FIREARMS/TOOLMARKS ANALYTICAL METHODS

Table of Contents

Revision History

Revision #	Description of Changes
1	Original Issue of combined method; included in this were grammatical corrections, clarification to documenting observations in iLIMS and generalizing trigger pull testing
2	Grammatical corrections. AM# 1; 4.4: added chemical testing to section. 4.6.3.5: added AFTE GRC and general guidelines for searching; 4.3.9 added section for general guidelines of test fires. AM# 4; 4.3: changed to return test marks to agency. AM# 6; 4.4.1.2 and 4.4.2.2: added bracketing wording. AM# 7; 3.2.12: added "or equivalent". 4.1.3: added "Magnaflux". AM# 8; removed duplicated references. Added section 4.8 to AM# 6, clarified control requirements.
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4	AM# 1; 4.3.9.1: Added check of test fire ammunition for manufacturing and cycling marks. AM# 6; 4.3.1.3: Remove test marks from paper before use.
5	Updated references. AM #2; 2.1.2: Added "Sawed Off Rifle or Shotgun". AM# 6; 4.1.1 and 4.2.1: Changed "will" to "can". 4.4.1 and 4.4.2: Allowed the use of an identical firearm.
6	Updated references. AM#1: Clarification on casting, add disposition of casts (4.3.7.11). Added details for test firing equipment and use (4.3.9.2 and 4.3.9.3). Added section on situational/function testing (4.3.10), Added section on the examination of rusty firearms (4.3.11), Clarification to land and groove measurements and GRC search criteria. AM#4 Added cast item designation and disposition; AM#5 Added Documentation requirements for verifications. AM#7 Added section on Barcode decryption
7	AM #3 clarifying trigger pull variabilities; AM #6 additional clarification points added to interpretation. Addition of AM #9 IBIS/NIBIN entry
8	AM #1: Clarified documentation of comparison items. Added 4.6.4 Chemical testing for fragments. AM #6: Changed to Proximity Determination. AM#9: Defined case identification number.
9	AM #6 Additional information on evidence types accepted for Proximity Determination, AM #9 added comparison notation

AM #1: Firearms Physical Exam and Classification

1.0 Background/References

1.1 This method is designed to act as a guideline to assist in the proper examination of firearms evidence. The examiner may be further assisted by appropriate technical references as well as private and commercial references. The many variables involved in the examination of firearm related evidence precludes a "recipe" type manual.

1.2 References:

- Association of Firearm and Toolmark Examiners Glossary, 6th ed. 2001.
- Firearms and Toolmarks Technical Procedures Manual, Washington State Patrol
- Forensic Firearms Identification Unit, Test Methods: Indiana State Police Version 18
- Firearms/Toolmark Procedures Manual, Virginia Department of Forensic Science. Revision 7
- "Physical Examination and Classification of Firearms" Firearms and Toolmarks Procedures Manual, Virginia Division of Forensic Science Amendment C.
- NRA Firearms Factbook. National Rifle Association of America.
- Mathews, J. Howard Firearms Identification Vol. I, 1973.

2.0 Scope

2.1 This analytical method deals with the general, visual and physical examination of firearms.

3.0 Equipment/Reagents

- Comparison microscope
- Stereo microscope
- Ruler
- Barrel rod
- Tape measure
- Scale/Balance
- Micrometer/Caliper
- Methanol
- Acetone
- 10% bleach solution (mix bleach with water at about 1:10 prepare fresh)
- Dish soap and water

4.0 Procedure

4.1 General, Visual and Physical Examination:

4.1.1 Firearm/Ammunition submitted without request for Comparison:

4.1.1.1 Visual and physical examinations are conducted to determine, at minimum, the following firearm features, to be recorded in iLIMS:

- Caliber/Gauge
- Make/Model
- Serial number and location
- Type of action
- Safeties
- Operating condition
- Rifling characteristics
- Trigger pull (refer to Analytical Method 3 for analytical method)

4.2 Trace Material

Evidence is often submitted with debris that may cover its characteristics. In order to determine class characteristics or compare individual characteristics of the firearm evidence the debris may need to be removed. The debris may consist of blood, tissue, paint, fibers, glass, etc. The value of the debris as trace evidence should be considered during examination. The examiner may choose to forward the item to another section for testing or to collect the trace evidence and create a new evidence item. The examiner will note the finding in his or her case notes.

4.2.1 After an assessment and appropriate actions have been taken to collect or forward trace evidence, the evidence may need to be cleaned to allow for proper examination of the evidence. The examiner will choose an appropriate cleaning solvent or solution. Typically, methanol, acetone, a 10% solution of bleach and water or dish soap and water will be used.

4.3 Firearm Functionality Examination

A firearm examiner may be called upon to examine a firearm to determine if the firearm will malfunction. Many of these tests deal with the question: "Will the firearm fire without pulling the trigger?" In these instances, it should be the goal of the examiner to acquire a detailed account of the incident, followed by a thorough examination and testing of the firearm. Examinations may include external and internal observations, striking or dropping the firearm in attempts to duplicate the incident as reported. The 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 should be specifically documented in the examiner's notes. A systematic approach should be used for the malfunctioning firearm examination, with recording of all findings and observations. No one procedure can sufficiently outline the steps necessary to examine all firearms for any malfunction. The following examinations should serve as a guideline.

4.3.1 Prior to completion of any examination perform a five step safety check

4.3.1.1 Remove the magazine (pistol/rifle) or unlatch the cylinder/open the loading gate.

4.3.1.2 Rack the slide (pistol)/charge the bolt (rifle) at least three times with force or manually eject the cartridge case(s).

4.3.1.3 Lock or hold open the slide/bolt/cylinder.

4.3.1.4 Look to make sure no cartridges are in the chamber.

4.3.1.5 Feel to make sure no cartridges are in the chamber.

4.3.2 Visual condition of the firearm as received:

- Cocked/uncocked
- Safety position
- Loaded/unloaded
- Cartridge position
- Stuck cartridge/discharged cartridge cases
- Presence and/or location of flares

4.3.3 Visual abnormalities

- Barrel (loose, damaged, etc.)
- Receiver (condition)
- Slide (condition)
- Parts broken or missing (firing pin, ejector, extractor)
- Screws (loose or missing)
- Alterations or adaptations
- Sights

4.3.4 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
- Trigger (not returning, sticks, broken spring, etc.)
- Trigger Pull (single action, double action) and striking of hammer

4.3.5 Safeties

- ¼, ½, full cock, seating check (any false positions)
- Function (grip, magazine, disconnector)
- Rebound hammer or inertia firing pin
- Firing pin (relationship to primer, condition)

- Drop hammer several times to check safeties
- Position of the slide or bolt in order to fire
- Condition of safeties

4.3.6 Action Check

- Check feeding magazine (lips, follower), carrier or lifter, and feed ramp
- Slamfire
- Extractor and/or ejector markings on evidence cartridges/discharged cartridges.
- Marks exhibited on the cartridges/discharged cartridge cases
- Check for any inherent "quirks" known about the particular firearm based on literature or case data.

4.3.7 Action – Internal

- Hammer notches (worn, burrs, dirt, etc.)
- Sear (worn, broken, burrs, etc.)
- Safeties (relationships and general parts relationship)
- Springs (weak, broken, altered, etc.)
- Signs or any tampering or faulty assembly

4.3.8 Bore/Chamber Casting

Bore and Chamber casting may be completed at the analyst discretion for a number of reasons. Those include possible evaluation for potential subclass characteristics and occasionally, firearms are received for which the caliber may not be known or may be different than is designated on the firearm and in the industry literature. In order to facilitate firing of test shots that are the correct caliber for a particular firearm, it may be necessary to make a bore and/or chamber cast.

Casts can be made using various casting materials such as low melting point metals and silicone rubber compounds.

4.3.8.1 Insure that the firearm is not loaded

4.3.8.2 Open the action and remove the bolt or bolt assembly

4.3.8.3 Check the bore for obstruction

4.3.8.4 Push a cleaning patch in the barrel, from muzzle end, until it is ½ inch to ¼ inch from the beginning of the chamber

4.3.8.5 Lubricate the chamber

4.3.8.6 Prepare the casting material according to manufactures instructions

4.3.8.7 Pour casting material into the chamber until full

4.3.8.8 Do not allow casting material to flow into the breech as it will make extraction of the cast difficult

4.3.8.9 Remove cast from breech end

4.3.8.10 For Chamber casting: Use the same steps for casting the bore, but only the last three inches of the bore need to be cast.

4.3.8.11 Casts produced during the analysis process shall be considered a sub-item of the item that was used in the casting process. Any cast produced will be documented in the firearms notes and included with the test fires or entered into the LIMS system as a sub-item with a description to include "cast of. A barcode will be affixed to the cast packaging and upon completion of examination the casts will be returned to the submitting agency along with the tool. Alternatively, casts could be included in the same ILIMS item as the test fires as long as the description includes notation of the casts being included.

4.3.9 The correct caliber of firearm can be determined by measuring the mouth, base, overall length, rim (if pertinent), shoulder length of the cast, or the diameter of the bore cast. Record the interpretation in iLIMS.

4.3.10 Test Firing Methods:

4.3.10.1 Purpose of test firing is to collect ammunition components for microscopic comparison, determination of marking reproducibility and uniqueness used for comparison, as well as determination of the firearm's functionality. Test fires from eligible firearms will be entered into IBIS/NIBIN. A minimum of two (2) test shots should be fired and recovered. Prior to use of ammunition for producing test fires, the ammunition should be checked for manufacturing and cycling marks that could affect comparisons. Recovery methods include water recovery tank, cotton recovery system and the bullet trap. The recovery method used will be based on the examiners experience in conjunction with the type of firearm and ammunition used. Test firing shall not be done alone.

- Note any operational problems or general functionality of the firearm
- Check the barrel for obstructions before firing
- Misfires
- Ammunition involved (proper cartridge, type reloads, etc.)
- Check consistency of the impression on test-fired components and evidence

4.3.10.2 Water Tank and Cotton Box Recovery

The water recovery tank is generally used to recover bullets from handguns and small caliber rifles. Recovery of fired projectiles using the Cotton box is generally for larger caliber rifles.

- Ensure that down range area is free from personnel
- Proper hearing and eye protection must be worn by all individuals near test firing
- Ensure that the bullet collection device is properly prepared
  - (Water tank) Ensure that the tank is set to blower and the main power is on.
- Notify the appropriate individuals that test firing will be occurring (this may include Forensic employees as well as Patrol and Dispatch)
- Ensure that all lids or doors of the recovery tank are closed and properly secured
- No more than three (3) cartridges/shotshells should be loaded into the firearm during the initial testing of the firearm.
- Load a semiautomatic firearm with the muzzle inserted into the shooting tube or pointed toward the entry end of the cotton box.
- Test firing into the bullet recovery system should be done with the muzzle of the firearm inserted into the shooting tube (water tank) or within an appropriate distance from the entry end of the cotton box.
- Note any operational problems or malfunctions with firearm.
- Recover the test fired bullets using an appropriate device
- Retrieve all fired cartridge cases/shotshells.

