration was not possible, a notation of "obliterated" should be designated.
- **Test fired ammunition will not be routinely used for comparison purposes in evidence examination but mainly as an individual characteristic database. All test fired ammunition will be uniquely identified, sealed, inventoried, and placed in a secure limited access location.**

4.3.2 Test Fire Selection and Handling

- Whenever practical, the firearm examiner should use laboratory reference ammunition that is similar to the submitted evidence.
- The firearm examiner may use ammunition submitted with the firearm if necessary.

- The ammunition shall be inspected first to ensure it is factory produced ammunition. Using reloaded ammunition may be necessary, but extreme caution should be exercised.

All test fires are considered reference materials and will be treated as such.

5 MALFUNCTIONING FIREARM PROCEDURE

5.1 Scope

In some instances, it may be necessary 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?" Examinations may include external and internal observations, or striking or dropping the firearm in attempts to duplicate the incident as reported. The firearm examiner should attempt to conduct the examinations in a manner so as not to alter the firearm. However, there may be occasions when damage may occur. Any change to the firearm shall be specifically documented in the examiner's notes.

5.2 Precautions/Limitations

The firearm examiner shall visually inspect the firearm to ensure that it is not loaded. If loaded, immediate steps should be taken to ensure that the firearm is safely unloaded. Care shall be exercised when the force to be used in testing could alter or damage internal parts and their working relationship(s). Damage caused by the examiner may prevent the examiner from determining the cause of the reported malfunction.

The firearm examiner should consult available manufacturer specification publications as well as disassembly/assembly and exploded diagram manuals.

5.3 Procedures/Instructions

While it may not always be necessary to disassemble the firearm at this point in the examination, the firearm examiner or technician will have the discretion to disassemble a firearm when:

- The firearm is damaged upon receipt and incapable of being rendered safe or test fired as received.
- The firearm is rusted or corroded and disassembly is necessary for rendering the firearm functional and safe for test firing.
- The firearm is suspected as having been altered for full automatic fire. If full automatic conversion is suspected, the examiner shall test fire the firearm in its original, "as received", condition before disassembly.
- Any other condition as to where the firearms examiner may deem as necessary to disassemble.

Extreme caution should be exercised if disassembly is required. Proper documentation must be made prior to disassembly and during the disassembly process.

As part of this procedure, the firearms examiner may perform an "impact test" on the firearm utilizing a primed cartridge case. An "impact test" is used to determine if the firearm will discharge because of any type of impact. An "impact test" should consist of the following steps:

- Ensure that the firearm is unloaded.
- Load a primed cartridge case into the chamber of the firearm. A dummy round may also be used with "sticky wax" or other similar type of material in the primer pocket to detect a firing pin strike.
- Holding the muzzle away, strike the firearm forcibly with a rubber mallet, or other nonmarring impact tool, on the top, bottom, right side, left side, and back of the firearm.
- Check and observe if the firing pin has penetrated the primer pocket area. Document all observations.
- The examiner should repeat these strikes while the firearm is in various operating stages (i.e.; single-action, double action, safety on, safety off, and any other possible combinations).

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:

The firearm examiner should examine the physical condition of the firearm as received, and document the following as necessary:

- Cocked/un-cocked
- Safety position (i.e., off or on safe)
- Loaded/unloaded
- Cartridge position (for revolvers only)
- Stuck cartridges and/or fired cartridge cases
- Presence and/or location of flare marks (revolvers only)

5.4 Visual Abnormalities

The firearm examiner should look for the following abnormalities, and document as necessary:

- Barrel (loose, etc.)
- Barrel (outside bulge, inside bulge ring)
- Receiver (cracked, etc.)
- Slide (condition)
- Parts broken or missing
- Screws (loose or missing)
- Alterations
- Sights (loose or missing)

5.5 Action (External)

- Relationships of the action parts
- Correct assembly

- The proper locking of the action on closing
- Cylinder rotation (securely locks)
- Hand relationship to the ratchet (worn)
- Trigger (not returning to forward position, sticks, broken spring, etc.)
- Trigger pull (single action, double action) and striking of hammer

5.6 Action (Internal)

Disassembly is required to check internal parts for condition and operability

- Hammer notch – check for burrs, dirt, wear, or other abnormalities
- Check the sear to see if broken, worn, or altered
- Make sure safeties are in correct alignment
- Check to see if springs are broken, worn, or altered
- Check for signs of any tampering or faulty assembly
- Any other observations that may have an impact on the function of the firearm

5.7 Safeties

The safeties should be individually checked for operability and inspected for damage to both passive and manual safety components.