4.3.10.3 Bullet/Snail Trap Recovery

- The snail trap is generally used to test fire firearms when the recovery of projectiles is not necessary.
- Ensure that down range area is free from personnel
- Proper hearing and eye protection must be worn by all individuals near test firing
- Ensure that the bullet collection device is properly prepared
- Notify the appropriate individuals that test firing will be occurring (this may include dispatch, patrol and residence that have requested notification)
- No more than three (3) cartridges/shotshells should be loaded into the firearm during the initial testing of the firearm. Maintain a safe distance from the trap opening to avoid ricochet, Fire the firearm into the front of the snail trap
- Retrieve cartridge cases/shotshells

4.3.10.4 Preparing primed Cartridges/Shotshells for test firing or Drop testing procedures

It may be necessary to test firearm functionality without test firing the firearm using whole ammunition. To prepare a primed only case: use the inertial bullet puller to remove the bullet from the appropriate cartridge (do not use the inertial puller with rimfire cartridges).

4.3.10.5 After test firing the examiner shall mark each bullet and cartridge case with a minimum of, item designation (i.e. 1.1A, 1.1B, 1.1C). When the items are very limited in space, full case and item designators and examiner markings may be placed on packaging.

4.3.10.6 Test fires shall be considered a sub-item of the firearm they resulted from. Test fires will be entered into the LIMS system and a barcode affixed to the test fire packaging. Upon completion of examination the test fires will be returned to the submitting agency along with the firearm.

4.3.11 Special Situation Testing: This includes situation testing of malfunctioning based on information provided by the submitting agency. Tests can include but are not limited to drop testing or striking the firearm with a rubber or plastic mallet. Drop testing should be performed using a padded landing zone for the firearm to assist in preventing examiner caused damage. The force used in situational testing could potentially alter or damage internal parts and working relationship(s) within the firearm. Care should be used to minimize potential examiner-caused damage. Primed only casings should be used in situational testing, to allow for examination of potential firing.

Interpretation:

- If the primed case detonates, examination of the internal parts of the firearm should be completed to determine if there is potential damage, missing or broken parts.
- If the primed case does not detonate, this is indication that the firearm may not discharge when dropped, slammed, thrown down or falls due to improper storage or neglect.

4.3.12 Rusty Firearm Examination

Rusty firearms or those found in water, etc. may be submitted for examination. To prevent further damage to the firearm, immediate attention should be given to firearms that are recovered from water. The examiner should instruct the agency that recovers the firearm to submit the firearm in a container of the fluid it was found/recovered from. If this is not possible, the submitting agency should immediately and thoroughly coat the firearm with a water displacing product (i.e. WD-40). It should be noted that the firearm may be non-functional based on the extent of the rust but it may still be loaded.

It is the responsibility of the examiner to determine:

- If the firearm is safe
- What extent restoring the firearm is possible (i.e. for test firing, for determining manufacturers information, serial number etc)

Suggested Technique

- The firearm should be soaked in penetrating oil, de-rusting solvents or similar material to dissolve rust
- Periodically check the firearm until desired information is attainable.
- Clean the firearm with gun cleaning solvent, cleaning patches and cloth (only non-marring items should be placed in the barrel of the firearm.
- Any and all methods used to clean the firearm shall be documented in the case notes

4.4 Sound Suppressor Examination

4.4.1 A silencer or sound suppressor is a device designed to reduce the noise of discharge that is attached to the barrel of a firearm. Silencers can be commercially made or homemade.

4.4.1.1 Examine the device to determine if it is, or is not characteristic of, a silencer or sound suppression device.

4.4.1.2 Check the bore for obstruction

4.4.1.3 The device can be tested for the presence of lead, copper and/or nitrites using the chemical testing methods outlined in AM# 6.

4.4.1.4 A noticeable reduction in sound between firing of the firearm with the device attached vs. the firing of the firearm without the device is sufficient to determine if the device is a sound suppressor.

4.4.1.5 Multiple tests should be conducted with and without the device.

4.4.1.6 Observations shall be recorded in iLIMS.

4.5 Classification of Fired Cartridge Cases

4.5.1 Caliber Determination

4.5.1.1 Caliber can usually be determined by examination of the headstamp of the cartridge case, and is written as a numerical term that may be depicted with or without a decimal point. If it is not legible on the headstamp, the case can be compared with laboratory standards or manufacturer literature.

4.5.2 Determination of Marks

4.5.2.1 Visual and microscopic examination of cartridge cases may reveal a variety of markings. Types of marks that might be found may be as follows:

- Breech face class marks
- Extractor marks
- Ejector marks
- Resizing marks
- Chamber marks
- Anvil marks (rimfire only)
- Magazine marks
- Ejection port marks
- Other marks

4.5.2.2 As appropriate, compare marks on cartridge cases tests from a firearm or with other cartridge cases (see AM# 5: Microscopic Comparison)

4.5.2.2.1 Only the above marks necessary to effect an identification or elimination are required to be documented in the case notes.

4.5.2.2.2 Documentation of all items compared should be recorded in ILIMS.

4.5.2.3 Interpretation of Results

- May determine caliber and brand/manufacturer/marketer of cartridge case
- May determine if there are suitable markings for identification with a firearm or other fired or chambered components.
- May determine possible firearms that could have fired the cartridge case.
- May be able to identify the firearm in which it was fired or worked through the action of the firearm.

4.6 Classification and Examination of Fired Bullet Evidence

4.6.1 General, visual, and physical examination:

- Caliber/gauge
- Bullet weight
- Number of land and groove impressions
- Direction of twist
- Measured width of land impressions
- Measured width of groove impressions
- Measured diameter
- Bullet composition
- Bullet style

- Possible manufacturer/marketer of the bullet/projectile
- Description of the base of the bullet
- Type and position of cannelures
- Any extraneous markings to include flared base, skid marks, shave marks, and other marks
- Presence of gunpowder and/or powder imprints adhering to the base
- Condition of the fired evidence as received
- Suitability of the fired evidence for comparison purposes

As appropriate, compare marks on bullets with tests from a firearm or with other bullets (see AM# 5: Microscopic Comparison). Documentation of all items compared should be recorded in ILIMS.

4.6.2 Caliber Determination

Caliber or the base diameter is one of the class characteristics of a fired bullet, and is written as a numerical term that may be depicted with or without a decimal point. The determination of caliber may 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 a fired bullet. The condition of the bullet will determine which steps can be utilized:

4.6.2.1 Compare the base diameter of the evidence bullet directly with known test fired standards

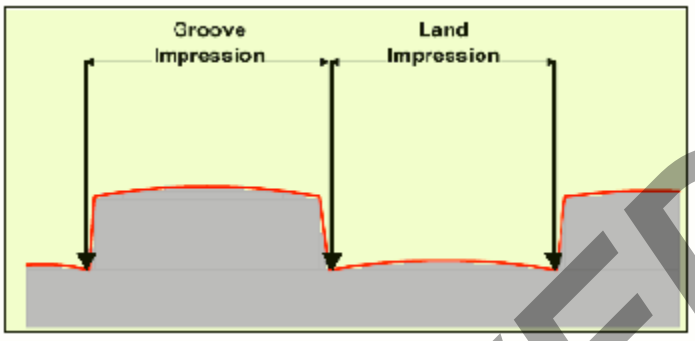
4.6.2.2 Measure the base diameter of the evidence bullet using a measuring device and compare this measurement with known measurements published in reference literature.

4.6.2.3 Determine the number of land and groove impressions and compare to Section 13, Table 8 of the AFTE Glossary 6th edition.

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

4.6.3 Methods of Measuring Lands and Grooves

One of the class characteristics used in firearms identification is the width of land and groove impressions. These measurements may aid the examiner during the identification or elimination of a suspect firearm. If no firearm is submitted, the measurements will be used for determining the General Rifling Characteristics (GRC) of the possible firearm involved. When measuring a fired bullet to determine the width of the land and groove impressions, the points used for the beginning and end of the measurements comply with discipline-wide practices. Below are the points that should be utilized during measurement.



The measuring of land and groove impressions on a fired bullet can be accomplished by utilizing either the air-gap method, the LCD method or one of the stereo microscope methods. It may be necessary to measure several suitable land and groove impressions to obtain a reliable measurement. Measurements taken are recorded into iLIMS.

4.6.3.1 Air Gap Method

4.6.3.1.1 In the air gap method the fired bullet in question is mounted on one stage of the comparison microscope. The measuring device is mounted on the other stage. Both stages must be using the same magnification level and be in focus.

4.6.3.1.2 The land or groove impression is aligned with one of the anchor points of the measuring device and the measurement recorded.

4.6.3.2 Stereo Microscope Grid Method

4.6.3.2.1 The fired bullet in question is either held or mounted on a steady surface beneath the stereo microscope.

4.6.3.2.2 The land or groove impression of the fired bullet is positioned with both of the anchor points corresponding to points on the alignment grid. Record the measurement.

4.6.3.3 Stereo Microscope Ruler Method

4.6.3.3.1 The fired bullet in question is either held or mounted on a steady surface beneath the stereo microscope.

4.6.3.3.2 The land or groove impression at the base of the fired bullet is placed perpendicular to the scale of the ruler. The distance between both of the land or groove impression are measured and recorded.

4.6.3.4 LCD Measuring Scale Method

4.3.6.4.1 Place the bullet on the left stage and install crosshair eyepiece. Focus and align crosshair with edge of land or groove. Zero the LCD measuring scale. Move stage so crosshair is aligned with other side of land or groove. Record the measurement.

4.6.3.5 General Rifling Characteristics File (GRC)

The FBI's or AFTE's General Rifling Characteristics File (GRC) can be utilized when attempting to determine a list of possible firearms that could have fired an evidence bullet when no firearm is submitted. The GRC specifications can be accessed using various software utilities or the printed reference material. The GRC file is an investigative aid and should not be considered as an all-inclusive list of firearms available with those particular class characteristics.

4.6.3.5.1 To Complete a GRC Search the following should be used as a guideline:

- Fill in the applicable fields at the bottom of the GRC Search page with pertinent case information, Scientists name, and information obtained from bullet examination, and then run the database search.
- Search parameters for land and groove impression widths, where the edges are rounded with no clear edge and/or there is some variation in measurements, should include a tolerance of +/- 0.005 inch.
- Search parameters for land and groove impression widths, where the edges are crisp, defined rifling edges and/or there is minimal variance in measurements, should include a tolerance of +/- 0.002 inch to +/- 0.005 inch.
- If multiple evidence bullets have been identified to each other, one list of possible firearms may be generated.
- If multiple evidence bullets cannot be identified to each other a list should be complied for each bullet individually.

If the list contains more than 10 firearms the four most common may be reported or it may be reported that the list is too numerous to be of use for investigative purposes.

4.6.3.6 Interpretation of Results

Caliber is written as a numerical term and may be depicted with or without the decimal point. If the base is mutilated the examiner may only be able to determine that the evidence is consistent with a range of calibers or the caliber cannot be determined.

- May determine caliber/gauge, brand, type, style, general rifling characteristics of the fired bullet
- May determine if there are suitable markings for identification with a firearm or with other fired components
- May determine list of possible firearms that could have fired a bullet
- May be able to identify the firearm in which it was fired
- May be able to exclude a firearm from having fired a bullet based on class characteristics.

4.6.4 Chemical Testing

Chemical testing used for copper and lead may be conducted on possible fragments that are submitted to the laboratory for analysis.

4.6.4.1 Dithiooxamide (DTO)

The DTO test utilizes a color chemistry reaction to indicate the presence of copper.

4.6.4.1.1 Swab Technique

4.6.4.1.1.1 Dampen a swab with Ammonium Hydroxide.

4.6.4.1.1.2 Swab the area of interest.

4.6.4.1.1.3 Apply Dithiooximide solution to swab.

4.6.4.1.2 Controls

A positive and negative control will be run each day the reagents are used and the results of the control will be noted in the examination notes.

4.3.2.3.1 A positive and negative control can be obtained by creating a test mark on an appropriate piece of material with known copper, or by wetting two swabs with the Ammonium Hydroxide solution and rubbing one on a known piece of copper and then adding the DTO solution to both swabs.

4.6.4.1.3 Interpretation of Results

A dark greenish-gray color reaction, corresponding to the area tested, indicates a positive reaction for copper. Results will be noted in examination documentation; photographs are not required.

4.6.4.2 Sodium Rhodizonate Test

The Sodium Rhodizonate test utilizes a color chemistry reaction that is specific for lead

4.6.4.2.1 Swab Technique

4.6.4.2.1.1 Dampen a swab with Acetic Acid.

4.6.4.2.1.2 Swab the area of interest.

4.6.4.2.1.3 Apply Sodium Rhodizonate solution to swab.

4.6.4.2.1.4 Apply Buffer solution to swab. (optional)

4.6.4.2.1.5 Apply Hydrochloric Acid solution to swab.

4.6.4.2.2 Interpretation of Results

A violet or purple colored stain, corresponding to the area tested constitutes a positive reaction for lead. Results will be noted in examination documentation; photographs are not required.

4.6.4.2.3 Controls

A positive and negative control will be run each day before the reagents are used to ensure they are working properly. A positive and negative control may be prepared by placing a test mark with a piece of lead on an appropriate material or by wetting two swabs with a 5% solution of HCl and swabbing a piece of lead with one.

4.7 Physical examination and Classification of Shotshell Evidence

4.7.1 Shotshell Cases

4.7.1.1 Examination of shot shell cases may include general, visual, physical, gauge determination, and marks determination:

- Shape of shotshell
- Gauge
- Possible manufacturer/marketer of the shotshell case
- Ignition system
- Description of metal used in hull and primer
- Description of headstamp
- Description of firing pin impression

4.7.1.2 Shotshell Gauge Determination

Gauge can easily be determined by examination of the headstamp of a shotshell case. If the headstamp is not legible, the shotshell can be compared with laboratory standards or available manufacturer literature.

4.7.1.3 Determination of Marks

Visual and microscopic examination of the shotshell case may reveal a variety of markings. Types of marks that might be found are as follows:

- Breech face marks
- Firing pin impression
- Extractor marks
- Ejector marks
- Resizing marks
- Chamber marks
- Magazine marks
- Ejection port marks
- Markings on the exterior surface of hull
- Other marks

As appropriate, the analyst will compare marks on shotshell case with test from a firearm or with other shotshell cases (see AM# 5: Microscopic Comparison)

4.7.1.4 Interpretation of Results

- May determine gauge and brand/manufacturer/marketer of shotshell case
- May determine if there are suitable markings for identification with a firearm or with other fired components.
- May determine possible firearms that could have fired the shotshell case.
- May be able to determine the firearm in which the shot shell was fired or worked through the action.

4.7.2 Wads

4.7.2.1 Wad Gauge Determination

- Gauge can usually be determined by measuring the diameter of the wad and comparing with laboratory standards or available manufactured literature.
- Direct comparison of the evidence wad to a known reference of similar manufacturers in the composition, design, and diameter.
- Gauge size can also be determined by measuring the base diameter of the wad and comparing the measurement to known wad-reference measurements.
- Manufacturer data may be determined by locating information stamped into the wad or by comparing the evidence wad to a known reference. Care must be taken since manufacturers may trade components.

4.7.2.2 Determination of marks on wads

Visual and microscopic examination of the wad may reveal a variety of markings. Microscopic examination of the evidence wad could reveal markings that may be suitable for identification with the shotgun that fired it. If evidence shotshells are submitted with the evidence wad, it may be necessary to disassemble one of the shotshells for a comparison of the unfired wad with the evidence wad.

4.7.2.3 Limitations of method

If the wad is mutilated or soaked with blood the examiner may not be able to specifically determine the gauge size. Some manufactures may also duplicate the design of other manufactures.

4.7.3 Pellets

Visual and microscopic examinations may be done to determine the following:

- Determine the total number of pellets received
- Determine the composition of the pellets
- Determine the number of pellets suitable for comparison purposes
- Note if pellet sizes all appear to be similar - if different determine each size
- Compare evidence pellets to known shot sizes.

4.7.3.1 Comparison of pellets by weight

4.7.3.1.1 Determine the number of pellets suitable for weighing

4.7.3.1.2 Weigh the pellets in grains

4.7.3.1.3 Consult known pellet weights in the NRA Factbook, Table 1 of Appendix G of the AFTE Glossary 6th ed. or most current edition, or manufacture's data.

4.7.3.1.4 The weight of the evidence pellets can also be directly compared to known pellets using the same number of pellets until a similar known weight is obtained.

4.7.3.2 Measuring pellet size

4.7.3.2.1 Choose the best specimen and measure diameter using a micrometer/caliper.

4.7.3.2.2 Consult known pellet sizes in the NRA Factbook, Table 1 of Appendix G of the AFTE Glossary 6th ed., or manufacture's data or compare to a known sample.

4.7.3.3 Interpretation of Results

It may be possible to determine the shot size and composition of pellets.

4.8 Safety Considerations

This procedure involves hazardous materials, operations and equipment. This procedure does 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 must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions. Consult the appropriate MSDS/SDS for each chemical prior to use.

4.9 Photographs

Photographs shall be stored digitally retained by the laboratory.

AM #2: Barrel Length and Overall Length Measurement of a Firearm

1.0 Background/References

1.1 Background:

This procedure is used for determining the barrel length and overall length of a firearm. Barrel length is defined as the distance between the end of the barrel and the face of the closed breechblock or bolt for firearms other than revolvers. On 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.

1.2 General References:

- "The Proper Method for Measuring Weapons," AFTE Journal, Vol.14, No. 3, p. 10

2.0 Scope

2.1 Measurements will be classified as "Descriptive" or "Reported."

2.1.1 Descriptive measurements are defined as routine firearm dimension measurements for general documentation. Descriptive measurements are recorded in case notes only.

2.1.2 Reported measurements are defined as measurements which are relevant to the determinations of possession of a "Short Barrel Rifle", "Short Barrel Shotgun" "Sawed Off Rifle or Shotgun." Reported measurements require the use of a NIST-traceable measuring device. Reported measurements are recorded in the case notes and on the case report.

2.1.3 For barrel length of a shotgun or rifle, if the descriptive measurement is less than 16 inches for a rifle or less than 18 inches for a shotgun, a reported measurement shall be taken.

2.1.4 For overall length of a shotgun or rifle, if the descriptive measurement is less than 26 inches, a reported measurement shall be taken.

2.1.5 If a reported measurement is requested by the customer, but cannot be made with a NIST traceable device because the barrel or overall length is too long, the laboratory will inform the customer that the analysis cannot be performed.

3.0 Equipment/Reagents

3.1 Measurements at or under 24 inches for barrel length or 36 inches for an overall length:

3.1.1 A NIST-traceable or certified measuring device (e.g., ruler or barrel rod) capable of measurements to:

- 1/16th of an inch for a barrel rod.
- 1/32nd of an inch for a ruler.

3.2 Measurements over 24 inches for barrel length or 36 inches for overall length:

- A standard tape measure may be used directly or against a non-marring dowel.

4.0 Procedure

Care must be taken if any object is placed down the barrel for measurement purposes.

4.1 Barrel Length

4.1.1 Revolvers

4.1.1.1 Measure the distance from the breech end of the barrel to the muzzle, excluding the cylinder. This measurement shall be done directly by using a barrel rod. The barrel rod shall be inspected for damage before use (see AM #8 section 1.1). When using a measuring device down the barrel, the rod shall be held parallel with the barrel and read with the barrel end at eye level. Be sure not to damage the barrel or breach when measuring barrel length.

4.1.1.2 This measurement will be recorded in the case notes rounded up to the nearest 16th of an inch.

4.1.2 Firearms other than Revolvers

4.1.2.1 Measure the distance from the breech face in a closed and locked position to the longest point of the muzzle. This measurement shall be done directly by using a barrel rod. The barrel rod shall be inspected for damage before use (see AM #8 section 1.1). When using a measuring device down the barrel, the rod shall be held parallel with the barrel and read with the barrel end at eye level. Be sure that the firing pin does not protrude past the breach. Be sure not to damage the barrel or breach when measuring barrel length.

4.1.2.2 This measurement will be recorded in the case notes rounded up to the nearest 1/16th of an inch.

4.1.2.3 For barrel length of a shotgun or rifle, if the descriptive measurement is less than 16 inches for a rifle or less than 18 inches for a shotgun, a reported measurement shall be taken and recorded in the case notes. The reported measurement shall be adjusted for any bias associated with the reference standard (e.g. butting) if the measurement is between 15 ¾ inches and 16 inches for rifles or 17 ¾ inches and 18 inches for shotguns.

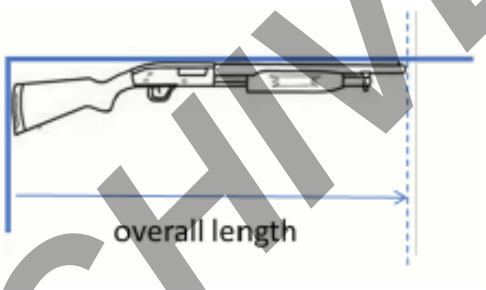
4.1.2.4 If the barrel length of the shotgun or rifle exceeds the length of the 24 inch NIST-traceable barrel rod, a non-marring dowel rod may be used for a descriptive measurement. The non-marring dowel rod measurement will be compared to a standard tape measure for a descriptive measurement. The measurement will be rounded up to the nearest 1/16 inch on the standard tape measure. Descriptive measurements shall be recorded in the case notes.

4.2 Overall Length

4.2.1 Measure the distance from the butt to the muzzle. Measurement shall be made parallel to the bore using a ruler. The ruler shall be inspected for damage before use. This measurement will be recorded in the case notes rounded up to the nearest 1/32nd of an inch.

4.2.1.1 For overall length of a shotgun or rifle, if the descriptive measurement is less than 26 inches, a reported measurement shall be taken and recorded in the case notes.

4.2.1.2 If the overall length of the shotgun or rifle exceeds the length of the 36 inch NIST-traceable ruler, a standard tape measure may be used for a descriptive measurement. A descriptive measurement using a standard tape measure will be rounded up to the nearest 1/16 inch. Descriptive measurements shall be recorded in the case notes.



4.3 Reporting and Interpretation of Results

4.3.1 For reported measurements, the examiner shall document the serial number of the NIST-traceable or certified measuring device used (i.e. ruler or barrel rod).

4.3.2 “Reported measurements” shall be included in the case report.

4.3.3 “Descriptive measurements” shall not be reported in the case report.

4.3.4 At a minimum, the laboratory will report the measurement result and the estimated expanded uncertainty when it impacts evaluation of a statute, legal requirement, or upon customer request. When measurements are reported, the measurement uncertainty and a statement regarding the coverage probability of 99.73% shall be on the report. The measurement result shall include the measured quantity value (y) along with the associated expanded uncertainty (U), and this measurement shall be reported as y+/-U where U is consistent with the units of Y (i.e. 18 1/2 inches +/- 3/32 inches). The current expanded uncertainty is published as a protected document in Qualtrax and is available to all analysts.