- Full cock, seating check (any false seating positions, push off, etc.)
- Grip, magazine, disconnector
- Thumb/finger – note positions when firearm will fire
- Rebound hammer or inertia firing pin
- Firing pin condition
- Drop hammer several times to check above safeties
- Position of the slide or bolt in order to fire (out of battery discharge)
- Condition of safeties
- Any other observations that may have an impact on the safety features of the firearm

5.8 Action Check

- Check feeding (magazine, carrier or lifter, feed ramp, magazine lips, etc.)
- Check for the possibility of slam fires
- Check for unusual marks exhibited on the cartridges/fired cartridge cases submitted with the firearm

5.9 Test Fire Firearm

- Note any operational problems (misfires, failure to feed, failure to extract/eject, etc.)
- Check the integrity/condition of fired cartridge cases

6 AUTOMATIC FIREARM PROCEDURE

6.1 Scope

To determine if a firearm is capable of full automatic fire, whether manufactured as a full automatic firearm, or showing signs of modification and/or alteration. Firearms suspected of the capability of full automatic fire require research and special safety precautions during test firing.

These procedures may coincide with the Malfunctioning Firearm Procedure.

6.2 Precautions/Limitations

The firearm examiner shall visually inspect the firearm to ensure it is not loaded. If loaded, immediate steps shall be taken to ensure the firearm is safely unloaded.

The firearm examiner should consult available manufacturer specification publications as well as disassembly/assembly and exploded diagram manuals.

6.3 Performing an External Examination (Disconnector Function)

A disconnector is defined as a device intended to disengage the sear from the trigger. In semi-automatic firearms, it is intended to prevent full automatic firing.

- Dry Fire Check – Ensure that the firearm is unloaded then manually cock the hammer/ striker assembly. Note: A dummy cartridge with a primer pocket filled with wax material can be utilized in this examination to observe if the firing pin has penetrated the primer area.
- Pull the trigger to cause sear release, applying constant pressure to the trigger (do not release).
- Cock the hammer/striker assembly.
- Release the trigger to determine if the disconnector has engaged the sear. There should be an audible click to signify engagement upon release of the trigger.
- Pull the trigger again.
- If the firearm does not dry fire (sear release) then it has failed this examination and may be capable of automatic mode of fire.
- If the firearm has a selector, perform the external test for each firing position the selector can be moved to which allows the firearm to fire. Keep in mind that a selector position which allows for full automatic fire may not be marked or in a position typical for semi-automatic versions of the examined firearm.
- If the firearm fires with an open bolt design, cock the bolt to the open position then dry fire the firearm keeping constant pressure on the trigger.
- Pull back the charging handle to cock the bolt. If the bolt will not cock while the trigger is depressed, then the firearm has failed the exam.
- Note: the lack of trigger disconnection after firing in some firearms may not lead to full automatic fire.

6.4 Examination of Firearm Modification/Conversion

- The firearm examiner may research the firearm to determine what parts or modifications are needed to make the firearm capable of full automatic fire.
- Look for external signs of conversion typical for your firearm. Do not field strip the firearm at this point.

- Pay close attention to firearms that have very light and/or inconsistent trigger pull. If you have a select-fire firearm that is capable of both semi-automatic and full automatic fire, you may measure and record the trigger pull in both modes.

6.5 Test Firing Suspected Modified/Converted Firearms

- Poorly converted firearms may be dangerous to shoot by hand. Therefore, the firearm examiner should consider the use of a remote firing device.
- If the cartridge case shows no signs of distress then place three cartridges in the magazine and pull the trigger leaving constant pressure on the trigger.
- If the firearm is capable of full automatic fire, the firearm should fire all three cartridges with one pull of the trigger.
- If the firearm has cartridge feeding issues try another brand of cartridges. For best results use only cartridges with full metal jacketed bullets.

6.6 Internal Examination of the Firearm

- Using research and/or experience, field strip and internally examine the firearm.
- Try to determine why the firearm is capable of full automatic fire if not designed as a full automatic firearm. Keep in mind that some firearms are capable of full automatic fire due to breakage of normal parts or poor maintenance of the firearm. It is recommended that the firearm examiner photograph any and all observations of conversion/ modifications.
- If you cannot find sufficient information concerning any aspect of observation and/or examination of the firearm then consultation with a technical advisor is recommended. Some Technical Advisors are located by viewing the AFTE website.

7 MICROSCOPIC EXAMINATION AND COMPARISON

The MNPD-CL, Firearm and Toolmark Identification Unit conducts side-by-side, microscopic comparisons of known and questioned items. These microscopic comparisons can be utilized in determining if an item, such as a fired bullet, fired cartridge case, or fired shotshell, has been fired in a particular firearm. This process can also be used to determine if a fired 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.

The basis for identification in the discipline of Firearm and Toolmark Identification is founded on the principle of uniqueness, and is described in detail in the AFTE Theory of Identification, which states:

1. The theory of identification as it pertains to the comparison of toolmarks enables opinions of common origin to be made when the unique surface contours of two toolmarks are in “sufficient agreement.”