4.3.5 Measurement of Uncertainty Estimation

4.3.5.1 An expanded uncertainty of measurement was calculated for barrel length and overall length. Many factors (e.g. environmental and facility conditions, reference standards, analytical method factors) were evaluated for potential contribution to the expanded uncertainty of measurement. A reproducibility study was also performed as a part of the expanded uncertainty. An uncertainty budget is available for barrel length and overall length measurements. The final expanded uncertainty result is converted to a fraction consistent with the smallest division on the measuring devise (1/32th for overall length and 1/16th for barrel length) rounded using the Microsoft Excel arithmetic rules of rounding where by the half way number (5) is rounded up. The expanded uncertainty in the firearms discipline is reported at k=3. Fraction may be simplified as needed (i.e. 4/32nd = 1/8th).

4.3.5.2 At a minimum the uncertainty budget shall be reviewed annually, or upon recalibration of a reference standard, replacement of a reference standard, significant changes to the analytical method, or personnel change within the discipline.

4.4 Safety Considerations

4.4.1 This procedure involves hazardous materials, operations and equipment. This procedure does 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 must be exercised and the use of personal protective equipment must be considered.

4.4.2 Appropriate hearing and eye protection must be worn when applicable.

AM #3: Trigger Pull

1.0 Background/References

1.1 Trigger pull measures the amount of force that must be applied to the trigger of a firearm in a manner parallel to the barrel to cause the sear to release and discharge the firearm. Based on experience, trigger pulls can vary based on model, age, sear construction, condition, as well as, how close to parallel the barrel is positioned during examination of trigger pull. All of these factors and potentially others may have an effect on the trigger pull weight measured.

During the course of examining a firearm, prior to test firing, measuring trigger pull is useful for safety reasons and as an aid in determining the likelihood of accidental discharge.

1.2 References;

- AFTE Glossary

2.0 Scope

2.1 This procedure utilizes the force of gravity on known weights applied to a firearm's trigger while the muzzle is pointed away from and parallel to the applied force. The usual configuration involves holding the firearm with the muzzle vertical to the floor. Both single and double action trigger pulls should be measured.

3.0 Equipment/Reagents

3.1 The equipment used is a standard device with which weights in varying amounts can be applied to a rod constructed so that it can be hooked over a trigger without touching any other part of the firearm.

3.2 Standards consist of weights that can be combined for a cumulative effect.

4.0 Procedure

4.1 Performing Trigger Pull determinations. *Note: Make sure no live ammunition is in the weapon. For rimfire firearms a dummy cartridge should be used when performing trigger pull testing to avoid damaging the firearm.*

4.1.1 In single action mode, with firearm in a ready to fire state, apply weights to the trigger using the described trigger pull equipment so that the force is applied parallel to the barrel until the firearm will fire (WF).

4.1.2 Remove weights (applied parallel to the barrel) until the firearm will not fire (WNF).

4.1.3 Repeat these measurements until at least two measurements for each condition (will fire, and will not fire) agree within one quarter to one half pound of force.

4.1.4 Record results

4.1.5 Repeat steps 4.1.1 through 4.1.5 for double action mode.

4.2 Reporting Results

4.2.1 Resultant trigger pulls should be recorded in iLIMS. The resulting range of will not fire to will fire may be included in a final report, if requested.

4.3 Safety Precautions

All firearms must be checked to ensure they are not loaded before performing examination.

AM #4: Toolmarks Physical Exam and Classification

1.0 Background/References

1.1 Background

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 tool, which will determine what course the rest of the examination should follow.

1.2 References

- Firearms and Toolmarks Technical Procedures Manual, Washington State Patrol
- "Physical Examination and Classification of Firearms" Firearms and Toolmarks Procedures Manual, Virginia Division of Forensic Science Amendment C.
- "Mikrosil Casting Material Information". AFTE Journal. Vol. 15 No. 2, pg. 80.
- Janneli, R., and Geyer G. "Smoking a Bullet". AFTE Journal. Vol. 9, No. 2, pg. 128.

2.0 Scope

2.1 In order to compare a question toolmark with a questioned 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.

3.0 Equipment/Reagents

- Comparison microscope
- Stereo microscope
- Ruler or tape measure
- Micrometer/Caliper
- Dusting tool
- Test media (lead, copper, brass or other soft material)
- Methanol
- Acetone
- 10% bleach solution (mix bleach with water at about 1:10 prepare fresh)
- Dish soap and water
- Magnesium ribbon
- Casting material

4.0 Procedure

4.1 General, visual and physical examination:

The initial examination of a tool or a toolmark includes documentation of the physical description of the tool or toolmark. The tool and/or toolmark should be visually and/or microscopically examined for the presence of any trace material.

4.1.1 Trace Material

4.1.1.1 Evidence is often submitted with debris that may cover its characteristics. In order to determine class characteristics or compare individual characteristics of the tool or toolmark evidence the debris may need to be removed. The debris may consist of blood, tissue, paint, fibers, glass, etc. The value of the debris as trace evidence should be considered during examination. The examiner may choose to forward the item to another section for testing or to collect the trace evidence and create a new evidence submission. The examiner will note the finding in his or her case notes. After an assessment and appropriate actions have been taken to collect or forward trace evidence the evidence may need to be cleaned to allow for proper examination of the evidence. The examiner will choose an appropriate cleaning solvent or solution. Typically, methanol, acetone, a 10% solution of bleach and water or dish soap and water will be used.

4.1.2 Tool Examination

The tool examination is generally used to establish the following

- Brand and type of tool
- Size and condition
- Class characteristics of the tool
- Areas of use on the tool
- The medium used for testing
- The type of tests to be conducted (if any)
- Indexing of test standards/marks

4.1.3 Toolmark Examination

4.1.3.1 The toolmark examination is generally used to establish:

- The suitability of the toolmark for comparison purposes
- Class of tool that made the toolmark
- Type of toolmark (striated, impressed, combination)
- Direction of the toolmark
- If the toolmark is not suitable for comparison or does not have the same class characteristics as the suspect tool, then the toolmark is reported as unsuitable for comparison or the tool can be eliminated as having produced the toolmark

- If the toolmark is suitable for comparison, or the toolmark has the same class characteristics as the suspect tool, the examination should continue.

4.1.3.2 Methods used to Enhance Toolmarks for further examination:

- Dusting the tool with fingerprint powder
- Magnesium smoking to reduce the glare on shiny surfaces
    - Warning! UV protective safety glasses must be worn

4.1.3.2.1 Short pieces of magnesium ribbon are lit by a flame

4.1.3.2.2 The object to be smoked is passed over the smoke

4.1.3.2.3 If the object collects too much smoke wipe it off and repeat the process.

4.2 Casting

Casting is a procedure used in toolmark examination to make a reverse image of a tool or toolmark, which can then be used for comparative microscopic examination purposes. It may be necessary to make a cast of a tool or toolmark. If an item received for a toolmark examination is too large to be conveniently placed on the microscopes stage, a cast may be made of the tool or 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. Silicon rubber or similar products are used and manufactures instruction shall be followed.

4.2.1 Procedure

4.2.1.1Mix the casting material according to manufactures directions.

4.2.1.2 Apply the casting material over the tool or toolmark to be cast.

4.2.1.3 When the casting material is set or cool, gently tap to loosen the cast from the tool or toolmark and then lift to remove the cast

4.2.1.4 Consideration must be given to placing identifying marks as well as orientation marks on the back of the cast, or scribe identifying marks and/or orientation marks onto the tool or toolmark.

4.3 Toolmark Tests Produced

4.3.1 In order to perform a microscopic comparison of a submitted tool with a toolmark, test toolmarks must be produced with the suspect tool. The initial test media must be soft enough to prevent alterations of the tool's working surface; lead or copper are often used. Additional test marks might require the use of the material used in the original toolmark. Multiple test marks should be produced to allow for determination of reproducibility

4.3.2 The examiner shall mark each testmark used for comparison with a minimum of, examiners markings and item designation (ie. 1.1A, 1.1B, 1.1C).

4.3.3 Testmarks used for comparison shall be considered a sub-item of the tool they resulted from. Testmarks will be entered into the LIMS system and a barcode affixed to the testmark packaging. Upon completion of examination the testmarks will be returned to the submitting agency along with the tool.

4.3.3.1- Casts produced during the analysis process shall be considered a sub-item of either the toolmark or the tool testmark. Any cast produced will be entered into the LIMS system as a test mark item with a description to include "cast of". A barcode will be affixed to the cast packaging and upon completion of examination the casts will be returned to the submitting agency along with the tool.

4.4 Microscopic Comparison (Refer to AM# 5: Microscopic Comparison)

4.5 Interpretation of Results

- The toolmark(s) were identified as having been produced by the same tool or with the submitted tool
- The toolmark(s) were not produced by the submitted tool
- It was not possible to determine whether or not the toolmarks were made by the submitted tool or the same tool.
- Class characteristics of the tool may be identified from the toolmark.

4.6 Safety Considerations

This procedure involves hazardous materials, operations and equipment. This procedure does 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 must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions. Consult the appropriate MSDS/SDS for each chemical prior to use.

4.7 Photographs

Photographs shall be digitally retained by the laboratory.

AM #5 Microscopic Comparison

1.0 Background/References

1.1 Background:

A comparison microscope allows for side-by-side examination of evidence and test marks produced by the laboratory. The ability to complete side-by-side comparison allows an examiner to identify components back to a firearm that produced markings or identify a toolmark back to the tool that produced the mark. The evidence component is placed on one stage of the microscope, and the known is placed on the other stage.

1.2 References:

- "Microscopic Comparisons of Firearms" Firearms and Toolmarks Procedure Manual. Virginia Division of Forensic Science. Amendment B.

2.0 Scope

2.1 This procedure may also be used to compare two unknowns to determine if the same source produced the marks.

3.0 Equipment/Reagents

- Comparison Microscope
- Stereo Microscope
- Camera

4.0 Procedure

4.1 Comparison Microscope Set-up Procedure

4.1.1 Select the same objective (magnification) setting and ensure that the objectives are locked in place.

4.1.2 Select the same set of oculars

4.1.3 Adjust illumination as needed.

4.2 Analysis of Comparisons

4.2.1 If the suspect tool or firearm is submitted, test fires from the firearm or testmarks produced from the tool should first be compared to determine what microscopic characteristics are reproduced.

4.2.2 Compare the unknown evidence to either another piece of unknown evidence or a known test by placing the unknown on the left-hand stage and the known test on the right-hand stage.

4.3 If an identification is not evident consideration should be given to the following:

- Angle of lights
- Type of lights
- Need for additional known test samples
- Position of the evidence, the tests, or both
- Using magnesium smoking
- The possibility that the tool has changed
- Cleaning the firearm or toolmark and producing additional tests
- The possibility that a different tool or firearm was used

4.4 Interpretation and limitations or results

4.4.1 Identification

4.4.1.1 Criteria: 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.

4.4.1.2 Documentation: A photo will be taken to document identification along with written notes including which test item (ie 1.1A was used for comparisons) was used and describing how the identification was made.

4.4.1.3 It is recognized that photos are not used to make identifications or comparisons but are a means for recording purposes and generally document selected portions of and identification.

Photos are not used to make comparisons and make conclusions because:

- A photograph is a two-dimensional image of an object that is three-dimensional.
- Photographs often contain insignificant detail which will confuse people not trained in microscopic comparison.
- A photograph is a still. An actual comparison is very dynamic, and continuous movement of the samples is an integral part of the examination.

4.4.2 Inconclusive

4.4.2.1 Criteria:

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

4.4.2.2 Documentation: When an item is reported as inconclusive, detailed descriptions, including the test item used for comparison will be used to document class characteristics and describe why the sample is inconclusive.

4.4.3 Elimination

4.4.3.1 Criteria:

- Significant disagreement of discernible class characteristics and/or individual characteristics.

4.4.3.2 Documentation: Detailed notes, including the test item used for comparison, will be used to describe class characteristics and describe why the sample is an elimination.

4.5 Technical Verification

4.5.1 Technical verification is a process of independently performing a comparison or analyzing evidence to determine if the reviewer comes to the same conclusion regarding the analysis as the analyst.

4.5.2 Technical verification will be performed on all conclusions in which individual characteristics contribute to the conclusion (for example an elimination based on class characteristics does not require technical verification, but an inconclusive result based on matching class characteristics but insufficient individual characteristics does).

4.5.3 Documentation Requirements

4.5.3.1 If technical verification is done by an ISPFS examiner, the verification will be documented in the ILIMS assignment.

4.5.3.2 If technical verification is completed by an experienced firearms examiner not employed with ISPFS, a hardcopy Verification Checklist and Technical Review Checklist will be attached to the corresponding assignment and included in the notes packet in ILIMS.

4.6 Safety Considerations

This procedure involves hazardous materials, operations and equipment. This procedure does 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 must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions.

4.7 Photographs

Photographs shall be digitally retained by the laboratory.

AM #6: Proximity Determination

1.0 Background/References

1.1 The proximity determination procedures are used to determine approximate muzzle to target distance. When a firearm is fired gunshot residues, including primer residues, burned gun powder particles, partially burned gun powder particles, unburned gun powder particles, vaporous lead and particulate metals, are discharged from the firearm. These particles can potentially be deposited on objects forward of the barrel at the time of discharge.

1.2 References:

- ANON. "Gunshot Residues and Shot Pattern Test"; F.B.I. Law Enforcement Bulletin: 1970; Vol. 39, No 9, pp.7.
- Dillon, John. "The Modified Griess Test: A Chemically Specific Chromophoric Test for Nitrate Compounds in Gunshot Residues"; AFTE Journal, 22,3,248.
- Fiegel, F; Anger, V. Spot tests in Inorganic Analysis; 6th ed.; Elsevier Publishing: New York, NY, 1972.
- Dillon, John. "The Sodium Rhodizonate Test: A Chemically Specific Test for Lead in Gunshot Residues"; AFTE Journal, 22,3.
- Dillon, John. "A Protocol for Gunshot Residue Examinations in Muzzle-To-Target Distance Determinations"; AFTE Journal, 22,3.
- Dillon, John. "A Protocol for Shot Pattern Examinations in Muzzle-To-Target Distance Determinations"; AFTE Journal, 23,1.

2.0 Scope

The residues along with the morphology of the bullet hole may be effectively used in determining the possible muzzle to target distance.

3.0 Equipment/Reagents

3.1 Equiptment:

- Microscope
- Balance
- Laboratory glassware
- Rulers or Tape measure
- Transparent Overlays
- Camera
- Alternate Light Source
- Iron

3.2 Reagents:

- Sensitized Paper
- 15% Acetic Acid Solution
- 5% Hydrochloric Acid Solution
- Buffer Solution (for Sodium Rhodizonate)
- Diphenylamine Solution
- Dithiooxamide Solution
- Ammonium Hydroxide: Water 2:5
- (Water used in solutions may be tap water)

Note: Reagents in this method are generally prepared for single use. When applicable, storage conditions and/or requirements for stored reagents or materials are notated in the preparation instructions for that item.

4.0 Procedure

4.1 Visual examination

4.1.1 The visual examination of an item for gunshot residue can include the examination and/or consideration of the following. Visual examination can include items of clothing submitted to the lab for examination or photographs submitted as evidence.

- The presence of vaporous lead (smoke)
- The presence of particulate metals (shavings of lead, copper, brass)
- The presence of unburned, burned and partially burned gunpowder
- A hole in the item
- The presence of a visible ring around the perimeter of holes
- The location of all holes, tears, etc.
- The presence of burning, singeing or melting.
- The presence of any possible masking effects.

Data regarding the physical effects and visible residues examined shall be included in the examination notes. Visual examination may be aided with the use of filtered or IR photography, or an alternate light source. Copies of any photographs submitted as evidence will be retained and location of where the photographs are stored documented in the examination notes.

4.1.2 Interpretation of Results for Visual Examinations:

4.1.2.1 Indicative of/ Consistent with the discharge of a firearm:

- Vaporous lead (smoke)
- Particulate metals
- Unburned, burned and partially burned gunpowder
- Melted adhering gunpowder

4.1.2.2 Indicative of/Consistent with a contact shot:

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

4.1.2.3 Limitations:

Possible masking effects

- Dark background color
- Blood Staining
- Clothing type, material, adverse handling or improper packaging may affect adherence of particles and limit the ability to perform range determinations.

When visual examination of photographs is completed, a disclaimer stating the opinions and interpretations are based on the damage depicted in the submitted photographs must be used on the report.

Conclusions where only photographs and/or autopsy reports are used shall be limited to:

- **Contact/near contact:** The muzzle of the firearm was in contact with or very near the target at the time of discharge with possible soot, ripping, tearing, and/or singeing of the target material.
- **Intermediate:** The range at which a firearm and ammunition combination will deposit visible or detectible gunpowder particles on a target.
- **Distant:** Only the bullet reaches the target {determined by chemical testing (bullet wipe), defect characteristics, or autopsy information}. No tearing of the target material observed and no gunpowder particles or soot are observed or chemically detected.

4.2 Microscopic Examination

4.2.1 The microscopic examination of an item for gunshot residue can 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 unburned, burned and partially burned gunpowder
- The presence of melted adhering gunpowder
- The presence of burning, singeing, or melting
- The presence of any possible masking effects

4.2.2 Interpretation of Results for Microscopic Examinations

4.2.2.1 Indicative of/ Consistent with the discharge of a firearm

- Vaporous lead (smoke)
- Particulate metals
- Unburned, burned and partially burned gunpowder
- Melted adhering gunpowder

4.2.2.2 Limitations:

Possible masking effects

- Dark background color
- Blood Staining

Clothing type, material, adverse handling or improper packaging may affect adherence of particles and limit the ability to perform range determinations.

4.3 Chemical examinations methods

Evidence items should be chemically processed prior to creation of test shots. Cartridge cases and bullets fired during range determination need not be collected. If items are collected they will be logged into the ILIMS system and designated as an additional sub-item of the firearm in which they were fired from. Sub-items will be documented on the examination report and returned to the submitting agency.

If multiple chemical examinations are going to be performed on an item they must follow a specific order. Modified Griess first, Dithiooxamide second, then Sodium Rhodizonate.

4.3.1 Modified Griess Test

The Modified Griess test may be used independently and or in conjunction with other tests in range determinations. The Modified Griess test utilizes a color chemistry reaction to help distinguish gunshot residue patterns not visible to the naked eye or when using a microscope. The 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-napthol and produces an orange-red color.

4.3.1.1 Preparation of Reagents

(The following may be made in different amounts using appropriate ratios for single-use.)

4.3.1.1.1 Sensitized Paper:

- Add 0.75 g Sulphanilic acid to 150 ml water
- Add 0.42 g of Alpha Napthol to 150 ml methanol
- Mix solutions together in a clean tray
- Saturate filter paper, desensitized photo paper or computer photo paper in solution
- Dry the paper and store in an airtight plastic container for up to 2 months.

4.3.1.1.2 Acetic acid Solution

- Prepare a 15% glacial acetic acid solution.

4.3.1.1.3 Nitrite test swabs

- Dissolve 0.06 g of sodium nitrate in 100 ml water.
- Saturate filter paper or cotton swabs in the mixture. Dry and store in an airtight plastic container for up to 6 months.

4.3.1.2 Application Procedure

4.3.1.2.1 Direct application (should be used when item is thin fabric or porous material)

4.3.1.2.1.1 Place sensitized paper directly under area to be tested.

4.3.1.2.1 2 Soak a piece of nitrate-free cheesecloth or filter paper with the acetic acid solution, and place this over the reverse side of the evidence.

4.3.1.2.1 3 Apply heat and pressure with an iron until the acetic acid solution treated paper is dry.

4.3.1.2.2 Reversed application (should be used with items of thicker fabric or non-porous material)

4.3.1.2.2.1 Moisten the side of the sensitized paper that will be in contact with the questioned area with the acetic acid solution.

4.3.1.2.2.2 Place the sensitized paper over the area to be tested.

4.3.1.2.2.3 Place a piece of filter paper or nitrite-free cheesecloth over the sensitized paper.

4.3.1.2.2.4 Apply heat and pressure with an iron until the acetic acid solution treated paper is dry.

4.3.1.3 Controls

Prior to the use of sensitized paper on case items a positive and negative control will verify the sensitized paper was prepared correctly. The controls for the Modified Griess procedure consists of placing a test mark, utilizing a nitrite test swab, on the edge of each sensitized paper being used. An immediate orange color should appear. The color shift indicates that the sensitized paper is sensitive to the presence of nitrites. Cut the test marks off the paper before applying to the evidence to avoid contamination.

The negative control may consist of making a similar test mark using a non-nitrite test swab with the Acetic Acid solution or the treatment of the paper with Acetic acid prior to testing the item. No color reaction should take place.

4.3.1.4 Interpretation of Results

Any orange, orange red indications on the paper are the results of the chemically specific test for the presence of nitrite residues. Positive results shall be documented with photographs including a ruler, negative results and results of controls need only be noted.

4.3.1.5 Limitations:

Clothing type, material, adverse handling or improper packaging may affect adherence of particles and limit the ability to perform range determinations.

4.3.2 Dithiooxamide (DTO)

The 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. This test may be effective in determining physical characteristics of bullet holes including entrance vs. exit holes. A fired bullet passing through clothing or other items often leave traces of copper around the bullet hole. The copper transfer comes from copper-containing bullets, and/or the barrel of the firearm. The transfer may be in the form of minute particles, a fine coating of particles, or a fine cloud of vaporized copper. The copper transfer may be an obvious ring or wipe but is often not visible

4.3.2.1 Preparation

(The following may be made in different amounts using appropriate ratios for single-use.)

4.3.2.1.1 Dithiooxamide Solution: 0.2% solution Dithiooxamide in ethanol (w/v).

4.3.2.1.2 Ammonium Hydroxide solution: 2 parts conc. ammonium hydroxide to 5 parts water.

4.3.2.2 Application Procedure

4.3.2.2.1 Place about three drops of Ammonium Hydroxide solution on filter paper.

4.3.2.2.2 Place the treated paper over the area to be tested.

4.3.2.2.3 Place a second piece of filter paper over the first and apply moderate pressure.

4.3.2.2.4 Remove both pieces of paper and place about 3 drops of Dithiooxamide solution to the tested area of the filter paper.

4.3.2.3 Swab Technique

4.3.2.3.1 Dampen a swab with Ammonium Hydroxide.

4.3.2.3.2 Swab the area of interest.

4.3.2.3.3 Apply Dithiooximide solution to swab.

4.3.2.3 Controls

A positive and negative control will be run each day the reagents are used and the results of the control will be noted in the examination notes.