2. This “sufficient agreement” is related to the significant duplication of random toolmarks as evidenced by the correspondence of a pattern or combination of patterns of surface contours. Significance is determined by the comparative examination of two

or more sets of surface contour patterns comprised of individual peaks, ridges and furrows. Specifically, the relative height or depth, width, curvature and spatial relationship of the individual peaks, ridges and furrows within one set of surface contours are defined and compared to the corresponding features in the second set of surface contours. Agreement is significant when the agreement in individual characteristics exceeds the best agreement demonstrated between toolmarks known to have been produced by different tools and is consistent with agreement demonstrated by toolmarks known to have been produced by the same tool. The statement that "sufficient agreement" exists between two toolmarks means that the agreement of individual characteristics is of a quantity and quality that the likelihood another tool could have made the mark is so remote as to be considered a practical impossibility.

3. Currently the interpretation of individualization/identification is subjective in nature, founded on scientific principles and based on the examiner's training and experience.

7.1 Summary of the Examination Method

The examination methodology is a process that begins with the evaluation of the class characteristics and ends with the analysis of individual characteristics. This process is outlined below.

7.1.1 Evaluation

The unknown(s) should be documented and evaluated to identify characteristics suitable for comparison prior to comparison with a known. 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. The initial examination phase evaluates evidence to determine if the observed class characteristics are the same between two specimens (two unknown specimens, or an unknown and a known specimen). If the specimens are suitable for examination and the class characteristics are the same, then it is possible that the toolmarks were produced utilizing the same tool (such as a firearm). If they are different, then the two specimens can be eliminated as being produced by the same tool.

7.1.2 Comparison

If the class characteristics are consistent between two specimens, then a comparative examination is performed utilizing a comparison microscope. The methodology utilized in the examination process is pattern matching. This comparison is conducted to determine: 1) if any marks present are subclass characteristics and/or individual characteristics, and 2) the level of correspondence of any individual characteristics.

7.1.3 Conclusion

If sufficient agreement of individual characteristics is observed between two specimens, an identification conclusion is rendered. If all the discernible class characteristics are the same, but sufficient agreement or disagreement of the individual characteristics is not observed, then an inconclusive determination is rendered. In certain situations, an elimination conclusion may be rendered on observed differences in individual characteristics.

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 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.

7.2 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.

7.3 Conclusion Not Evident

If a conclusion is not initially evident, the examiner should consider the following factors:

- Angle of lights
- Type of lights
- Need for additional known standards
- Position of the evidence, the tests, or both
- Possibility of cleaning the firearm or tool and producing new tests
- Possibility that the firearm or tool has changed
- Possibility that a different firearm or tool was used
- The entire unknown should be considered

8 DISTANCE DETERMINATION: VISUAL, MICROSCOPIC, AND CHEMICAL PROCEDURES

8.1 Scope

Gunshot residues are discharged from a firearm during the firing process. These residues will be in the form of burnt, partially burnt, and unburned gunpowder particles, vaporous lead and particulate metals. Muzzle-to-target distance determination is based on gunshot residue examination and/or shot pellet patterning examinations, and the comparison of these residue patterns to those produced by the suspect firearm and like ammunition, at known distances. The comparison of these gunshot residues, along with the morphology of the bullet hole or the size of the pellet pattern, can effectively be used in determining whether an item of evidence/clothing was in the near proximity of a firearm when discharged, and to give a range for the muzzle-to-target distance.

8.2 Precautions/Limitations

The firearm examiner shall handle the evidence as gently as possible, keeping in mind that the residues are very fragile by nature and can be lost if mishandled.

Because of the variations observed between different firearms and ammunition, it is imperative that the suspect firearm and like ammunition be used for producing test patterns. If the firearm is unavailable or unsafe to fire, the same type firearm may be substituted from the Firearms Reference Collection. Care should be taken to ensure the barrel length of the reference firearm is the same as the suspect firearm. Ammunition of the same type and design may be substituted for evidence ammunition when the known components are the same.

At the discretion of the firearm examiner, distance determination examinations may not be conducted until a suspect firearm is confirmed through microscopic comparison of the evidence bullet(s) and/or cartridge case(s) to test fired ammunition components.

8.3 Hazards/Safety

It is the responsibility of the firearm examiner to employ appropriate safety and health practices.

Safe firearm handling procedures shall be strictly followed at all times.

Appropriate hearing and eye protection shall be worn during test firing.

Proper caution shall be exercised and the use of personal protective equipment shall be considered to avoid exposure to dangerous chemicals. It is recommended that the firearm examiner consult the appropriate Safety Data Sheet (SDS) for each chemical prior to use.

The examiner shall use gloves, and work within a fume hood when preparing all reagents.