4.3.2.3.1 A positive and negative control can be obtained by creating a test mark on an appropriate piece of material with known copper, or by wetting two swabs with the Ammonium Hydroxide solution and rubbing one on a known piece of copper and then adding the DTO solution to both swabs.

4.3.2.4 Interpretation of Results

A dark greenish-gray color reaction, corresponding to the area tested, indicates a positive reaction for copper. Results will be noted in examination documentation; photographs are not required.

4.3.2.5 Limitations:

Clothing type (ie certain materials) may affect adherence of particles and limit the ability to perform range determinations.

4.3.3 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 vs. exit holes. Fired bullets passing through clothing and/or other objects often leave traces of lead around the bullet hole. The 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 not visible.

4.3.3.1 Preparation of Reagents

(These reagents may be prepared in different quantities with the appropriate ratios.)

4.3.3.1.1 Sodium Rhodizonate Saturated Solution: Saturate water with sodium rhodizonate.

4.3.3.1.2 Hydrochloric Acid Solution: Prepare a 5% HCl solution (5 mls conc. HCl in 95 mls of water).

4.3.3.1.3 Buffer Solution: Dissolve 1.9g sodium bitartrate and 1.5g tartaric acid in 100ml of DI water. This may require heat and agitation.

4.3.3.1.4 Acetic Acid Solution: Prepare a 15% acetic acid solution (15 mls glacial acetic acid in 85 mls of water).

4.3.3.2 Application Procedures

4.3.3.2.1 Bashinsky Transfer Technique

4.3.3.2.1.1 Uniformly dampen a piece of filter paper with Acetic Acid solution.

4.3.3.2.1.2 Place the treated filter paper over the hole/area to be tested.

4.3.3.2.1.3 Place a second piece of paper over the first and apply moderate pressure or apply a hot iron for approximately 5 seconds.

4.3.3.2.1.4 Remove both pieces of filter paper and spray the Sodium Rhodizonate solution on to the tested area of the filter paper.

4.3.3.2.1.5 Spray the tested area of the filter paper with the Buffer solution (optional)

4.3.3.2.1.6 Spray the tested area of the filter paper with the Hydrochloric acid solution.

4.3.3.2.1.7 Repeat this process on all hole/area to be tested. Both sides of the hole should be tested if there is question of direction.

4.3.3.2.2 Direct Application

4.3.3.2.2.1 Apply Sodium Rhodizonate solution on to the questioned area.

4.3.3.2.2.2 Apply the Buffer solution to the questioned area (optional)

4.3.3.2.2.3 Apply the Hydrochloric acid solution to the questioned area.

4.3.3.2.2.4 Repeat this process on all hole/areas to be tested. Both sides of a hole should be tested if there is question of direction.

4.3.3.2.3 Swab Technique

4.3.3.2.3.1 Dampen a swab with Acetic Acid.

4.3.3.2.3.2 Swab the area of interest.

4.3.3.2.3.3 Apply Sodium Rhodizonate solution to swab.

4.3.3.2.3.4 Apply Buffer solution to swab. (optional)

4.3.3.2.3.5 Apply Hydrochloric Acid solution to swab.

4.3.3.3 Interpretation of Results

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. Results will be noted in examination documentation; photographs are not required.

4.3.3.4 Controls

A positive and negative control will be run each day before the reagents are used to ensure they are working properly. A positive and negative control may be prepared by placing a test mark with a piece of lead on an appropriate material or by wetting two swabs with a 5% solution of HCl and swabbing a piece of lead with one.

4.3.3.5 Limitations:

Clothing type, material, adverse handling or improper packaging may affect adherence of particles and limit the ability to perform range determinations.

4.3.4 Diphenylamine Test

The diphenylamine test utilizes a color chemistry reaction to indicate the presence of nitrates and/or nitrites. Diphenylamine reacts with the nitrates or nitrites to give a dark blue color reaction. Some gunpowder particles may be deposited on surrounding objects or clothing. This test can effectively identify an area in which a firearm was discharged through the examination of vacuum sweepings or clothing.

4.3.4.1 Preparation (may be mixed at different quantities with using appropriate ratios.)

4.3.4.1.1 Diphenylamine Solution: add 0.3g diphenylamine to 20ml conc. sulfuric acid. Add this mixture to 10ml glacial acetic acid.

4.3.4.2 Application Procedure

4.3.4.2.1 Examine evidence macroscopically and microscopically.

4.3.4.2.2 Separate potential gunpowder particles based on size, color and shape.

4.3.4.2.3 Place Diphenylamine reagent in an empty spot test well and then add the unknown particles.

4.3.4.3 Interpretation of Results

A dark blue color reaction with an unknown particle indicates the presence of nitrates or nitrites. Results will be noted in examination documentation; photographs are not required.

4.3.4.4 Controls

A positive control of known gunpowder will be tested each day the reagent is used and the results will be noted in the examination documentation.

4.4 Test Pattern Methods

In muzzle to target determinations if observations support the findings of a "contact shot" no comparison is necessary. If the observations do not support a "contact shot" finding, a hypothesis will be formed based on observations. Test patterns will be produced at the appropriate ranges designated by the results of the evidence testing. Test Patterns will be creating using methods defined in section 4.4.1 or 4.4.2 of this method.

4.4.1 Non-Shot Pellet Test Pattern Production

It is an essential prerequisite that the suspected firearm or other identical firearm and ammunition consistent with the suspect ammunition be utilized.

4.4.1.1 Preparation

4.4.1.1.1 Attach appropriate sized piece of an appropriate test material to nitrite-free cardboard backing board.

4.4.1.1.2 Tests should be shot in increasing or decreasing range increments until a distance is established both shorter and longer than, that which reproduces the gunshot residue patterns on the suspect item.

4.4.1.1.3 Tests may be shot in duplicate if ammunition supplies allow.

4.4.1.1.4 If the test patterns are obtained outside, they must be obtained during appropriate weather conditions. It must not be raining or have strong winds present.

4.4.1.2 Interpretation of Results

By utilizing the suspect firearm and appropriate ammunition it is possible to obtain a reproduction of a gunshot residue pattern present on a suspect item. Therefore, one can ascertain the approximate distance that a particular firearm's muzzle was from the submitted item when it was shot by bracketing the suspect pattern with test patterns at known distances. A conclusion can be reached by comparing the diameter of the known patterns with the unknown pattern. Patterns can be measured with a ruler or transparent overlay to determine the approximate diameter of major concentration. To employ a bracketing technique it is necessary to determine at what distance a smaller known pattern is consistently produced and at what distance a larger know pattern is consistently produced.

The witness sheets will be stored centrally in the lab. The location of the sheets will be documented in the case notes.

A disclaimer should be noted on the report that the ranges are determined under controlled conditions. Conditions that may have been present during the time of the incident may have an adverse effect on the possible ranges. Possible scene based factors that could affect the pattern range could include: weather conditions, dynamic movement of the target material at the time of the shot, non-flat target surfaces, as well as, treatment of the target material post incident. All of these factors which are difficult to accurately account for may have an influence on the amount of particles detected during analysis versus the amount of particles that may have been present at the time of the incident.

4.4.2 Shot Pellet Test Pattern Production

It is an essential prerequisite that the suspect firearm or other identical firearm and ammunition consistent with the suspect ammunition be utilized.

4.4.2.1 Preparations

4.4.2.1.1 The test media for shot pellet test patterns is an appropriate sized piece of poster board, heavy paper or cloth attached to cardboard.

4.4.2.1.2 Tests should be shot in increasing or decreasing range increments until a distance is established, both shorter and longer than that which reproduces the shot patterns on the suspect item.

4.4.2.1.3 Test may be shot in duplicate if ammunition supplies allow.

4.4.2.1.4 If the test patterns are obtained outside, they must be obtained during appropriate weather conditions. It must not be raining or have strong winds present.

4.4.2.2 Interpretation of Results

By utilizing the suspect firearm and appropriate ammunition it is possible to obtain a reproduction of a shot pattern present on a suspect item. Therefore, one can ascertain the approximate distance that a particular firearm's muzzle was from the suspect item when it was shot by bracketing the suspect pattern with test patterns at known distances. The witness sheets will be stored centrally in the lab. The location of the sheets will be documented in the case notes.

4.5 Safety

These procedures involve hazardous materials. It is the responsibility of the user of these procedures to establish appropriate health and safety practices. Proper caution to include adherence to test firing rules and the use of personal protective equipment must be considered to avoid exposure to potential hazards. Consult the appropriate MSDS/SDS for each chemical prior to use.

4.6 Possible Results for Range Determinations

There are many possible results relating to muzzle to target distance and the reporting of residues and shot patterns.

4.7 Photographs

Photographs shall be stored centrally in the laboratory.

4.8 Reviews

Results may be reviewed using just notes and photographs or by using the witness panels at the reviewer's discretion.

AM #7: Serial Number Restoration

1.0 Background/References

1.1 Background:

Many valuable items manufactured today have serial numbers for identification. These numbers are usually die-stamped. This process produces a compression of the metal/plastic in the area immediately surrounding and a short distance below the penetration of the die. Serial numbers are produced in a variety of ways.

1.2 References:

- Treptow, Richard, S., Handbook of Methods for the Restoration of Obliterated Serial Numbers, NASA, 1978.
- Polk, Donald, E. and Giessen, Bill, C. "Metallurgical Aspects of Serial Number Recovery", AFTE Journal ,Vol. 21, No. 2, p.174.
- Bureau of Alcohol, Tobacco and Firearms Laboratory, Serial Number Restoration Handbook, 1999.

2.0 Scope

2.1 The serial number may be restored if the obliteration is not taken past the previously mentioned compression zone. It is desirable to remove 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.

3.0 Equipment/Reagents

3.1 Equiptment

- Balance
- Laboratory glassware
- Polishing tools (i.e. dremel tool)
- Sand paper, steel wool
- Magnets
- Camera

3.2 Reagents

The following recipes are the most common reagents used for serial number restoration. Other acceptable reagents used for serial number restoration can be found in literature provided by the BATF, FBI, AFTE, and the "Handbook of Methods for the Restoration of Obliterated Serial Numbers" by Richard S. Treptow. (See References in this section) Varying the reagent concentrations is acceptable.

NOTE: ALWAYS ADD ACID TO WATER. NEVER ADD WATER TO ACID.

3.2.1 Fry's Reagent:

Combine nine (9) grams of Crystalline Cupric Chloride with twelve (12) mL of Concentrated Hydrochloric Acid and ten (10) mL of distilled water. Utilizing these proportions, mix the quantity desired.

3.2.2 Nitric Acid Solution:

Prepare a 25% Nitric Acid solution (25 mL of Concentrated Nitric Acid and 75 mL of distilled water), mix the quantity desired.

3.2.3 Cupric Ammonium Chloride Solution:

Add one (1) gram of Cupric Ammonium Chloride and ten (10) mL of Concentrated Hydrochloric Acid to ten (10) mL of distilled water. Utilizing these proportions, mix the quantity desired.

3.2.4 Ammonium Persulfate Solution:

Prepare a 10% Ammonium Persulfate solution (10 grams of Ammonium Persulfate and 100 mL of distilled water), mix the quantity desired.

3.2.5 45% Sodium Hydroxide Solution:

Prepare a 45% Sodium hydroxide solution (45 grams of Sodium Hydroxide and 100 mL of distilled water), mix the quantity desired.

3.2.6 10% Sodium Hydroxide Solution:

Prepare a 10% Sodium hydroxide solution (10 grams of Sodium Hydroxide and 100 mL of distilled water), mix the quantity desired.