When mixing acid and water the firearm examiner shall add acid to water. Never should water be added to acid!

Sulfanilic Acid is toxic and a corrosive and can pose a **SEVERE HEALTH AND CONTACT HAZARD.**

Alpha Naphthol is toxic and can pose a **SEVERE HEALTH HAZARD.**

Methanol is flammable and can pose a **SEVERE FLAMMABILITY HAZARD.** Methanol is also a poison and can pose a severe **CONTACT AND HEALTH HAZARD.**

Glacial Acetic acid is a corrosive and can pose a **SEVERE CONTACT HAZARD**. Glacial Acetic acid is also flammable and can pose a **SEVERE FLAMMABILITY HAZARD.**

Hydrochloric Acid is toxic and a corrosive and can pose a **SEVERE HEALTH AND CONTACT HAZARD.**

8.4 Procedures and Methodology

Prior to performing distance determination examinations on evidence items, a link should be established through microscopic comparison of a bullet(s) and/or cartridge case(s) to a firearm.

Additionally, the ammunition manufacturer and type should be determined by comparison to evidence ammunition, or by utilizing the Ammunition Reference Collection.

Prior to microscopic and chemical examination of evidence items for gunshot residues, the items must be thoroughly documented and photographed, including a written description of the evidence item and packaging, the locations of any holes in the items, and a sketch or photograph of the item indicating the locations of the holes and other observations (blood, cuts made by medical personnel, etc.). The location of the examiner's marking should be indicated in the notes or sketch/photograph. If available, a copy of the autopsy report and diagram of gunshot wounds should be attained and reviewed.

8.5 Visual Examination

Evidence items will be visually examined for observable physical characteristics of gunshot residues. This examination should be performed in an uncontaminated area in the GSR room using a variable power stereomicroscope with adequate lighting.

During the visual examination, the examiner will look for physical effects that are indicative of, or consistent with, the discharge of a firearm. These effects include:

- A hole in the item (pattern of pellet holes).
- Stellate, or star-shaped, tearing of the item (consistent with contact gunshots).
- Vaporous lead (smoke).
- Soot
- Particulate metals (shavings of lead, copper, brass).
- Unburned, partially burned and/or burned gunpowder particles.
- Melted adhering gunpowder.
- Burned and/or singed fibers, or melted artificial fibers.

Other observations may include:

- The location of all holes, tears, missing buttons, etc.
- The presence of any possible masking effects (blood, mud, etc.).
- The direction of artifacts surrounding the hole.

All observations regarding these physical effects and visible residues shall be included in the firearm examiners notes, sketch/photographs and/or appropriate worksheet. Photographic documentation of these effects may aid in the documentation. Transparent overlays may be useful in documenting partially burned and unburned gunpowder particles, and their locations relative to the bullet hole(s). The Leeds Spectral Vision may be used when photographing gunpowder particles.

8.6 Chemical Examination Methods

8.6.1 Modified Griess Test Method

The Modified Griess test utilizes a chemical color 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 nitrous acid combines with Sulfanilic Acid and then Alpha-Naphthol to produce an orange-red color reaction.

It is at the discretion of the firearm examiner to conduct a Modified Griess Test when physical effects indicate a contact gunshot, or shot pattern. All other distance determination examinations require a Modified Griess Test.

The Modified Griess Test will be performed in an uncontaminated fume hood using a clean iron. The following steps will be followed when conducting a Modified Griess Test:

- Place the evidence item questioned side down on the emulsion-coated side of the treated photographic paper. Using a pencil or other marking device, index suspected bullet/pellet holes.
- Soak a piece of nitrite-free cheesecloth/gauze in a solution of 15% Acetic Acid and wring it out. Place the cheesecloth/gauze on the questioned item as the third layer.
- Using a hot iron, press the cheesecloth/gauze forcing the Acetic Acid solution through the evidence item.
- Carefully remove and discard the cheesecloth/gauze. Carefully separate the evidence item from the photographic paper.
- Examine the photographic paper for the presence of orange chromophoric reactions. The presence of orange coloration on the photographic paper is specific for the presence of nitrite residues.
- Record the results of this test in notes, on worksheets, or photographically.

8.6.2 The Reverse Modified Griess Test Method

The Reverse Modified Griess Test is used for non-porous evidence items, which would interfere with the penetration of the Acetic Acid solution through the item.

The following steps will be followed when conducting a Reverse Modified Griess Test:

- Wipe the emulsion-coated side of the photographic paper with a piece of cheesecloth/gauze saturated with the 15% Acetic Acid solution.
- Immediately place the photographic paper emulsion side down on the questioned surface. Apply a hot iron to the back of the photographic paper.
- Note: Placing filter paper between the iron the photographic paper can help prevent the photographic paper from sticking to the iron.
- Separate the photographic paper from the evidence item. Any orange indications on the photographic paper are the result of a chromophoric reaction chemically specific for the presence of nitrite residues.
- Record the results of this test in notes, on worksheets, or photographically.