3.2.7 Turner's Reagent:

Add 2.5 grams of Cupric Chloride to 40 mL of Concentrated Hydrochloric Acid, 25 mL of 100% Ethanol and 30 mL of distilled water, mix the quantity desired.

3.2.8 Davis Reagent:

Add 5 grams of Cupric Chloride to 50 mL of Concentrated Hydrochloric Acid and 50 mL of distilled water, mix the quantity desired.

3.2.9 Ferric Chloride:

Add 25 grams of Ferric Chloride to 100 mL of distilled water, mix the quantity desired.

3.2.10 Acidic Ferric Chloride:

Add 25 grams of Ferric Chloride to 25 mL of Concentrated Hydrochloric Acid and 100 mL of distilled water, mix the quantity desired.

3.2.11 Phosphoric/Nitric Acid:

Add 98 mL of 85% Phosphoric Acid (85 mL of Phosphoric Acid and 15 mL of distilled water) to 2 mL of Concentrated Nitric Acid, mix the quantity desired. Or, add 50 mL of Concentrated Phosphoric Acid to 3 mL of Concentrated Nitric Acid, mix the quantity desired.

3.2.12 Magnaflux:

Use Magnaflux 9CM Prepared Bath or Magnaflux 7HF Prepared Bath (or equivalent) available, premixed from: Magnaflux Corporation, 3624 West Lake Avenue, Glenview, IL, 60026. Phone (847)657-5300

4.0 Procedure

4.1 Surface Preparation and Restoration

Prior to chemical restorations attempts surfaces should be cleaned with methanol or acetone to remove and particles or debris remaining from polishing and or magnetic particle testing.

4.1.1 Polishing Technique

4.1.1.1 Note and record any visible characters prior to polishing.

4.1.1.2 Plastic – if possible, examine the reverse side of the item to see if any characters are visible.

4.1.1.3 Polish the obliterated area by hand, or using a grinding tool.

4.1.1.4 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 of the scratches.

4.1.1.5 Note and record any characters which become visible.

4.1.1.6 If all of the characters do not become visible, proceed to the appropriate chemical/heat restoration procedure

4.1.1.7 Clean the surface with acetone or methanol prior to chemical restoration.

4.1.2 Chemical Restoration (The following are considered recommendations)

Reagent/Procedure	Suitable for
Fry's, Turner's, Davis Reagent	Steel
Nitric Acid	Aluminum or Brass
Phosphoric/Nitric Acid	Steel / Pot Metal / Aluminum
Cupric Ammonium Chloride	Stainless Steel or Cast Iron
Ammonium Persulfate	Steel
Cupric Chloride	Steel
Sodium Hydroxide	Aluminum
Ferric Chloride	Steel / Pot Metal

Technique

4.1.2.1 Moisten cotton tip applicators (swabs) with the suitable chemical solution and apply to the obliterated area.

4.1.2.2 After a few seconds, wipe off the solution and inspect for visible numbers. Repeat as necessary. This process may take several hours. The examiner may wish to build a clay "dam" around the obliterated area, and fill it with a larger volume of solution.

4.1.2.3 Fry's Reagent - The examiner may wish to alternate between swabs saturated with the Fry's Reagent and the 25% Nitric Acid solution.

4.1.2.4 To speed up the process, the examiner may wish to use an electrochemical process. The positive (+) terminal of a standard lantern battery or other source is connected to the obliterated item and the negative terminal (-) is connected to the cotton swab.

4.1.2.5 If any characters become visible note and photograph these characters.

4.1.3 Magnetic Restoration (Magnaflux)

The Magnetic Particle Inspection procedure is a non-corrosive, non-destructive technique that utilizes a magnetic field. This method is only applicable with stamped serial numbers in ferrous substrates. Since this technique is non-destructive, it can be attempted at any stage of the restoration: before, during, or after any other methods.

Technique

4.1.3.1 Attach a horseshoe-type magnet to the obliterated test area so that the poles of the magnet are on opposite sides of the area to be restored. This will generate a magnetic field around the test area.

4.1.3.2 Shake the Magnaflux can vigorously and spray into a beaker or other receptacle.

4.1.3.3 With an eyedropper, apply Magnaflux to obliterated area.

4.1.3.4 The ferrous shavings in the Magnaflux solution should align themselves with the stress from the die stamping.

4.1.3.5 If any characters become visible, note and photograph these characters.

4.1.4 Heat Restoration

The Heat procedure is suitable for restoration of serial numbers in plastic.

Technique

4.1.4.1 Apply heat to the area of obliteration utilizing a high intensity lamp.

4.1.4.2 Continue the application of heat until the plastic in the obliterated area starts to liquefy.

4.1.4.3 If any characters become visible note and photograph these characters.

4.1.5 Barcode Decryption

4.1.5.1 Inspect barcode to ensure that at least portions of the full barcode are available.

4.1.5.2 Determine if all bars are present.

4.1.5.3 Delineate the bars into character units.

4.1.5.3.1 Use of an enlarged photograph or photocopy is recommended.

4.1.5.3.2 Start at the far left bar and count five bars over then label this as the first character set.

4.1.5.3.3 Repeat this procedure for the remaining bars to identify all character sets. There will be nine (9) character sets visible.

4.1.5.4 Interpret and document the barcode element size patterns.

4.1.5.4.1 Each bar and space from left to right is to be labeled "W" for wide or "N" for narrow.

4.1.5.4.2 Complete this for each character set.

4.1.5.4.3 Using the Bar Code 39 table below, begin correlating each developed pattern sequence from the individual character sets to determine the character represented by the pattern.

4.1.5.5 Record results in ILIMS.

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	

4.2 Controls

It will be determined that the reagents are functioning if there is a positive reaction with the metal in a serial number restoration.

4.3 Interpretation of Results

If any characters become visible note these characters including partials.

- Photographs are recommended for documentation.
- If unable to photograph, second examiner observation and sign off recommended.
- If known from a reference, report unrestored characters as letter or number.

4.4 Safety Considerations

This procedure involves hazardous materials, operations and equipment. This procedure does 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 must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions. Consult the appropriate MSDS/SDS for each chemical prior to use.

4.5 Photographs

Photographs shall be stored centrally in the laboratory.

AM #8: Maintenance and Calibration

1.0 Background/References

1.1 Background

To insure accurate data, all equipment that has a direct effect upon the comparison and measurement processes is kept in proper working order. Measurement devices and reference standards receive periodic calibration. Other equipment is examined and maintained periodically to verify safe/effective operation. Calibration / maintenance intervals may be adjusted based upon past performance, where the item has demonstrated that it will remain within specifications throughout the calibration interval.

Any equipment that appears to be damaged, out of calibration, or functioning improperly is removed from service, until the nature of the problem can be determined and corrected.

2.0 Scope

2.1 Defining the necessary maintenance and or calibration of equipment used in the Firearms Discipline

3.0 Equipment/Reagents

3.1 Equipment

- Balances
- Comparison microscopes
- Micrometers and Calipers
- NIST traceable devices
- Rulers and tape measures
- Gage blocks
- Trigger Pull Weights
- Leeds LCD Scale

4.0 Procedure

4.1 Maintenance and Calibrations

4.1.1 Balances

4.1.1.1 Maintenance and repairs performed on the balance will be recorded in a maintenance log.

- Balances will be calibrated once per calendar year by a certified outside vendor. If the balance is taken out of service for repair or an event occurs (such as moving the balance) an intermediate check will be performed and documented. In order to pass the intermediate check, the accuracy of the balance will be +/- 2%.
- The weights used in intermediate checks will be cleaned and calibrated every 5 years by an outside vendor. The weights will be handled with gloves or tweezers to keep them clean. They will be transported and stored in their case. The documentation for the calibration of the weights will be kept in the front office.

4.1.2 Comparison Microscopes

4.1.2.1 Each microscope will have a maintenance log and any maintenance or repair will be recorded. The uniform magnification of the comparison microscope is checked by comparing two identical stage micrometers at multiple magnifications.

4.1.2.1.1 The comparison microscope shall be checked once per calendar year, after repairs likely to affect magnification and after moving. If the checks indicate the microscope is out of calibration calibrations shall be performed by an approved outside vendor.

4.1.2.1.2 It is recommended that the microscope be cleaned and services by an approved outside vendor at least once every 5 years, or when needed.

4.1.3 Micrometers and Calipers

Each micrometer or caliper will be checked once per calendar year against a certified gauge block or micrometer disk. These checks will be documented and the micrometer or caliper must demonstrate accuracy within .001 inches of the intended measurement.

4.1.4 Rulers and other measuring devices.

4.1.4.1 NIST traceable devices

The measuring specifications and accuracy for NIST traceable measuring devices (e.g. barrel rods, traceable ruler) are determined during certification of these devices and can be found in each laboratory's equipment/instrumentation maintenance file. The NIST traceable measuring device will be calibrated and recertified every five years. NIST traceable measuring devices will be stored so as to prevent damage such as bending or melting. The devices shall be handled with care to prevent bending, melting or damage to measuring marks.

4.1.4.2 Rulers and tape measures

Non-calibrated rulers and tape measures may be used for descriptive measurements only. Descriptive measurements using an un-calibrated measuring device may be included in the case notes but will not be included in the report.

4.1.4.3 Damage or malformation

4.1.4.3.1 If damage or a malformation (i.e. breakage or melting) occurs that may affect the measuring device it will be taken out of service and marked as out of service until it is repaired or replaced.

4.1.4.3.2 Damaged NIST certified measuring devices will be calibrated by an approved vendor before being put back into service.

4.1.5 Gage blocks

Gage blocks will be calibrated by an outside vendor every five years. Gage blocks will be handled with care to prevent bending, breaking or melting and will be transported and stored in their case.

4.1.6 Trigger Pull Weights

Trigger pull weights will be checked once per calendar year. The weights will be checked using certified balance. Tolerance for each weight is +/- 1% of the expected value. If a weight does not fall within the expected value it will be taken out of service and corrective action will be taken. Corrective action may include cleaning the weight or replacing the weight. The weight must be checked and have satisfactory results before being put back in service.

4.1.7 Onstage LCD Scale

The on-stage LCD Scale will be checked against a stage micrometer. These checks will be documented and the Leeds LCD Scale must demonstrate accuracy within .001inches of the intended measurement. Checks will be performed once per calendar year and after changing the battery.

4.2 Handling and Verification of Externally Calibrated Items

4.2.1 Handling of Measuring Equipment

All measuring equipment will be handled and stored in the laboratory by appropriate analysts in a manner which prevents contamination, deterioration or damage and ensures proper functioning of the measurement equipment. All calibrated measurement equipment will be labeled, if possible, with the date of last calibration and date when calibration is next due.

4.3 Shipping

When a piece of equipment is sent to an approved vendor for repair, servicing or calibration it shall be packaged for shipping in such a way as to prevent damage.

4.4 Verification Upon Receipt of Externally Calibrated Item

Equipment received back shall be checked for damage and the certification documentation (containing measuring results, including the measurement uncertainty and/or a statement of compliance with an identified metrological specification.) will be reviewed and initialed before it is put back into service.

4.5 Review of External Calibration Documentation

Calibration Certificates for any externally calibrated item will be checked for compliance with ISO/IEC 17025:2005, Section 5.10 and initialed. All calibration certificates will be centrally stored.

4.6 Safety Considerations

This procedure involves hazardous materials, operations and equipment. This procedure does 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 must be exercised and the use of personal protective equipment must be considered to avoid exposure to haz9ardous conditions.