8.6.3 Sodium Rhodizonate 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.

8.6.4 Direct Application Technique (DAT)

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

8.6.5 Bashinsky Transfer Technique (BTT)

- Place a piece of Whatman filter paper over the appropriate area of the questioned item.
- Using a pencil or other marking device, index the suspected bullet/pellet holes.
- Uniformly dampen the filter paper while on the questioned item by spraying with a 15% solution of Acetic Acid.
- Cover the dampened filter paper with several layers of dry filter paper.
- Apply a hot iron to the filter papers and iron it until the damp paper is dry.
- Remove the filter paper which was in direct contact with the evidence item, and process it as in the direct application method. Note: Any positive reactions are a mirror image of the deposition of the questioned item.)
- Record the results of this testing in notes, on worksheet, and/or photographically.

8.6.6 Shot Pellet Patterning Methods

Shot patterns in evidence items/clothing should also be examined microscopically and chemically tested for nitrites and lead residues. This process may detect any possible bullet hole(s) or other residues within the shot pellet pattern.

The main basis for distance determination utilizing shot pellet patterns is simply the size and density of the shot pattern and the production of similar size patterns with the suspect firearm and similar ammunition.

8.6.6.1 Documentation of shot pellet patterns will include:

- The overall size of the pattern, including dimensional descriptions and measurements. A transparent grid may aid in the documentation and measurement of shot pellet patterns.
- Some pellet patterns will be elongated in shape due to the angles involved at the instance of firing. In the cases where elongated patterns are present, the narrower dimension of the elongated shot pellet pattern is the significant dimension and the basis of comparison with the diameter of test pellet patterns.
- Care should also be exercised when examining clothing items, as the body is a rounded object capable of many orientations, which must be accounted for when providing a muzzle-to-target distance bracket.
- The examiner can visually eliminate flyers, or holes which deviate from a roughly circular pattern.
- The examiner may need to examine the pellet pattern microscopically to detect finely divided plastic particulate, or filler material. Filler material may assist in identifying or corroborating the type of ammunition involved and is, in itself, indicative of the discharge of a shotgun.

A direct side-by-side comparison of the evidence pattern with test patterns produced with the suspect firearm and like ammunition, at known distances, is necessary to determine a muzzle-to-target range. The size of the patterns, and the density of the pellet holes, must be taken into consideration before arriving at a conclusion. The examiner must also conclude that the shot pellet pattern is complete, and not a partial pattern.

Note: A shot pellet pattern is not necessarily the product of a shotgun having been fired. There are numerous handgun loads by various manufacturers that fire shot pellets, especially in the smaller shot sizes.

Care must be taken when conducting a shot pellet pattern analysis when the evidence indicates a buckshot load was fired. Due to the limited number of pellets in buckshot loads, this type of ammunition rarely produces a circular pattern with a regular distribution of pellet holes.

8.6.7 Production of Test Patterns:

8.6.7.1 Non-Shot Pellet Test Pattern Method

- Attach pieces of cotton twill material or a piece of material similar to the evidence to a nitrite free cardboard backing board. The test medium shall be marked with the muzzle-to-target distance of the test fire.
- Tests should be shot one per piece of target media.
- It is essential that the suspect firearm and ammunition like that represented in the evidence be utilized for these tests. The evidence bullet(s) and cartridge case(s) should have been previously linked to the suspect firearm. If the exact firearm and ammunition

is not available, samples may be used from the Firearm and/or Ammunition Reference Collection.
- Test patterns should be shot at known distances to establish the range of gunshot residue produced by the suspect firearm and like ammunition.
- Process test media according to the methods outlined above.
- Record all observations in notes.

8.6.7.2 Shot Pellet Test Pattern Method

The test media for shot pellet test patterns is an appropriate sized cardboard target backer, or paper attached to such material.

- Tests should be shot one per piece of target media.
- It is essential that the suspect firearm and appropriate ammunition be utilized for these tests. Care should be taken to ensure the shotshells used to produce test patterns are the same type as the evidence in the case. This includes manufacturer, gauge, shotshell length, load type, pellet size, pellet composition, total weight of shot, and type of shot wads. If the exact shotshells are not available, it is at the examiner's discretion to decide which type of ammunition will best represent the evidence when producing test patterns.
- Test patterns should be shot at known distances to establish the range of shot pellet patterns produced by the suspect firearm and like ammunition.
- Record all observations in notes.

8.7 Records

The firearm examiner shall document their findings in the form of handwritten notes, computer generated notes, or by utilizing gunshot residue worksheets. If possible, the firearm examiner should consider photographing the evidence items before and after processing. The examiner shall strictly adhere to all note taking procedures as prescribed by laboratory policy.

8.8 Interpretations of Results

8.8.1 Indications consistent with the Discharge of a Firearm

- Vaporous Lead (smoke).
- Particulate Metals (shavings of lead, copper, brass).
- Partially Burned and Unburned Gunpowder.

8.8.2 Indications consistent with the Passage of a Bullet

- A hole in the item
- Visible ring around the perimeter of the hole(s)
- Positive Sodium Rhodizonate reaction immediately surrounding the hole(s)

8.8.3 Indications consistent with a Contact Shot

- Ripping or Tearing (Stellate)
- Burning or Singeing

- Melted Artificial Fibers
- Heavy Vaporous Lead Residues
- An Absence of Gunpowder Particles

9 PHYSICAL EXAMINATION AND CLASSIFICATION OF TOOLS AND TOOLMARKS PROCEDURE

9.1 Scope

This procedure is used for the initial examination and classification of tools and toolmarks. Tools can be of various types and classes (E.g., prying type, gripping type, opposed blade cutting, bypass cutting, flat blade, etc.). Toolmarks can be of two types, impressed or striated.

A tool is defined by AFTE as an object used to gain mechanical advantage. Tools are also thought of as the harder of two objects which, when brought in to contact with each other, results in the softer one being marked by the harder one.

Impressed toolmarks are those marks produced when a tool is place against an object and enough pressure is applied to the tool that it leaves an impression in the object.

Striated toolmarks are those produced when a tool is placed against an object softer than the tool and, with pressure applied, the tool is moved across the object, producing a scrape. The parallel surface irregularities produced by this scraping action are known as striations.

9.2 Procedures/Instructions

Describe the tool as received. A worksheet may be filled out and include the following:

- Trace evidence (paint, etc.) present on the tool
- 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, and any damage present
- Any areas that appear to have been used recently
- Type of tests conducted (if any)
- The methods used to produce test toolmarks, and the medium used
- Any other data deemed relevant by the examiner

Describe the evidence to be examined for toolmarks, and the type of toolmarks present. Notes may include:

- Location of the toolmarks
- Type of toolmark:
  - Impressed
  - Striated
- Class of tool that made the toolmark(s):
  - Cutting type (pinching, bypass, shear, etc.)

    - Prying type (flat blade, etc.)
    - Gripping type (serrated jaws, etc.)
- Physical characteristics of the toolmark(s)
- Direction of the toolmark
- The suitability of the toolmark for comparison purposes
- Any other data deemed relevant by the examiner

As part of the examination process, the firearm examiner shall evaluate the unknown item(s) to identify characteristics suitable for comparison.

10 TOOLMARK TEST STANDARDS AND CASTING PROCEDURE

10.1 Scope

This procedure will detail how toolmark test standards and casting materials are gathered.

10.2 Reagents/Materials

Silicone Casting Material

10.3 Procedures/Instructions

10.3.1 Test Mark or Test Cut Method

The initial test media must be soft enough to prevent alterations of the tool's working surface. Lead sheet or lead wire is the preferred media.

The firearm examiner may use material submitted by the submitting agency which was collected as "test" material.

Subsequent tests might require the use of a harder test media to better reproduce the toolmarks.

A systematic approach should be used for the production of test toolmarks. Consideration should be given to:

- Areas of recent use on the tool in question.
- Direction of use.
- Direction of force.
- Indexing of test toolmarks

10.3.2 Casting Method

- Prepare the casting material as per manufacturer's specifications.
- Place 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.
- A systematic approach should be used for the production of test marks or standards. Consideration should be given to:
    - Areas of recent use on the tool in question.

  - Direction of use.
  - Indexing of test standards/marks.
- Consideration must be given to placing identifying marks as well as orientation marks on the back of the cast.

All test toolmarks, test cuts, or casts will be treated like test fires.

- The test container will be marked with the laboratory number, tool exhibit number, and "test toolmarks, test cuts, test marks, or casts" for ease of identification.
- Generate an exhibit number in the Laboratory Information Management System (LIMS) and print a bar code label. Attach the bar code label to the test media container. Seal and initial the container.
- Scan the test media to the Test Fire Storage Location.

10.4 Records

The firearm examiner shall document their findings in the form of handwritten notes, computer generated notes, photography, or by utilizing a worksheet.

11 SERIAL NUMBER RESTORATION PROCEDURE

11.1 Scope

This procedure will detail how a firearm examiner or forensic technician shall perform serial number restorations on firearms and other items of evidence. This procedure includes polishing, magnetic particle inspection, chemical etching, and barcode decryption. These processes may aid the firearm examiner or forensic technician in the recovery of an obliterated or obscured serial number.

11.2 Precautions/Limitations

The firearm examiner or forensic technician shall proceed slowly and pick the appropriate method which will be most effective for the evidence submitted. The firearm examiner or forensic technician should also consult available literature or reference firearms to ascertain where the serial number should be located, whether the submitted evidence has a hidden serial number, or whether the submitted evidence/firearm was manufactured without a serial number.

11.3 Reagents/Materials

Turner's Reagent – Used on Cast Steel
Fry's Reagent – Used on Cold Rolled Steel
25% Nitric Acid – Used on Pot Metal
50% Nitric Acid – Used on Aluminum
Acidic Ferric Chloride – Used on Aluminum
10% Sodium Hydroxide – Used on Aluminum
Magna-Flux – Used on any metal

11.4 Hazards/Safety

It is the responsibility of the firearm examiner to employ appropriate safety and health practices. Safe firearm handling procedures shall be strictly followed at all times.

The examiner should use eye protection and gloves, and work within a fume hood when mixing all chemicals.

When mixing acid and water the firearm examiner shall add acid to water. Never should water be added to acid!

11.5 Reference Materials/Controls/Calibration Checks

A positive control for the chemical etching solutions will be conducted prior to the application of the reagent to the serial number area, and the results of this testing recorded in the case notes.

11.6 Procedures/Instructions

11.6.1 Documentation and Initial Examination

- Document and photograph the submitted evidence or firearm in its original condition. The Firearm Worksheet should be completed prior to serial number restorations on firearms.
- For serial number restoration on firearms, test fires should be obtained prior to serial number processing. In some instances, the firearm may need to be disassembled prior to the application of chemical etching solutions, and test firing should be conducted prior to disassembly.
- Determine where the serial number should be located using the Firearms Reference Collection or by conducting a literature search.
- Photograph the area where the serial number should be, in its original condition, and document the method of obliteration.
- A Serial Number Worksheet may be helpful for documentation of the serial number restoration process. An example of this worksheet can be found in the Quality Management System.

11.6.2 Polishing Procedure

- Document the submitted evidence/firearm in its original condition. Note and record any visible characters prior to polishing. It may be helpful to consult a firearm from the Firearms Reference Collection for exemplars of the characters used by a particular manufacturer. A photograph shall be made in this original condition.
- Polish the area of the obliteration using either a dremel type tool with a sanding or polishing disc, fine grit sandpaper, or steel wool.
- 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.
- If the serial number has not appeared proceed to the chemical etching procedure.

11.6.3 Chemical Etching Procedure

- Utilize the appropriate chemical etching solution(s) according to the evidence submitted. The firearm examiner or forensic technician should start with the weakest reagent first. It is acceptable to switch between reagents and/or to dilute reagents as needed.
- Prior to the application of the chemical etching solution to the serial number area, test the reagent in an area on the firearm away from where the serial number should be located. This test will serve as a positive control. If a bubbling reaction or color change reaction occurs, the reagent is working properly. This will be documented in the case notes or on the Serial Number Worksheet.
- Apply the chemical etching solution to the area of obliteration utilizing cotton tip applicators or swabs that have been moistened with the chemical etching solution.
    - It is generally best to work the reagents in one direction – either right to left or left to right dependent upon the evidence or preference of the firearm examiner.
- If the serial number has not appeared, it may not be restorable or the firearm examiner or forensic technician may proceed to a stronger chemical etching solution.
- Photograph and record results obtained during this process.
- All recovered serial numbers must be verified by a qualified firearm examiner. It may be necessary to have the recovered serial number characters verified during the recovery process.
- If circumstances do not allow for verification during or after the recovery process, the verification may be performed using photographs taken during the process

11.6.4 Magnetic Particle Inspection

- Make sure the surface where the serial number is stamped is magnetic or that the magnetic field will reach the obliterated area.
- Choose and apply magnet, centering the serial number between the two poles of the magnet.
- Spray Magna-Flux into a beaker and apply it to the serial number surface area with a dropper.
- Photograph and record results. Have the serial number verified by a qualified firearm examiner.
- If circumstances do not allow for verification during or after the recovery process, the verification may be performed using photographs taken during the process

11.6.5 Barcode Decryption

- Inspect bar code to ensure that at least portions of the full barcode are available.
- Determine if all bars are present.
- Delineate the bars into character units.
    - Use of an enlarged photograph or photocopy is recommended.
    - Start at the far left bar and count five bars over then label this as the first character set.
    - Repeat this procedure for the remaining bars to identify all character sets. There will be nine (9) character sets visible.
- Interpret and document the barcode element size patterns.

- Each bar and space from left to right is to be labeled "W" for wide or "N" for narrow.
- Complete this for each character set.
- Using the Bar Code 39 key table below, begin correlating each developed pattern sequence from the individual character sets to determine the character represented by the pattern.
- If circumstances do not allow for verification during or after the recovery process, the verification may be performed using photographs taken during the process
- Record results.

- Have the decryption process and decoded serial number verified by a qualified firearm examiner.

Bar Code 39 Table					
Character	**Pattern**	**Character**	**Pattern**	**Character**	**Pattern**
0	NNNWWNWNN	F	NNWNWWNNN	U	WWNNNNNNW
1	WNNWNNNNW	G	NNNNNWWNW	V	NWWNNNNNW
2	NNWWNNNNW	H	WNNNNWWNN	W	WWWNNNNNN
3	WNWWNNNNN	I	NNWNNWWNN	X	NWNNWNNNW
4	NNNWWNNNW	J	NNNNWWWNN	Y	WWNNWNNNN
5	WNNWWNNNN	K	WNNNNNNWW	Z	NWWNWNNNN
6	NNWWWNNNN	L	NNWNNNNWW	Space	NWWNNNWNN
7	NNNWNNWNW	M	WNWNNNNWN	*	NWNNWNWNN
8	WNNWNNWNN	N	NNNNWNNWW	$	NWNWNWNNN
9	NNWWNNWNN	O	WNNNWNNWN	/	NWNWNNNWN
A	WNNNNWNNW	P	NNWNWNNWN	+	NWNNNWNWN
B	NNWNNWNNW	Q	NNNNNNWWW	%	NNNWNWNWN
C	WNWNNWNNN	R	WNNNNNWWN	-	NWNNNNWNW
D	NNNNWWNNW	S	NNWNNNWWN	.	WWNNNNWNN
E	WNNNWWNNN	T	NNNNWNWWN	This cell blank	

11.7 Records

The firearm examiner shall document their findings in the form of handwritten notes, computer generated notes, photography, or by utilizing a Serial Number Worksheet. When possible, the firearm examiner should photograph the submitted evidence before, during, and after the restoration process. The examiner shall strictly adhere to all note taking procedures as prescribed by laboratory policy.

11.8 Interpretations of Results

If any characters become visible, note these characters. The firearm examiner shall be absolutely certain as to the characters which are restored.

The firearm examiner may report partial numbers which are restored.

- The examiner shall use an asterisk (*) to indicate an inconclusive character (e.g. 5 6 * 7 8, asterisk indicating that the number may be a 6 or a 0).
- The examiner may use a question mark to indicate an unrestored character (e.g.: 5 6 ? 7 8 ? 9 0).

12 NIBIN METHOD

The NIBIN/IBIS User Guides and Training Manuals shall be followed.

All authorized personnel in the FTIU will be certified by the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) in order to, and prior to, making independent entries into the NIBIN system.

The authorized NIBIN user shall ensure suitability of the items being entered.

Evidence cartridge cases submitted as a **NIBIN Only** request will be examined for suitability to be entered. Examination for suitability will include screening to determine the number of cartridge cases to be entered and which of those is most suitable. The best representative cartridge case should be entered.

All firearms and cartridge cases collected and submitted as a NIBIN only request or Test Fire Only request will be evaluated and processed for NIBIN entry.

In cases where evidentiary fired cartridge cases are submitted with a firearm for a **NIBIN only** request, preliminary screening for suitability will be done to determine the best representative(s) for entry.

In cases where the Test Fire Only request is being used the test fires will be transferred to the Pending NIBIN storage location to be made available for evaluation for NIBIN entry. A NIBIN only request will be created by the scientist/technician receiving the test fires for evaluation and entry into NIBIN. The results of the NIBIN only request will be reported.

The initial entry of a cartridge case(s) (evidence and/or test fire) into NIBIN along with any lead resulting from a NIBIN database search shall be reported to the customer.

At a minimum the top 30 correlation results plus all MNPD cases from the Unified Score column in MATCHPOINT shall be reviewed by the Examiner/Technician for all correlation results.

If no leads are made, the following steps shall be taken:

- A second review will be conducted by an authorized NIBIN technical/administrative reviewer.
- The second review will be documented on the NIBIN entry printout with the date the review was conducted and the initials of the reviewer.
- The NIBIN entry printout shall be uploaded into LIMS under the appropriate request as documentation of the review.

If a lead is made, the following steps shall be taken:

- The lead(s) will be marked in the NIBIN system, leaving the date of confirmation blank.
- Each lead shall be reviewed on MatchPoint by a qualified Firearm/Toolmark Examiner.
- A NIBIN Lead Notification Form will be printed from MatchPoint, signed by both the original examiner/technician and lead reviewer, and uploaded into the LIMS casefile.

- The lead may be reported without confirmation as long as the notification clearly states this information is being provided as an investigative lead only.

At the discretion of the Firearms Examiner, evidence and test fired cartridge cases submitted as Firearms/ballistics requests may be entered into the database.