AM #9: IBIS/NIBIN

1.0 Background/References

1.1 Background

In 1999, the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) established the National Integrated Ballistic Information Network (NIBIN) to provide federal, state, and local partner agencies with an automated ballistic imaging system. Integrated Ballistic Identification Systems (IBIS) technology takes digital images of cartridge cases from crime scenes or a crime gun test fires. Within hours, IBIS compares those images against previous NIBIN entries. If a high-confidence candidate emerges, firearms examiners can compare the original physical evidence microscopically to confirm the match. This is a NIBIN "lead," or the linking of two (or more) different investigations.

The goals of the NIBIN program are to reduce firearms violence through promoting a comprehensive evidence collection, timely entry and correlation of evidence, providing investigative support, and ongoing facilitation of feedback regarding NIBIN program. As an ATF-NIBIN partner, the Idaho State Police Forensic Services is committed to assisting the ATF in the NIBIN program.

Currently Coeur d'Alene Crime Laboratory has access to a regional IBIS and NIBIN unit located at the Washington State Patrol Crime Laboratory located in Cheney, Washington. These units are deployed by the ATF and are the property of the ATF and U.S. Government. Specialized security clearance is required for all IBIS/NBIN users, and is issued by the ATF.

Each IBIS /NIBIN user is required to complete the ATF IBIS/NIBIN Acquisition training and pass a competency test administered by the ATF prior to participating in the NIBIN program. There is no additional IBIS/NIBIN training that is administered by ISPFS.

1.2 References

1. *Moving Toward a More Effective NIBIN*, version 1.0, Ron Nichols, NIBIN National Technology Coordinator
2. *Memorandum of Understanding between the ATF and WSP regarding the NIBIN*, dated January 28th, 2014
3. *Coordinating NIBIN and Forensic Science Laboratory Efforts*, Ron Nichols, NIBIN National Technology Coordinator
4. Washington State Patrol Firearms and Toolmark Technical Manual Revision 11. December 10, 2018

2.0 Scope

2.1 Defining the requirements and standard procedures for firearms related evidence and submission to the NIBIN database.

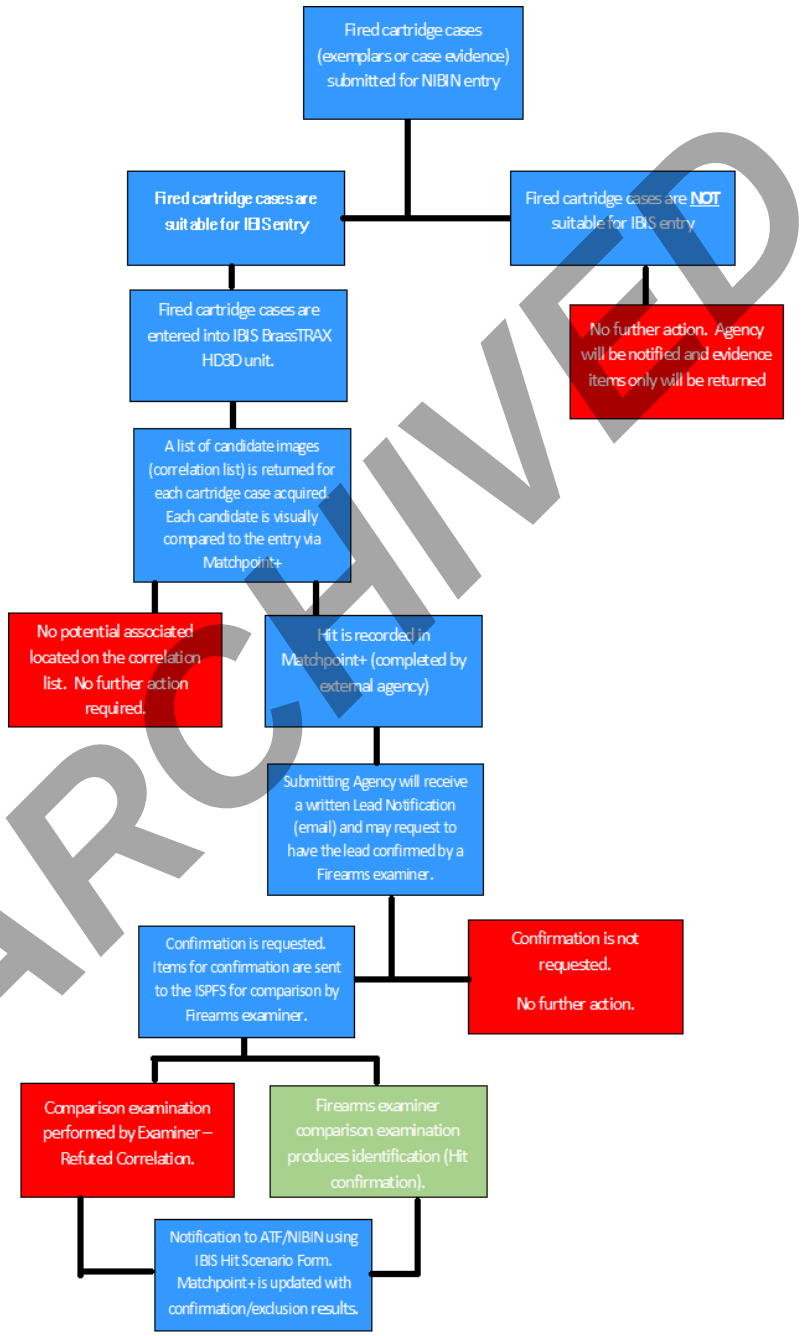
3.0 Equipment/Reagents

3.1 Equipment

- Stereo Microscope
- IBIS BrassTRAX HD3D acquisition unit

4.0 Procedure

4.1 IBIS Acquisition Flow Chart



4.2 Type of IBIS Entries

4.2.1 Methods of Submission

IBIS/NIBIN only test fires (exemplars) will be submitted to the lab with the required information.

All cartridge cases or firearms submitted to ISPFS for IBIS/NIBIN entry may be handled as follows:

- Cartridge cases or firearms submitted as evidence will be documented and handled per the ISPFS Quality Manual.
- Test fire cartridge cases created by the submitting agency exclusively for IBIS entry, will be designated as exemplars, and may be submitted to a drop box located in the ISP building or shipped to the ISPFS Laboratory in Coeur d'Alene. These cartridge cases may be entered into IBIS by any authorized NIBIN/IBIS operator. IBIS exemplars will be discarded after entry.

Following IBIS guidelines and ATF IBIS Data Entry Protocol, requested test fires will be entered into the NIBIN database. The selected cartridge cases may be cleaned with acetone when appropriate and placed in the cartridge case holder of the IBIS unit. When the acquisition is complete, the images are sent to the NIBIN server for correlations. A manual correlation may be requested as needed. Correlations will be performed and reported by an external agency.

4.2.2 Test Fired Cartridge Cases (Exemplars)

Exemplars generated by a law enforcement agency may be submitted by any of the methods described above. At this time, it is preferable for agencies to generate their own exemplars, as it streamlines the process for IBIS entry.

For agencies that need assistance creating exemplars for IBIS, the agency may bring the firearm in and the lab can assist with the test firing process. An agency representative will be present and complete the required collection and documentation for the exemplar submission.

The test fired cartridge cases will be examined microscopically and one will be selected to be entered into NIBIN unless the test fired cartridge cases differ considerably in appearance (i.e. different headstamp or compositions, primer shear on one and not the other, etc.). If they differ, two cases may be entered at the discretion of the IBIS user. When an ejector is present, the IBIS user should acquire the ejector mark based on ULTRA ELECTRONICS protocol.

4.2.3 Evidence Cartridge Cases

Cartridge cases and firearms recovered in association with a crime for IBIS entry must be submitted and documented as evidence. Any cartridge cases or firearms that meet the ATF criteria for entry will generally be entered into IBIS/NIBIN. **Evidence cartridge cases will not be accepted for IBIS entry using the drop box.**

Prior to handling casework evidence, the operator will review all pertinent case information to ensure all other case considerations such as, but not limited to, DNA or latent prints analyses have been addressed. For all entries, if two or more evidence cartridge cases are submitted of the same caliber family, the IBIS operator will examine the cartridge cases microscopically evaluating the caliber, the class characteristics of the breech face marks and the firing pin impression to determine which item(s) should be entered into IBIS. When an ejector is present, the IBIS user should acquire the ejector mark. If class characteristics vary or ammunition type varies, a test fire from each group should be entered into IBIS.

All casework evidence cartridge cases entered into NIBIN are to be documented in the matrix notes. The case record will include printouts from the IBIS instrument. All evidence cartridge cases will be entered into the IBIS instrument following ULTRA ELECTRONICS guidelines and ATF/IBIS Data Entry Protocol.

4.2.4 IBIS Reports

- For exemplars submitted to the laboratory for IBIS/NIBIN entry only, no report will be generated.
- For evidence cartridge cases, and/or Laboratory created test fires submitted to the laboratory for IBIS/NIBIN entry, a notation be put on the report denoting which items will be/were entered into IBIS/NIBIN, and the "Case Maintenance" printout will be included in the case record.

4.3 IBIS Acquisition Instrument

All equipment directly related to IBIS TRAX is owned by ATF and serviced by ULTRA ELECTRONICS. No adjustment or addition to any part of the system is permitted. The IBIS Acquisition Unit (AU) performs automatic self-diagnostic tests. If one of these tests reports an error, a calibration may be performed. Any time there is a problem that the user is unable or not authorized to resolve, ULTRA ELECTRONICS is to be called. No one may enter or retrieve data until they have been trained by the ATF or ULTRA ELECTRONICS and final approval is given by the ATF. All persons using the IBIS/NIBIN system must have an ULTRA ELECTRONICS generated password and security clearance granted by the ATF.

4.4 IBIS Acquisition

Creating a Case – For Dialog Box descriptions, refer to the IBIS training guide, available through the ULTRA ELECTRONICS website.

4.4.1 Case Maintenance

In addition to the IBIS training guide:

Case ID – All case identification begins with designated Agency abbreviation followed by the Agency Case number

Example: SP10-K19000001

All exhibits from a single case may be entered under one case number. The exhibits are to be labeled appropriately. Exhibits may include firearms, test fires and/or evidence.

For exemplars, case identification should use an abbreviation for the submitting agency and the agency case number.

Example: ACSO-2019DR12345

Any Exhibits entered out of the WSPCL drop-box should follow the convention used by Washington State Patrol NIBIN Users.

4.4.2 Firearms Entry

In addition to the IBIS training guide:

Exhibit number - Enter Gun 001, Gun 002, or Gun followed by the Item number from the Submission paperwork or item's packaging for as many firearms as are necessary to list. This exhibit number is often the same as what the submitting agency used as its evidence marking. Example: "GUN MC2"

4.4.3 Cartridge Case Entry

In addition to the IBIS training guide:

Exhibit number - All evidence exhibits begin with EX. After EX enter any identifiers that apply to the exhibit such as EX3-1 or EXMC10. All test fire exhibits will begin with TF. Test fires should be entered as TF 001, TF 002 and so on. Test Fires should correspond with the firearm entered in section 4.4.2 of this method. If comparisons and identifications have been made prior to entry, make a note in the comments section stating that Evidence Casings were also received but not entered since they were confirmed as being fired from the same gun.

4.5 Safety Considerations

This procedure involves hazardous materials, operations and equipment. This procedure does 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 must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions.