



WASHINGTON STATE PATROL

CRIME LABORATORY DIVISION

Firearms/Tool Marks Technical Procedures Manual

December 2022

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Introduction

The methods and procedures presented in this manual are designed to act as guidelines to assist in the proper examination of firearm and tool mark evidence. The examiner is additionally assisted by appropriate technical references maintained within the crime laboratory system, as well as private references and communications.

The many variables involved in the examination of firearms and tool mark related evidence preclude a "recipe" type manual. Formulas have been included where appropriate in the text and in the appendices where referenced. Further references or assistance may be obtained by contacting examiners within the Crime Laboratory Division (CLD) or members of the Association of Firearm and Tool Mark Examiners (AFTE).

The methods manual is subject to continual review and procedures may be updated or replaced with new methodology with approval by functional area consensus.

The forensic scientist responsible for firearm and tool mark examinations will conform to accepted methods and procedures. Proper ethical and professional standards will be maintained as an employee of the Washington State Patrol Crime Laboratory Division. Deviation from technical procedures will be carried out in accordance with the CLD Quality Operations Manual (QOM).

Each procedure in this manual requires certain safety practices. The examiner is reminded to practice good safety habits at all times.

Although many of the procedures in this manual are recognized internationally as standard methods, all of them must follow a quality assurance program involving technical review. Such a program is outlined in the CLD QOM. The responsibilities and procedures for conducting technical review and resolving differences are outlined in the CLD QOM.

Proficiency testing is recognized as an important adjunct to technical review, and together they function as critical elements of the overall quality assurance program. The proficiency testing program is outlined in the CLD QOM. Each year, every examiner must complete at least one firearm proficiency test and one tool mark proficiency test.

The critical issues of safety, training, and technical review require that a firearm/tool mark section be staffed with no less than two qualified examiners. If a firearm/tool mark section falls below this standard, a reasonable effort will be made by the CLD to bring that section up to minimum staffing.

Digital images will be stored in compliance with the CLD QOM.

1 FIREARM EXAMINATION PROCEDURES

1.1 INTRODUCTION

The procedures in this section require the skills of a trained firearm examiner. To be deemed fully trained, an examiner must have completed an appropriate and approved training program. For each procedure, a fully trained examiner must confirm that the training was completed and that the trainee is able to perform the procedure properly.

To ensure the accuracy and completeness of case documentation, the AFTE Glossary should be used for appropriate definitions and appropriate manufacturers' nomenclature should be used for describing firearms parts.

Forms/worksheets should be used to ensure inclusion of all pertinent facts pertaining to the submitted evidence. These forms/worksheets will be posted on the FLSB Portal.

The standard method for associating suspect firearms with fired ammunition components is comparison microscopy, using a microscope specifically designed for firearm/tool mark comparison.

Case files must document the start and end dates of examination. The start date is designated as the date the evidence is first examined as reflected in the case notes. The end date is designated as the date the report is signed by the examiner.

1.2 QUALITY ASSURANCE

Examiners are reminded of the importance of quality assurance as discussed in the "Introduction" of this manual and the CLD QOM. It is the responsibility of the firearms examiner to ensure that all microscopic examinations are verified by another qualified firearms examiner. Firearm examiners will follow performance check procedures and chemical logs as specified in the CLD QOM. When critical measurements are made by the examiner, it is the responsibility of the examiner to ensure that the device used to make the critical measurements has been calibrated.

1.3 TRACE EVIDENCE

Firearm related 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, this debris may have to be removed. This debris may consist of blood, tissue, paint, fibers, glass, etc. The value of this evidence should be considered during this examination. The examiner is cautioned that this type of evidence may present a health hazard. Trace evidence should be collected in compliance with standard laboratory procedure.

In addition to mechanical means, the following list of reagents may be used to clean evidence:

- Fifteen percent acetic acid or weaker
- Methanol
- Ten percent bleach
- Soap and water
- Haemo-Sol
- Acetone

Examiners are reminded that they are responsible for knowing the requirements and safety practices outlined in the Crime Laboratory Division Safety Manual. Examiners are also responsible for knowing the health hazards involved in the use of the chemicals named above. These chemicals and their hazards can be found in the Safety Data Sheets that are on file in each laboratory.

1.4 DNA/LATENT PRINT EXAMINATION

With recent advances in forensic science, the value of potential DNA and latent print evidence is a consideration when examining firearms evidence. Ideally, the user agency should determine whether DNA or latent print examination is required and whether firearm and tool mark evidence should be processed for DNA and latent prints prior to being examined by the Firearm/Tool mark Section. Items may be swabbed for DNA by the user agency prior to the submission of the evidence.

If any questions arise regarding potential DNA or latent print evidence, the matter should be brought to the attention of the supervisor and the case may warrant a call to the detective or officer involved to determine if DNA or a latent print examination is necessary. Since it may not be practical to do this on all evidence, this process should be handled on a case by case basis.

1.4.1 PROCEDURE FOR FIREARM/CARTRIDGE CASE SWABBING FOR DNA

In some circumstances it may be warranted for the firearms examiner to preserve potential DNA evidence prior to examining evidence using the following procedure:

- Wear gloves and lab coat. Additionally a mask and disposable sleeves, or a shield should be used.
- Moisten a sterile swab with distilled, deionized, or sterile water (try to use just one drop of water).
- Swab areas of the firearm that are rough (i.e. pistol grips and slide serrations). The barrel or slide can also be done if latent prints examinations have already been done. Areas can be swabbed with separate swabs or with one swab. Swab the entire exterior of cartridge cases.
- Dry the swab(s) (air dry or package using some product that allows the swab to be air dried with little air flow and no heat).
- Label a paper envelope or swab box with the type of sample, case number, date, and person who collected the sample.
- Package the swab in the appropriate packaging and place it inside of the packaging that also contains the firearm/item. In some instances, the item may be packaged separately following the CLD procedures for creating sub-items.
- Seal the outer firearm packaging.

1.5 EVIDENCE MARKING

Any evidence examined by members of the laboratory must be marked in some manner so that it can be identified in court. Items examined must bear the initials of the examining analyst, item number and the laboratory number, if practical. All markings or identifiers will be made in such a manner that the evidentiary value of the item is not compromised. The identifying markings may be placed on the proximal container if:

- The evidence is too small for an identifying mark.
- Marking the item will damage the evidence (e.g., a small fragment of a bullet where the rifling characteristics must be observed).
- The nature or texture of the item prevents it from being marked.
- Items have irregular or absorbent surfaces.
- Markings may compromise the value of an item, such as stolen property, that may be returned to the owner.

Identification marks or initials should be made with a scribe, engraver, permanent tag, waterproof marker on the item, waterproof marker on tape, or paint pen. If due to the nature of the evidence

it appears that the initials or marking may be at risk of rubbing off, a piece of clear tape can be placed over the markings for protection.

If engraving identifiers on firearms, it should be done in a discreet and inconspicuous manner to minimize defacing the value of the firearm. Examples of discreet areas are under the top strap, butt, inside edge of the magazine well, and under the trigger guard.

1.6 EQUIPMENT CALIBRATION AND PERFORMANCE CHECK PROCEDURES

Each scientist will be responsible for the performance checks of his/her personal equipment as described below. All members of the section shall ensure that all shared equipment is checked according to the schedule provided. If performance checks are not performed by a WSP contractor, the examiner will initial and date the record sheet in the performance logbook and record any adjustments or repairs.

Calipers, micrometers, force gauge, and the scale micrometer will have the performance checked if dropped or damaged. Balances will be checked if moved.

If calipers and micrometers do not measure properly and cannot be adjusted, the devices will be taken out of use and serviced by an authorized service provider or replaced.

Instrumentation that does not meet performance specifications or falls outside of the acceptable range shall be taken out of service. The instrument will be clearly labeled or marked as being "Out of Service" until it has been repaired and shown by calibration or performance verification to perform within specifications and the acceptable range. In addition, the removal of the instrument from service should be documented in the equipment/instrument log and should indicate why the instrument was removed from service. The date the instrument is placed back in service should also be indicated in these logs.

The MIKEMASTER 0-1" Surveillance Kit (or equivalent) used for performance checking calipers or micrometers will be calibrated prior to the interval listed on the calibration certificate.

1.6.1 CALIPER

1. Definition:

A device consisting of two moveable legs or jaws, used to measure the diameter, thickness, or distance between two surfaces.

2. Performance Check:

Using the calibrated MIKEMASTER 0-1" Surveillance Kit (or equivalent), compare caliper reading to measurements marked on the checking device for .140" up to .964" or over the entire measuring spectrum of the checking device. Note the results in the performance log. A performance check of calipers will occur on a yearly basis. The acceptable measurement range for the caliper is $\pm .001$ ".

1.6.2 MICROMETER

1. Definition:

An instrument used to measure accurately small distances, usually thickness or diameter. It is based upon the rotation of a screw having 40 threads per inch and may be used in conjunction with a comparison microscope.

2. Performance Check:

Using the calibrated MIKEMASTER 0-1" Surveillance Kit (or equivalent), compare micrometer readings to measurements marked on the checking device for .140" up to .964" or over the entire measuring spectrum of the checking device. Note the results in the performance log. A performance check of micrometers will occur on a yearly basis. The acceptable measurement range for the micrometer is $\pm .001$ ".

1.6.3 RULER

1. Definition:

An instrument used to measure length.

2. Performance Check:

Rulers used in casework will be checked against the GEI International, Inc. (or equivalent) certified ruler. A performance check of rulers will occur on a yearly basis. The acceptable measurement range for rulers is $\pm 1/16"$.

Rulers used for critical measurements must be calibrated prior to the interval listed on the calibration certificate.

1.6.4 HOTT ROD

1. Definition:

An instrument used to measure barrel length

2. Performance Check:

Hott Rods used in casework shall be performance checked against the GEI International Inc. (or equivalent) calibrated ruler if the Hott Rod is dropped or damaged in any way.

Hott Rods used for critical measurements must be calibrated prior to the interval listed on the calibration certificate.

1.6.5 DIGITAL SCALE BALANCE

1. Definition:

An instrument used to measure weight.

2. Performance Check:

Using calibrated weights, place an appropriate sized weight for the balance being checked on the platen. **DO NOT OVERLOAD BALANCE.** Check that the weight measured by the balance matches the weight marked on the calibrated weight. If the readout does not comply with the weight, follow the procedure supplied by the manufacturer for the particular balance or have the balance serviced by an authorized service provider. Note any adjustments made in the performance log. A performance check of balances will occur if the balance is moved.

Digital scale balances are calibrated onsite by an authorized vendor at least once per year (see the CLD QOM).

1.6.6 TRIGGER PULL DEVICE

1. Definition:

An instrument for measuring the amount of force that must be applied to the trigger of a firearm to cause sear release. Hanging weights, spring gauges, or the Imada Digital Force Gauge may be used to measure trigger pull. The arm of the trigger pull weights or force gauge will be rested against the trigger at a point where the trigger finger would normally rest, with the force applied approximately parallel to the bore axis.

2. Performance Check:

The hanging weights will be checked by weighing each individual weight on a balance that has been calibrated. Note any differences in the performance log. If a discrepancy is noted between the hanging weights and the calibrated balance, this discrepancy must be taken into account if the hanging weights are used in casework. This discrepancy should be noted in the case notes until the weights can be replaced. Unless damaged, a check of trigger pull weights should only be performed once every five years. The acceptable measurement range for trigger pull weights is $\pm .05$ lb.

Spring gauges and the Imada Digital Force Gauge will be performance checked using the hanging weights that have been weighed on a calibrated balance. If the reading does not comply with the weight, a note shall be made in the performance log and the digital force gauge should be serviced by an authorized service provider. A performance check of the digital force gauge will occur on a yearly basis. The acceptable measurement range for the Imada Digital Force gauge is $\pm .05$ lb.

1.6.7 STEREOMICROSCOPE

1. Definition:

An optical instrument which provides three dimensional viewing of an object.

2. Performance Check:

A WSP contractor services the firearms section microscopes. Preventative maintenance is recommended to be performed on a biyearly basis by this vendor. A sticker providing the information regarding maintenance of the microscope is located on each microscope. A performance check of the stereomicroscope is required only if measurements of objects are taken through the stereomicroscope.

1.6.8 COMPARISON MICROSCOPE

1. Definition:

An optical instrument that is essentially two compound microscopes connected to an optical bridge that allows the viewer to observe two objects simultaneously with the same degree of magnification.

2. Performance Check:

A WSP contractor services the firearms section microscopes. Preventative maintenance is recommended to be performed at an interval of not more than three years (see the CLD QOM). Service may be required at other times if the microscope is not functioning appropriately or becomes damaged. A sticker providing the information regarding maintenance of the microscope is located on each microscope. Each objective through which measurements are taken will be performance checked. A calibrated measuring object (ruler, calipers, etc.) should be placed on each stage of the comparison microscope and viewed through the eyepieces.

The examiner will ensure that a chosen length (for example .125") lines up appropriately when viewed through the eyepieces. If the lengths on both sides line up appropriately when viewed through the eyepieces, the microscope system is calibrated and working properly. If the lengths on both sides do not line up appropriately when viewed through the eyepieces, the system is not working properly and needs to be adjusted or serviced.

1.6.9 SCALE MICROMETER

1. Definition:

A small glass disk engraved with a scale used in the field of a microscope to measure small distances by direct comparison. Normally used to measure the widths of bullet land and

groove impressions by placing the scale micrometer on one stage of the comparison scope and the bullet on the other stage.

2. Performance Check:

The scale micrometer will be performance checked against the GEI International, Inc. (or equivalent) calibrated ruler or performance checked digital calipers. A performance check of the scale micrometer will occur on a yearly basis. The acceptable measurement range for scale micrometers is $\pm .005$ ".

1.7 CHEMICALS AND REAGENTS

Reagents prepared in the laboratory shall be labeled with, at minimum, the identity of the reagent, and the date of preparation or lot number. A log book shall be maintained identifying the preparer of the reagent.

Griess, Sodium Rhodizonate, Dithiooxamide, and 2 NN Copper reagents must be checked for reliability with positive controls before use and be documented in the notes.

Chemical etchants must be tested for reliability before use. Apply a small amount of the etchant to an area of the metal to be etched and watch for a chemical reaction. Documentation in the notes is required.

Documentation of control testing will clearly indicate the result of the testing (i.e. OK instead of an ambiguous check mark).

1.8 FIREARMS SAFETY IN THE LABORATORY

1.8.1 LOADED STATUS CHECK /SAFETY

Firearm evidence in the laboratory is not dangerous if handled correctly and treated with respect. Occasionally, loaded weapons are received in evidence for a particular examination. These firearms should be taken to the designated firing area to be rendered safe. All firearms should be treated as though they are loaded. This rule cannot be overstressed and must be followed at all times, whether it is at the front counter or in the vault, firearms section, range, or court. Safe gun-handling prevents accidents.

A rule that needs strict adherence is to keep the muzzle pointed in a safe direction at all times! Some firearms are received containing live ammunition and, therefore, this precaution is extremely important.

Due to variations in facilities and personnel, the procedure for conducting the safety/loaded check shall be determined in each laboratory by the laboratory manager. The firearms section shall provide special handling for firearms that are unable to be safely unloaded. A designated qualified person will be provided to visually and physically check the "loaded" status of all firearms submitted to the laboratory. Upon completion of the loaded status/safety check, the packaging or firearm tag will be clearly marked (i.e. sticker or stamp) including initials and date. The laboratory request will also be stamped as "safety checked" including initials and date. In the event that a qualified person is not available to complete a safety check, the submitted firearms shall be placed in a box or other designated area and marked substantially as follows:

**CAUTION: FIREARM
NEEDS SAFETY/LOADED
CONDITION CHECK**

A designated area shall be provided within each evidence vault for the safe and proper storage of firearms.

1.8.2 LABORATORY/FIREARMS SECTION HEALTH AND SAFETY RULES

- No one will be down range/in front of the examiner while a weapon is being handled and/or fired.
- Firearms to be test-fired will be loaded and unloaded only in the firing area. Test firing or any examination of the firearm that uses live ammunition, or a live ammunition component, will only be performed in designated test firing areas.
- Ear and eye protection must be worn by all persons present during live firing.
- Questions of safety have to be resolved prior to the procedure continuing.
- It is recommended that two people be present in the facility during test-firing.
- When using an outside agency's range, public or private, existing range rules will be strictly followed.
- After all examinations are completed; no loaded firearm will be placed in the evidence vault or returned to any agency.
- Each laboratory will have a range use policy.

1.8.3 LEAD MONITORING

The Washington Department of Labor and Industries (L&I) Washington Industrial Safety and Health Act (WISHA) regulation WAC 296-62-07521 applies to all occupational exposure to lead. Evaluation of employee lead exposure, such as exposure that occurs during the discharge of firearms, requires medical surveillance to monitor or evaluate exposure to airborne lead concentrations. Employees shall be required to have biological monitoring of blood lead levels and zinc protoporphyrin levels annually. The cost of this testing will be paid by the Crime Laboratory Division. All medical records will be retained by the WSP Human Resources Division. Any deviation from the published standards will be given immediate attention. Please visit <http://lni.wa.gov/Safety/Topics/AtoZ/Lead/Default.asp> for further information regarding lead safety.

1.8.4 HEARING MONITORING

WISHA regulation WAC 296-817 applies to all hearing loss prevention. Evaluation of employee sound exposure, such as encountered with the discharge of firearms, requires medical surveillance to monitor or evaluate potential hearing loss. Employees shall be required to have their hearing tested on a yearly basis. The cost of this testing will be paid by the Crime Laboratory Division. All medical records will be retained by the WSP Human Resources Division. Any deviation from published standards will be given immediate attention. Please visit www.osha.gov for further information regarding this standard.

1.9 **CASWELL CLEANING**

The shooting range units in the labs (Seattle, Spokane, Tacoma, and Vancouver) will be cleaned and serviced as necessary. It is recommended at least every five years.

1.10 **CASES WITHOUT FIREARMS**

The examiner shall document with forms or worksheets, and sketches or photographs the condition and general information regarding the evidentiary items.

The examiner should determine the caliber and class characteristics of fired ammunition components.

Caliber determination of relatively intact fired bullets is best done by direct measurement of the base of the bullet, weighing the bullet and comparison to known reference materials. With bullets in which the base is mutilated, this determination may be somewhat more difficult. Bullet

fragments can be compared to reference materials. The caliber may be based on base style, cannellure to base or cannellure to nose distances, and the number, type, and style of cannellures. Also useful for consideration is the nose shape or design, and manufacturing details such as surface coatings or materials used in the manufacture of proprietary products which may lead to successful identification of the bullet and subsequently the caliber. In some cases, the rifling type might assist in identifying the caliber of the bullet fragment. Other class characteristics include, but are not limited to, direction of twist, and the number of land and groove impressions and their widths.

Determination of caliber and class characteristics of fired cartridge cases or shotshells can be based on the manufacturer and caliber information from the headstamp or shotshell tube, firing pin impression shape and size, extractor and ejector positioning, unique breech marks, resizing marks, chamber marks, anvil marks, magazine marks, manufacturing marks, and case composition. Cartridge cases with no caliber information in the headstamp can be measured and compared to known reference materials.

These bullet and cartridge case characteristics can be compared to appropriate data files (such as the FBI General Rifling Characteristics Database) and lab data in order to generate a list of possible firearms that could have discharged the evidentiary ammunition component. The GRC database is an investigative aid only and is not to be construed as an all-inclusive list of firearms with all known rifling characteristics. When a list of firearms is reported, appropriate qualifying statements should be included to reflect any limitations of the data.

Expanded hollow point or damaged bullets may have to be straightened/unfolded to observe class and individual characteristics. Documentation should be made of the condition of these bullets prior to straightening/unfolding.

Evidence pellets can be received ranging in conditions from pristine to mutilated. Size determination of damaged pellets should be carried out with care. The examiner should choose the most intact (i.e. round) pellets for the examination.

Pellet size determination is normally conducted by one or more of the three procedures listed:

- Direct comparison with known shot sizes.
- Weighing a specific number of shot in comparison to the same number of known shot sizes of similar composition, or values established in reference material.
- Measuring diameter and comparing to known shot sizes or establishing reference material.

Shotgun wads can be identified as to their gauge, manufacturer and shotcup size in most cases. Direct comparison to reference standards is recommended for gauge, brand, type or design determinations. In all gauge determinations, one standard gauge larger and one standard gauge smaller should be used to help isolate the gauge of the evidence sample. This is especially useful with the more difficult non-plastic wadding if mutilated or swollen from body fluids. The use of a stereo microscope is recommended to look for manufacturer symbols and/or numbers on plastic wads. Plastic wads should be examined microscopically for striations that could be compared back to the barrel that fired it.

The following methods are useful in gauge determinations:

- Direct comparison to reference ammunition components/reference materials.
- Use of additional evidence shotshells, which can be cut open and disassembled for examination and comparison.
- Base measurement by the use of a micrometer, caliper, or other performance checked device.

All expended bullets and cartridge cases in a case submission should be compared in order to determine the number of possible firearms involved.

1.11 CASES WITH FIREARMS

Note: If a firearm is submitted for IBIS/NIBIN examination only, an operability examination is not required. Please refer to the IBIS/NIBIN (Chapter 5) section of this manual.

The examiner should document a case with notes, worksheets, and sketches or photographs noting the condition of and general information about the submitted firearm (i.e., smoke rings, trace evidence, and fired components associated with the firearm prior to firing, and trigger pull determination during further examination).

The examiner should perform appropriate safety tests prior to test-firing.

1.12 MECHANICAL OPERABILITY/PRE-FIRING SAFETY EXAM

It is the responsibility of the firearm examiner to ensure that appropriate safety function checks are performed on a firearm prior to test-firing. Below is a list of safety checks which should be considered in every case. The examiner should be mindful that individual situations may require more extensive safety checks than that which are listed here. Examiners are reminded to be careful not to lose or destroy trace evidence while performing the safety check.

1.12.1 FOR ALL FIREARMS:

1. Is the firearm unloaded? (Check tubular magazines carefully.)
2. General Examinations
3. Is the chamber/bore clear?
4. Are there any signs of cracks or weaknesses in major parts of the firearm, such as the frame, slide or barrel?
 - a. Are there any loose, damaged or missing parts?
 - b. Are there any dangerous modifications?
 - c. Is the barrel bulged, obstructed or loose?
 - d. Are there any loose or missing screws?
 - e. CAUTION: Movement or replacement of parts may make the weapon safer, but may also significantly alter the operational characteristics.
 - f. Are there any firearm recall notices that must be considered, if applicable?
5. Trigger Pull (performed typically after test firing)
 - a. Determine the trigger pull. Trigger pull is defined as the force needed on the trigger as it is applied parallel to the barrel until the sear of the firearm releases. Trigger pulls should be documented as an approximate weight or weight range. Trigger pulls are used as a portion of the assessment of the internal function of the firearm.
 - b. Equipment - The equipment used is a standard device with which weights in varying amounts or gauges can be applied to a rod constructed so that it can be hooked over a trigger without touching any other part of the firearm.
 - c. Performance checked standard trigger weights or gauges are all acceptable methods of measuring trigger pull.
 - d. Is there a proper trigger pull weight for the firearm model in both single action and double action modes?
 - e. Does trigger return reliably?
 - f. Consideration should be given to measuring trigger pull weight after test firing.
6. Hammer

- a. Will it push off?
 - b. Does the half cock notch catch?
 - c. Will the hammer fall from the half cock notch when the trigger is pulled?
 - d. Are there any false seating positions?
 - e. Will the hammer/striker release when the bolt is closed quickly?
7. Drop/Impact (jar off) testing is a recognized procedure
 8. Restoring evidence firearms to safe operating conditions is a recognized practice.
 9. Examination/Disassembly of damaged/altered firearms to determine operating condition is a recognized practice.
 10. Safeties/Types of Safeties
 - a. Do they operate? (Check each safety independently.)
 - b. Engage safety, pull and release trigger. Does the weapon fire when the safety is then disengaged?

1.12.2 FOR REVOLVERS:

1. Cylinder
 - a. Is the cylinder secure when closed?
 - b. Do the chambers align with the barrel?
 - c. Is the cylinder bulged?
2. Cylinder Rotation
 - a. Does the cylinder bind?
 - b. Does it lock up in both single action and double action?
 - c. Does it skip chambers with partial trigger return?
3. Safeties
 - a. Transfer Bar/Hammer Block – Is one present and operational?
 - b. Are there other safeties such as ¼ cock, ½ cock or manual safeties?

1.12.3 FOR NON-REVOLVER FIREARMS:

1. Disconnecter
 - a. Is one present?
 - b. Does it work? (Hold trigger and cycle action.)
2. In/out of battery?
 - a. Does the slide/bolt engage tightly?
 - b. Will the weapon fire when the slide/bolt is partially open?
3. Firing Pin – Is it free to retract and not binding?
4. Bolt Action – Will the striker drop when the bolt is closed quickly?
5. Trigger
 - a. Is the pull weight normal for the type of firearm? Standard trigger weights, spring gauge, or electronic gauge are all acceptable methods for measuring trigger pull.

- b. If pressure is applied as the action is closed, will the hammer fall?
6. Magazine capacity (Check with dummy ammunition).
7. Feeding (Check with dummy ammunition.)

1.12.4 FOR MUZZLE LOADERS:

1. If a black powder firearm is received in a loaded condition, it must have the projectile and charge removed. It may then be properly loaded prior to test firing.
2. Does the chamber/barrel appear intact/safe?
3. Is this an “original” muzzleloader or a modern reproduction? “Originals” should always be remote fired.
4. If any of the above considerations cannot be answered with a clear “yes” or otherwise rectified and test firing is necessary, that firearm should be remotely fired.

1.12.5 IMPROVISED FIRING DEVICES

Occasionally items which originally were not designed to function as firearms, but have been altered in an attempt to produce a firearm, are submitted to the laboratory for function testing or determination of lethality. These improvised firing devices can vary greatly in their design and construction. The examining scientist must ensure that these examinations are handled safely and scientifically, and that all steps taken in the examination of such devices are fully documented and can be reproduced by another examiner.

The examining scientist must understand that depending on construction and/or condition these improvised firing devices may be fragile and potentially unsafe to fire, and that firing the item may result in the destruction of the improvised firing device. Therefore, all non-destructive options for testing should be explored (i.e., firing a primed cartridge case instead of a cartridge). These potential hazards and the possibility of destruction of the device must be discussed with the requesting officer and/or prosecuting attorney prior to function testing or lethality determination.

If destruction of the item may occur during testing of the improvised firing device, written documentation from the requesting officer or prosecuting attorney must be obtained indicating that it is understood that the item may be consumed/destroyed during the testing process and that permission has been given to proceed with the testing.

Once a firearm or improvised firing device has been examined for safety, operability, and documentation/notes are completed, the firearm will be ready to be test fired.

1.13 **TEST FIRING**

An objective of test firing is to duplicate as closely as possible the conditions at the time of a shooting incident in a controlled laboratory environment. If applicable and available, ammunition similar to what was used in the shooting incident should be used for test firing purposes. For test firing for IBIS/NIBIN purposes only, use recommended ammunition. Prior to test-firing, the examiner should evaluate the need for swabbing the barrel or indexing test ammunition.

The examiner should test fire a minimum of two cartridges so that the test components can be examined for reproducibility to determine if they are suitable for comparison to unknowns should comparisons be required.

When choosing ammunition for test firing, consider:

- Was the firearm designed for the ammunition to be used (i.e., rechambered for a different caliber, wildcat cartridges, +P cartridges)?
- Was the firearm originally designed for black powder loads (i.e., Damascus barrels)?
- Are there any ammunition recall notices that must be considered, if applicable?

In order to perform a microscopic comparison of a submitted firearm, a minimum of two (2) test fires should be fired and recovered. Recovery methods include the water tank, the cotton or string recovery box, and the bullet trap. The type of firearm and ammunition tested will usually dictate the type of recovery method used. The water recovery tank is usually used to recover bullets from handguns and some rifles. The string recovery box is usually used to recover bullets from rifles and slugs fired from shotguns. Always check the water level in the tank before firing and add water as needed.

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

- Laboratory case number and/or
- Item number and/or
- Examiner's markings/identifiers

The examiner should consider indexing and sequencing each shot as necessary.

1.14 PROCEDURE FOR TEST FIRING

- Ensure that the downrange area is free of personnel.
- Proper hearing and eye protection must be worn.
- Ensure that the bullet collection device is properly prepared.
- Ensure that the exhaust fans or system is turned on.
- Ensure that all warning systems (and/or monitoring equipment) are activated and functioning.
- The examiner should consider loading no more than two (2) cartridges into the firearm during the initial testing of the firearm.
- Fire the firearm through the shooting port. If the firearm is capable of firing both single and double action modes, a minimum of one (1) shot per mode should be obtained.
- Note any operational problems or malfunctions with the firearm.
- Recover the fired bullets using a net, pole, or some other appropriate device.
- Ejected cartridge cases should be retrieved. Devices to catch the fired cartridge cases are commercially available.

1.15 REMOTE FIRING

During the course of examining a firearm, it may be determined that it would be unsafe for the examiner to fire a firearm by holding it as designed. If it is necessary to obtain test standards from such a firearm, the firearm should be fired remotely. The Zero-One® (or a similar device) can be used for firing long arms and some handguns, while the Ransom Rest® (or a similar device) can be used for firing handguns.

1.16 DOWNLOADING

The examiner should be aware of the dangers of firing down-loaded ammunition and the possible change in the microscopic striations of these bullets.

For a variety of reasons, it may be necessary to reduce or change the powder load of a cartridge in order to obtain a velocity suitable for safely collecting test standards. The following steps may be taken to download a cartridge:

1.16.1 PROCEDURE FOR DOWNLOADING

- Pull the bullet from the cartridge using an inertia bullet puller or reloading press.

- Remove the existing powder and weigh it.
- Weigh the pulled bullet (if evidence).
- Pour the appropriate powder amount into the empty cartridge case. A reduced load using 50% of the original powder weight can be used. It should be noted that great care must be taken when performing this type of downloading. 50% downloading CANNOT be used with slow burning powders.
- Loosely pack a small piece of tissue or other similar material into the case to fill the case volume between the bullet and the powder.
- Seat the bullet back into the cartridge case using a mallet or a reloading press to the appropriate cartridge overall length.
- When using downloaded ammunition, it is imperative that the examiner checks the barrel for obstructions between each firing. The bullet, cartridge case, or shotshell of each test shot should be marked appropriately. Remote firing should be considered if appropriate.

1.17 PRIMED CARTRIDGE CASE/SHOTSHELL

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

1.17.1 PROCEDURE FOR FIRING A PRIMED CARTRIDGE CASE/SHOTSHELL

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

- Ensure that downrange is free of personnel.
- Proper hearing and eye protection must be worn.
- Ensure that the exhaust fans or system is turned on.
- Ensure all warning systems (and/or monitoring equipment) are activated and functional.
- Load the primed empty cartridge case, primed empty shotshell or commercial firing pin testing device into the chamber of the firearm and test fire in front of the bullet trap.
- When using a primed empty case it is imperative that the examiner check the barrel for obstructions between each firing.

Repeat if the firearm has more than one action.

1.18 IF AMMUNITION SUBMITTED AS EVIDENCE IS TO BE USED FOR TEST FIRING:

- Notify the submitting agency that the evidence ammunition will be used, obtaining permission to do so when necessary. Permission will be documented in the case file and/or LIMS.
- Is the correct ammunition being used?
- Are they reloads? As a general policy, they will not be used unless necessary. Remote firing is strongly recommended.

- Is the ammunition of the correct caliber?
- If evidence ammunition is fired in a case, it must be labeled as such, documented in the case notes and report, and released back with the evidence.

1.19 BARREL LENGTHS AND OVERALL LENGTHS

One of the routine procedures conducted in a firearm identification examination is determining the barrel length and in some cases the overall length of the 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. Barrel and overall lengths can have potential statute violations per the Gun Control Act of 1968 (public law 90-618) and Chapter 9.41 of the Revised Code of Washington (RCW).

All measurements are to be made with performance checked devices. If measuring a modified firearm, additional requirements must be met (refer to 1.19.3). For any measurement made of a modified firearm, the examiner's notes must record the unique identifier of the measuring device used.

To ensure that all examiners measure the values in the same way, the following rules have been adopted:

1.19.1 BARREL LENGTHS (UNMODIFIED FIREARM)

Removable barrel extensions, poly chokes, flash hiders, etc., are not part of the measured barrel lengths

1. Revolvers:

Measure the distance from the breech end of the barrel to the muzzle, excluding the cylinder.

2. Firearms other than revolvers:

With the firearm unloaded and in the closed and locked position, insert a barrel gauge (i.e. Hott Rod™) down the barrel until it is resting against the breech face. The rod must be parallel to the bore. Read and record the measurement of the longest point of the muzzle directly off the gauge rounding up to the next 1/16th of an inch. A photograph of the measurement may also be taken.

3. Alternate method for firearms with barrel lengths longer than 24".

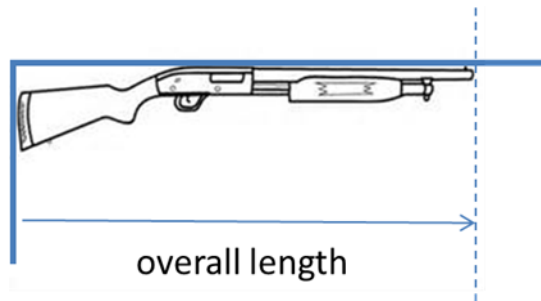
Using a non-surface marking rod, measure the barrel of the unloaded firearm by inserting the rod until it is resting on the breech face in a closed and locked position. With the rod parallel to the bore, mark the rod at the longest point of the muzzle. The rod is then measured.

1.19.2 OVERALL LENGTHS (UNMODIFIED FIREARM)

Removable barrel extensions, poly chokes, flash hiders, etc., are not part of the measured barrel lengths.

Measurement shall be made parallel to the bore and include the longest distance from the butt to the muzzle. The firearm will be placed along a flat surface, in a location where there are two vertical edges at right angles to each other. The barrel of the firearm will be placed on the long axis, and the longest most portion of the butt end of the firearm will be placed at the adjacent

vertical edge. See image below. The longest portion of the barrel end can then be measured rounding up to the next 1/16th of an inch.



1.19.3 BARREL AND OVERALL LENGTHS OF MODIFIED FIREARMS

For firearms where the overall and/or barrel lengths have been modified, all measurements are to be made with calibrated measuring devices following the procedures listed above. These calibrated devices will be visually examined prior to use to assess for damage to the device that would make it invalid for use. The devices approved for these measurements are:

- 36 inch steel ruler, Fowler brand
- Hott Rods™, #7/32 HTRD-W24L and #5/32 HTRD W24L

In order to comply with the above cited statutes, rifle barrels must be sixteen inches or longer, shotgun barrels must be eighteen inches or longer, and rifle and shotgun overall lengths must be twenty-six inches or longer.

The following are critical measurements requiring a measurement of uncertainty calculation:

- Altered barrel length of a shotgun measures between 17½ and 18½ inches
- Altered barrel length of a rifle measures between 15½ and 16½ inches
- Altered overall length of a shotgun or rifle measures between 25½ and 26½ inches

When a measurement falls within these critical values, the examiner's notes must record the unique identifier of the calibrated measuring device used for measurement. Additionally, the measurement will be verified by another experienced firearms examiner and the verification date and examiner's initials will be documented in the case notes.

These critical measurements will be reported in inches rounded up the nearest 1/8 of an inch.

1.20 **MEASUREMENT OF UNCERTAINTY ESTIMATION**

The measurement and uncertainty will be expressed as $y \pm U$ with the units of y (length) and U (uncertainty) being consistent. When the measurement is expressed as a fraction, the uncertainty may be expressed as a fraction.

While other factors were considered (e.g., environmental conditions and procedure), the greatest source of measurable variability can be attributed to two factors: the measuring device and the subjective evaluation of the longest points of the barrel or firearm. Thus, the uncertainty of measurement for these measuring devices is:

- $\pm 1/16^{\text{th}}$ of an inch with a level of confidence of 95% for barrel lengths

- +/- 3/16th of an inch with a level of confidence of 95% for overall lengths.

The report must include the measurement result, the measurement uncertainty and the level of confidence. The report will include the measurement result and the measurement uncertainty reported to same level of significance.

For example:

The length of the rifle barrel was measured to be 16 3/8 inches +/- 1/16th of an inch at a level of confidence of 95%.

The overall length of the rifle was measured to be 26 1/8 inches +/- 1/8th of an inch at a level of confidence of 95%.

A level of confidence of 95% indicates that 95% of the data collected will fall within two standard deviations ($k=2$) of the mean result. Measurement uncertainty for barrel and overall length calculations are made with a coverage factor of $k=2$.

The measurement uncertainty will be reviewed by the FA/TM section FS4 yearly to determine if changes, such as a change in a measuring device, laboratory protocols, or RCW statutes have occurred, that will affect the measurement uncertainty. This yearly review will also address any changes in calibration values of the measuring devices. If a change has occurred, the measurement uncertainty that is calculated by the calibration report will be updated and recorded. If no other change has occurred, this will be the extent of the measurement uncertainty assurance at that time. Similar measuring devices in different laboratories will be evaluated against the estimation of measurement uncertainty by comparing each device's uncertainty as determined by the calibration service. If all of the devices have the same uncertainty, no additional calculation is necessary.

If significant changes have occurred to personnel, protocols, or devices used, the measurement uncertainty will be reassessed. The recalculation of the measurement uncertainty will include sending the same modified firearm(s) to each laboratory to be measured multiple times over a period of time by each firearm/tool mark forensic scientist. The FS4 will then recalculate the measurement uncertainty and adjust the FATM Technical Manual as appropriate.

1.21 MICROSCOPIC COMPARISONS

Microscopic comparisons are generally performed on fired ammunition components such as bullets, cartridge cases, and wadding. The examiner should follow these basic procedural techniques in order to facilitate microscopic examinations:

ENSURE THAT THE COMPARISON MICROSCOPE IS PROPERLY ADJUSTED FOR EQUAL MAGNIFICATION AT BOTH STAGES.

Directly illuminate the land impressions of bullets during the initial examination. Usually oblique lighting is preferred.

Compare the test-fired components to ensure reproducibility of class and individual characteristics prior to comparing them to the evidence components. Evaluate the possibility of subclass characteristics on the test-fired components as well as the evidence components.

Adopt a consistent procedure for the handling and documentation of comparison evidence.

During the comparison, documentation of the phase orientation of test-fired and evidence components is recommended. The conclusions reached by an examiner during a microscopic comparison are made based on the Association of Firearm and Tool Mark Examiners (AFTE) Theory of Identification, listed below.

1. The theory of identification as it pertains to the comparison of toolmarks enables opinions of common origin to be made when the unique surface contours of two toolmarks are in “sufficient agreement”.
2. This “sufficient agreement” is related to the significant duplication of random toolmarks as evidence by the correspondence of a pattern or combination of patterns of surface contours. Significance is determined by the comparative examination of two or more sets of surface contour patterns comprised of individual peaks, ridges and furrows. Specifically, the relative height or depth, width, curvature and spatial relationship of the individual peaks, ridges and furrows within one set of surface contours are defined and compared to the corresponding features in the second set of surface contours. Agreement is significant when the agreement in individual characteristics exceeds the best agreement demonstrated between toolmarks known to have been produced by different tools and is consistent with agreement demonstrated by toolmarks known to have been produced by the same tool. The statement that “sufficient agreement” exists between two toolmarks means that the agreement of individual characteristics is of a quantity and quality that the likelihood another tool could have made the mark is so remote as to be considered a practical impossibility.
3. Currently the interpretation of individualization/identification is subjective in nature, founded on scientific principles and based on the examiner’s training and experience.

All evidentiary identifications, inconclusives and eliminations (to include differences in class characteristics) must be verified by another qualified firearms examiner with initials and date on the notes page prior to the report being issued.

1.22 RANGE OF CONCLUSIONS

Examiners will use one of the four following conclusions in the final report when describing the conclusions reached during the examination. Examiners can use the below Glossary definitions to properly qualify the conclusion stated in the Results and Conclusions section of the report.

1.22.1 IDENTIFICATION –

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 tool marks made by different tools and is consistent with the agreement demonstrated by tool marks known to have been produced by the same tool. Example: “... was identified as having been...”

1.22.2 INCONCLUSIVE –

Some agreement of individual characteristics and all discernible class characteristics, but insufficient for an identification.

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. Example: “...was inconclusive due to...” or “...could not conclusively be identified or eliminated due to...”

1.22.3 ELIMINATION –

Class characteristics disagree.

Class characteristics agree and there is a documentable and discernible difference in individual characteristics, then an elimination can be made. Example: “...was eliminated as having been...”

1.22.4 UNSUITABLE –

Unsuitable for examination. Suitability is at examiner discretion and must be verified by another qualified examiner. Example: "...was unsuitable for analysis due to..."

1.22.5 GLOSSARY

Examiners can use one or more of the four following glossary conclusion definitions in the final report to properly qualify the conclusions reached during the examination and reported in the Results and Conclusions section of the report.

Identification: The opinion of a qualified examiner that there is sufficient agreement of features and microscopic detail (class and individual characteristics) to conclude that two (or more) tool marks originated from the same source.

Elimination: The opinion of a qualified examiner that there is sufficient disagreement of features and microscopic detail (class and/or individual characteristics) to conclude that two (or more) tool marks originated from different sources.

Inconclusive: The opinion of a qualified examiner that there is not sufficient agreement or disagreement of features and microscopic detail (class and/or individual characteristics) to conclude that two (or more) tool marks originated from the same source or from different sources.

Unsuitable: The opinion of a qualified examiner that there is not sufficient microscopic detail or features for comparison.

1.23 **DOCUMENTATION OF CONCLUSIONS**

A photo will be taken to document an identification along with notes describing how the identification was made.

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

Photos are not used to make verifications of comparisons and are for notes/documentation purposes only because:

- A photograph is a two-dimensional image of an object that is three-dimensional.
- Photographs often contain insignificant detail and could be misinterpreted by those 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.

For unsuitable for examination, inconclusive, and elimination conclusions, detailed descriptions will be used to document class characteristics and describe why the sample is unsuitable for examination, inconclusive, or an elimination.

1.24 CARTRIDGE CASE EJECTION PATTERNS

A cartridge case ejection pattern is used to determine how a particular firearm ejects the cartridge cases in the firing process under specific test conditions. Variables affecting the dispersion of cartridge cases from the firearm include, but are not limited to, the firearm, the type of ammunition, the shooter's hold, movements of the shooter, the gun height, the angle or position of the gun, and the surface on which the cartridge case lands.

1.24.1 PROCEDURE FOR PERFORMING A CARTRIDGE CASE EJECTION PATTERN

- The same firearm and ammunition represented in the shooting scenario should be used in the testing.
- The firearm must be fired in the same direction for each shot toward a reference point, with the barrel parallel to the ground.
- X-Y coordinates can be laid out on the ground for subsequent plotting of either the impact point or final resting point of each expended cartridge case, or determine the angle of ejection from the point of aim and the distance the cartridge ejects from the pistol.
- A minimum of ten shots will be fired to generate an ejection pattern.
- If needed, multiple series of shots can be carried out varying one parameter at a time, such as height of the gun, firm vs. loose hold on the gun, pointing the firearm in a different orientation, or varying the surfaces (e.g., pavement vs. grass).

1.25 AIR GUN LETHALITY

Knowledge of the minimum velocity needed by a bullet or projectile to perforate skin can be of importance in investigating a shooting case involving an air gun. The wounding potential depends on the ability of a projectile fired from such a gun to perforate skin. Experimentation has shown that for a 0.177 caliber pellet, a velocity of at least 331ft/s is required to perforate skin. A velocity of at least 245 ft/s is required for a .22 caliber pellet.

Determination of the potential lethality of projectiles fired from air guns is based on one or a combination of the following procedures:

- Determination of maximum velocity of the air gun by use of a chronograph.
- Determination of depth of penetration of projectile fired into ballistic gelatin.
- Determination of range of velocities as pressure diminishes.

1.26 TISSUE SIMULANTS

There are a variety of tissue simulants available to the firearms examiner for experimental purposes. The most commonly used simulant is 10% ballistic (ordnance) gelatin; however other accepted simulants may be used.

1.26.1 BALLISTIC GELATIN:

Ordnance or ballistic gelatin is a very useful tissue simulant with which to perform bullet testing as a terminal ballistic test medium. Due to the formulation, the gelatin closely approximates the behavior of muscle tissue when struck by a projectile. The media used should be prepared using the procedures provided by the manufacturer.

1.26.2 CALIBRATION OF GELATIN BLOCK

When using ballistic gelatin as a tissue simulant, the following calibration procedure should be followed:

To yield reproducible results, the gelatin should be calibrated using a standard BB shot at 590 fps +/- 20 fps, which should give a penetration of 8.5 cm +/- 1.5 cm measured from the front surface of the gelatin block to the leading edge of the BB.

1.26.3 REFERENCES

"American National Standard Voluntary Industry Performance Standards Criteria for Evaluation of New Firearms Designs Under Conditions of Abusive Mishandling for the Use of Commercial Manufacturers," Sporting Arms and Ammunition Manufacturer's Institute, Inc., November 5, 1985.

DiMaio, V.J.M, Copeland, A.R., Besant-Mathews, P.E., Fletcher, L.A., and Jones, A., "Minimal Velocities Necessary for Perforation of Skin by Air Gun Pellets and Bullets," Journal of Forensic Sciences, Vol. 27, No. 4, October 1982, pp. 894-898.

Fackler, Martin L., "Ordnance Gelatin for Ballistic Studies," AFTE Journal, Vol. 19, No. 4, October 1987, pp. 403-405. Fackler, Martin L., and Malinowski, John A., "Ordnance Gelatin for Ballistic Studies: Detrimental Effect of Excess Heat Used in Gelatin Preparation," American Journal of Forensic Medicine and Pathology, Vol. 9, No. 3, 1988, pp. 218-219.

Haag, Lucien C., "Ballistic Gelatin: Controlling Variances in Preparation and a Suggested Method for the Calibration of Gelatin Blocks," AFTE Journal, Vol. 21, No. 3, July 1989, pp. 483-489.

Raynor, Ken and Fenton, Brad, The NRA Gunsmithing Guide – Updated, National Rifle Association, Washington, D.C., 1983, pp. 151.

"Standard Consumer Safety Specification for Non-Powder Guns," American Society for Testing and Materials report F 589-92, December 1992.

Thompson, Evan, "Ordnance Gelatin Testing Procedures," AFTE Journal, Vol. 25, No. 2, April 1993, pp. 87-89.

1.27 **SILENCERS (SOUND SUPPRESSORS)**

The examiner should evaluate the item as to structure and design. This includes identifying components and structural configurations which may indicate an attempt to reduce the noise of discharge. This examination shall be non-destructive and not alter the integrity of the device.

If testing the effectivity of the device is requested it is recommended that the user agency contact the Bureau of Alcohol, Tobacco, Firearms and Explosives lab.

1.28 **FULL-AUTOMATIC FIREARMS AND CONVERSIONS**

It is a recognized practice to disassemble full automatic firearms to study the design and to identify any altered internal parts. The examiner should evaluate the design, and test the mechanical function of the firearm or component to determine the possibility of full automatic function.

Extreme caution should be used in the test-firing of any suspected full automatic firearm. Trainees should not be allowed to handle these cases unless closely supervised. Firearms converted to full automatic modes of fire are susceptible to a wide range of malfunctions.

When necessary, lubrication may be applied to the firearm to facilitate examination. The original condition of the firearm will be recorded in the examiner's notes, as will the addition of lubricant. Lubrication may affect the rate of fire and/or the functionality of the firearm.

It is recommended that while test-firing for the collection of samples, no more than two rounds of ammunition be loaded into the firearm. Test-firing for rate of fire should be conducted at a range adequate to accommodate full automatic fire of the caliber being fired.

An approved shot timer should be used if recording the rate of fire. A firearm having a rate of fire of five or more shots per second (greater than 300 rounds per minute) is defined as a machine gun by RCW Chapter 9.41. This measurement is defined as a critical measurement that would normally require an uncertainty of measurement consideration. While this measurement is

defined as a critical measurement, due to numerous variables effecting rate of fire and the inability to calibrate the shot timer, an uncertainty of measurement cannot be determined for rate of fire. It is recognized that full auto firearms encountered in the laboratory will likely have a rate of fire far greater than the threshold of 300 rounds per minute (rpm) listed in RCW 9.41. In the remote likelihood a firearm is encountered that approaches this 300 round per minute threshold (between 250 and 350 rpm) the firearm will be reported as a full automatic firearm with the rate of fire being uncertain. The definition of a full automatic firearm (machine gun) from the National Firearms Act may be reported. The National Firearms Act, 26 U.S.C. 5845(b), defines a machine gun to include any weapon which shoots, is designed to shoot, or can be readily restored to shoot, automatically more than one shot, without manual reloading, by a single function of the trigger.

For firearms having a magazine capacity of ten cartridges or greater, the testing procedure shall include three ten shot strings of fire. The average of the three ten shot strings will be reported. Firearms with magazines having less than a ten cartridge capacity will be timed three times at a minimum with at least five cartridges per string. The average rate of fire in rounds per minute will be reported.

Firearms that function in a full automatic fashion but due to malfunction do not meet the timing requirements of this policy will be reported as full automatic firearms with the rate of fire being uncertain.

1.29 RUSTED FIREARM EXAMINATION

Rusted firearms or those found in water, etc., may be submitted for examination. Immediate attention must be given to these firearms to prevent further damage to the firearm. The examiner should instruct an agency recovering the firearm in a fluid such as water, to submit the firearm in a container of the fluid. If this is not practical, the agency can be instructed to immediately and thoroughly spray the firearm with a water-displacing product such as WD-40® or other similar product to prevent further deterioration. It should be noted that the firearm might be too rusted to be functional.

An examiner must take all necessary steps to insure that the firearm is unloaded. If it cannot be readily verified to be unloaded, it must be examined in an area designated for the firing of firearms. Determining whether or not a firearm is unloaded may necessitate a complete disassembly or in some cases, destruction (e.g. cutting) of the firearm.

The examiner must determine to what extent restoring the firearm is necessary (i.e., for test firing, for recovering manufacturer information, serial number, etc.).

The examiner should soak the firearm in penetrating oil, de-rusting solvents or similar material. Rust/corrosion may be removed using a soda blaster (application of sodium bicarbonate using compressed air). Periodically, the firearm should be checked until it functions, or the desired information is recovered. The restoration/cleaning process of the firearm will be documented.

The examiner should clean the firearm with gun cleaning solvent, cleaning patches and cloth. Care must be taken if any object is placed down the barrel. Only a non-marring item should be placed down the barrel.

1.30 BORE AND CHAMBER CASTINGS

Occasionally, rifles are received of unknown calibers or calibers that may differ from the designation on the weapon and in the literature. In order to fire test shots that are of correct caliber for a particular firearm, it may be necessary to make a bore or chamber cast. Then, by measuring the cast, the correct cartridge can be determined.

Several methods are available and include casting material such as low melting point metals and silicone rubber compounds. The specific method will be at the discretion of the examiner.

1.31 LAND AND GROOVE MEASUREMENTS

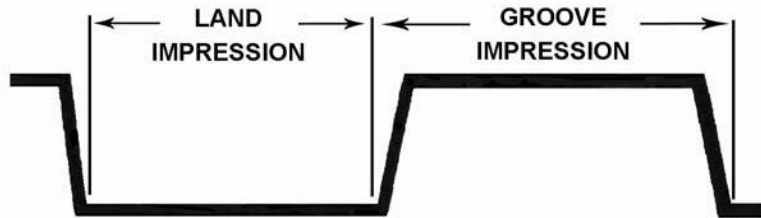
One of the class characteristics used for bullet identification is land and groove impression measurements. Land and groove impression measurements should be taken as close as possible to the base of the bullet to eliminate errors in measurement that may occur due to slippage that can result from the bullet engaging the rifling in areas closer to the nose of the bullet.

Several instruments are available for making such measurements, and the technique of measurement is approximately the same in each. The critical parameters are the points used for beginning and end of a measurement. Use one or more of the methods listed below:

1.31.1 AIR GAP METHOD

See AFTE Newsletter, No. 4, December 1969, pp. 28-34.

1.31.2 MICROSCOPE WITH PERFORMANCE CHECKED MEASURING EYEPIECE, RULE, OR MICROMETER.



Measure land impression and groove impression as shown above.

1.32 PHOTOGRAPH/VIDEO EVIDENCE

Photograph and video evidence submitted can be examined to see if there are any firearms depicted in the images. This is a feature comparison examination. Care should be taken to understand about compression, original format, aspect ratio, and other digital artifacts that may distort the images. There are many resources to compare images of possible firearms (reference collection firearms, internet images, manufacturer resources, etc.). There are many airgun, airsoft, and replicas that are licensed and have manufacturer logos similar to firearms. Understanding the limitations and wide range of newly manufactured firearms is critical to making accurate and supportable conclusions. It is a valid conclusion to report that there is not enough information in the image/video to be able to determine if a firearm is depicted.

2 SERIAL NUMBER RESTORATION

2.1 INTRODUCTION

Serial numbers and other important information on most firearms, as well as many other objects, are often die-stamped. This process produces a compression of the material in the area immediately surrounding and a short depth below the penetration of the die. Even though the number may be obliterated by filing or grinding, restoration may be possible if the removal of the material is not past this compression area. If the obliteration is beyond this area, restoration is impossible for die-stamped numbers. Etched or engraved numbers may be more difficult to restore due to shallow or nonexistent areas of compression. When possible, the serial number of record is to be restored. Other serial numbers and characters can be restored as applicable and necessary.

Because the stamping of a figure alters the metal's crystalline structure well below the surface, a number can appear to have been obliterated while evidence of the figure still remains. The examiner will employ accepted physical and/or chemical restoration techniques in the attempt to restore the serial number. If after processing the number is not restored, it is then acceptable to conclude and report that the serial number could not be restored/recovered. If the area of the serial number is missing or perforated (example- drilled through) no restoration will be attempted as the material containing the compressed areas has been removed.

If a hidden number placed on the firearm by the manufacturer is to be reported in lieu of the serial number of record, the location of that number must be documented, photographed and verified by another scientist.

Forms/worksheets should be used to ensure evaluation of all pertinent facts related to the submitted evidence. Forms/worksheets will be posted on the FLSB SharePoint site.

The firearms reference collection and other reference materials (such as the Firearms Reference Table from the Royal Canadian Mounted Police) are invaluable resources for identifying the serial number location(s), duplicate or partial serial numbers, letter/number style and arrangement. It is good practice to record the serial number and/or the reference collection tag number of the firearm(s) used as serial number references. The manufacturer and/or factory certified armorers can be good sources of information, especially regarding hidden serial numbers.

Two methods are commonly used for serial number restoration attempts. These methods are chemical etching and magnetic restoration.

2.2 QUALITY ASSURANCE AND SAFETY

Examiners are reminded of the importance of quality assurance as discussed in the "Introduction" of this manual and the CLD QOM. The restored serial number or portions of the serial number characters must be verified by another forensic scientist with initials and the date on the notes page. Hidden numbers and their location will be verified in a similar fashion.

Examiners are reminded that they are responsible for knowing the requirements and safety practices outlined in the Crime Laboratory Division Safety Manual. Examiners are also responsible for knowing the health hazards involved in the use of chemicals in the laboratory. These chemicals and their hazards can be found in the Safety Data Sheets that are on file in each laboratory.

Because the reagents are etching solutions and may contain acids or bases, they are potentially dangerous. The reagents should be used under a fume hood or in a well-ventilated area only by qualified, trained personnel. Examiners should wear the appropriate Personal Protective Equipment, (i.e. lab coat, gloves, safety glasses, etc.) when performing this process.

When not in use, these reagents should be stored in the appropriate chemical storage area.

2.3 CHEMICAL ETCHING

The most commonly employed procedure for serial number restoration involves the use of a chemical etching solution. Reagents should be selected based on the type of metal on which the serial number is to be restored. Chemical etching solutions used by the Crime Laboratory Division can be found in section 2.4 of this manual, or are contained in the Handbook of Methods for the Restoration of Obliterated Serial Numbers (2.10).

The chemical etching technique is generally the same for all metals, but the reagents differ depending on the type of metal or alloy. The most important step is to evaluate the object to determine the type of metal or alloy to be restored. It is prudent to start with weaker chemical etching solutions and progress to stronger ones if necessary. Some reagents may be diluted with water to adjust their strength as needed. Ideally, the final surface should be polished to a smooth finish with obliteration defects and gouges removed to the greatest extent possible (deep defects may not be completely removed). Sometimes this step alone will make part or all of a number visible. If a firearm is corroded, care should be taken while removing the corrosion. The metal is weaker and can flake off easily. Examination with low magnification and oblique lighting may also be helpful. Materials other than metal may require another technique.

2.4 SOLUTIONS FOR CHEMICAL ETCHING

The following list includes the suggested uses for the reagents below- it is simply a guideline. Chemicals intended for use on ferrous guns may be used on non-ferrous guns, and vice versa. The reaction obtained from each reagent will vary from firearm to firearm. In addition, 25% nitric acid can be used as a highlighter in both ferrous and non-ferrous serial number restorations. The lot number and reagent quality check of the solutions applied during the restoration process must be documented in the case notes as outlined in the CLD QOM.

Ferrous, or magnetic metals (including steel, iron, stainless steel, etc.)

Heyn's Solution

Cupric ammonium chloride 1 gram
Concentrated hydrochloric acid 12 milliliters
Deionized water 12 milliliters

Turner's Reagent

Cupric chloride 2.5 grams
Ethanol 25 milliliters
Concentrated hydrochloric acid 40 milliliters
Deionized water 30 milliliters

Davis Reagent

Cupric chloride 5 grams
Concentrated hydrochloric acid 50 milliliters
Deionized water 50 milliliters

Fry's Reagent

Cupric chloride 90 grams
Concentrated hydrochloric acid 120 milliliters
Deionized water 100 milliliters

Ammonium persulfate

Ammonium persulfate 10 grams

Deionized water 100 milliliters

25% Nitric Acid (can be used to highlight numbers as they resurface)

Concentrated nitric acid 25 milliliters

Deionized water 75 milliliters

Non-ferrous, or non-magnetic metals (including aluminum, zinc, nickel, etc.)

Ferric chloride

Ferric chloride 25 grams

Deionized water 100 milliliters

Acidic ferric chloride

Ferric chloride 25 grams

Concentrated hydrochloric acid 25 milliliters

Deionized water 100 milliliters

10% Sodium hydroxide

Sodium hydroxide 10 grams

Deionized water 90 milliliters

Sodium hydroxide (for aluminum)

Sodium hydroxide 5 grams

Deionized water 100 milliliters

Cupric chloride in nitric acid (for aluminum)

Cupric chloride 5 grams

Concentrated nitric acid 3 milliliters

Deionized water 100 milliliters

Knowles process (for zinc alloys)

Solution #1

Phosphoric acid (85%) 98 milliliters

Concentrated nitric acid 2 milliliters

Solution #2

Concentrated nitric acid 5 milliliters

Deionized water 95 milliliters

Solution #1 is applied for 10 seconds and then wiped off. Solution #2 is then applied and the number should appear within 30 seconds.

5% Nitric acid (for nickel alloys)

Concentrated nitric acid 5 milliliters

Deionized water 95 milliliters

Accelerated by DC voltage

For restorations in brass

Sodium sulfate 1.5 grams

Chromic acid 20 grams

Deionized water 100 milliliters

For restorations in lead

Molybdic acid 100 grams

Ammonium hydroxide 140 milliliters

Deionized water 240 milliliters
Filter then add
Concentrated nitric acid 60 milliliters

2.5 PROCEDURE FOR CHEMICAL ETCHING

The original state of the questioned area will be documented. A tape lift (done with black fingerprint powder, a Dry Erase marker, or rubbing a pencil on the area), a photograph, sketch, and/or notes of the obliterated surface must be performed prior to the restoration attempt.

Clean the surface with acetone or another suitable solvent (optional). Be aware that some solvents may damage some finishes and polymer parts.

Polish the metal surface by using a Dremel (or similar) rotary tool or by hand using a series of abrasive papers/steel wool/polishing compounds from medium to ultra-fine grade. It is best to polish in one direction. Deep gouges may require the use of an electric wheel fitted with emery paper or similar polishing compound. Take care not to heat the working surface due to friction.

Continue to evaluate the surface. Chemical etching can be started at any time. Metal particles can fill in low portions of impressed characters and an application of chemical etching solution can remove those particles.

Ideally, the final polished surface should be mirror-like with cuts and blemishes removed to the greatest extent possible (deep cuts may not be completely removed).

Clean the surface with acetone or another suitable solvent (optional). Be aware that some solvents may damage polymer parts.

Apply the chemical etching solution with Dacron, cotton, or fiberglass swabs. Observe the etching action of the solution carefully.

When numbers appear, wipe off the solution, or rinse the solution off with water. Document the numbers as they appear. Sometimes the numbers can be better seen if water, glycerin, or a similar liquid is applied to the surface. If the serial number is clearly visible, a photograph can be taken of the restored area.

If the numbers are not clear, re-polish the surface and reapply the chemical etching solution and observe the etching action. It may take several attempts to adequately restore the entire number. Be careful not to etch beyond the numbers or the compression area.

Once the procedure is completed, and the final appearance of the restored area is documented (photograph preferred) apply oil or another suitable material to the restored surface to minimize oxidation.

2.6 ACCELERATED ETCHING WITH DC VOLTAGE

It is sometimes desirable to accelerate the etching process. This can be done with DC voltage, using a 6- to 12-volt battery, DC power supply, or a toy train transformer. The transformer is best because the voltage can be varied to suit your needs from 0 to about 10 volts DC.

2.7 PROCEDURE FOR ACCELERATED ETCHING WITH DC VOLTAGE

Two lengths of appropriate gauge wire are each fitted with an alligator clip on one end of each wire. The opposite ends of the wires are attached to the positive and negative terminals of the DC source.

Clip the positive wire to the firearm or item being examined.

Attach the negative wire to a Dacron, cotton, or fiberglass swab moistened with chemical etching solution. Make sure that the clip touches the upper portion of the fiber bundle of the swab and is in contact with the solution. Also be sure the swab is moist. Dry swabs can cause scratching of the surface.

Touch the swab to the area being examined and move it across the area. It is best to move the swab in one direction.

Watch the area closely and monitor the speed of the reaction. Adjust the voltage up or down as necessary. The maximum voltage should not exceed 10 volts.

When the number is visualized, remove the swab, wipe off the solution or rinse with water. Document the number/characters as they appear.

It may be necessary to repeat the process, but be careful not to etch beyond the compression area.

Once the procedure is completed and the restored area is documented (photograph preferred), apply oil or another suitable material to the area to minimize oxidation.

NOTE: Avoid electrical shocks. Keep the transformer away from water. Make sure the floor is dry. Observe the safety precautions common to electrical appliances.

2.8 MAGNETIC RESTORATION

Magnetic restoration is based on principles that are used for magnetic particle inspection. Magnetic particle inspection is used to find surface and subsurface flaws in ferrous materials such as steel and iron. Using this technique, the item is first magnetized and then saturated with fine magnetic particles suspended in oil or water. The particles migrate on the surface to areas of distortion in the magnetic field, such as fractures in the material. The stamping or impressing of a serial number in a firearm or other ferrous object causes distortion of the magnetic field in the metal, thus allowing magnetic restoration. Magnetic restoration is non-destructive and can be done at any time during the restoration process or even multiple times if there is a concern that too much of the metal is being removed during the polishing or chemical etching processes.

2.9 PROCEDURE FOR THE MAGNETIC RESTORATION OF SERIAL NUMBERS

The initial step of magnetic restoration is the same as that of chemical etching. Ideally the final polished surface should be smooth, with gouges removed to the greatest extent possible. If small scratches and gouges are left in the metal, the magnetic particles will migrate to these defects. If desired, flat/matte white spray paint may be applied to the area to be restored to better visualize the magnetic particles.

Once the surface is polished, a magnet is placed with the magnetic poles situated at either end of the area of obliteration. Different strengths of magnets can be helpful for different thicknesses of metal.

After placement of the magnet, the area of obliteration is flushed with magnetic particles suspended in either oil or water. Tilting the surface back and forth slightly may assist in the resurfacing of the number. Repositioning the magnet may be necessary to restore the entire serial number. If the serial number is clearly visible, a photograph can be taken of the restored area.

The benefit of magnetic restoration is that it is completely non-destructive to the object being tested; however, there are two limitations that may be encountered with magnetic restoration. The first limitation is magnetic restoration can only be used with ferrous materials. The second limitation is that visualizing the number may be difficult. The latter difficulty can be lessened by using the magnetic restoration method in conjunction with chemical etching. A magnifying lamp may also be used to view the restorations.

Once the magnetic restoration procedure is completed, the recovered number will be verified and the restored area will be documented as described above.

2.10 REFERENCES

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Structures Division, NASA Lewis Research Center, Ohio 44135 (Grant NSG 3036 (3030); NASA Contract Report CR-1353).

3 PROXIMITY ANALYSIS

3.1 INTRODUCTION

The procedures in this section require the skills of a trained examiner. To be considered trained, the examiner must have successfully completed an appropriate and approved training program, such as the Gunpowder and Primer Residues Course offered by the FBI Academy, Quantico, Virginia, or equivalent course. The examiner must also complete an approved competency examination prior to performing casework and periodic proficiency testing.

Training guidelines should include, but should not be limited to, the WSP Crime Laboratory Division Firearms Training Manual, the Association of Firearm and Tool Mark Examiners (AFTE) Training Manual, the FBI gunpowder and primer residues course outline, and the FBI Scientific Working Group for Firearm and Tool mark Examination (SWGUN) Guidelines for Gunshot Residue Distance Determinations maintained by the Organization of Scientific Area Committees for Forensic Science Firearms and Toolmarks Subcommittee.

It is recommended that the AFTE Glossary and the FBI gunpowder and primer residues course outline be used for appropriate definitions.

Forms/worksheets should be used to ensure evaluation of all pertinent facts related to the submitted evidence. Forms/worksheets will be posted on the FLSB SharePoint site.

In addition to written notes, documentation of chemically processed items will be in the form of photographs, digital images or photocopies of the results. This documentation may only be necessary for positive results.

The remaining sections of this document contain examination methods that can be used independently or in conjunction to determine general muzzle to object proximity in accordance with generally accepted procedures in the discipline of forensic firearms examination. Examiners are expected to conduct tests and appropriate experiments to evaluate the effects of case specific factors that may influence their final opinion.

3.2 QUALITY ASSURANCE

Examiners are reminded of the importance of quality assurance as discussed in the Introduction of this manual and the CLD QOM. It is the responsibility of the firearms examiner that all test results be verified. Firearm examiners will follow performance check procedures and chemical logs as specified in the CLD QOM.

The procedures in this section include the following:

- Bullet defect and Range Determination (3.3).
- Gunshot Residue Examination Sequence (3.4).
- Range Determination, using shotguns and shotshells (3.9).
- Stippling Proximity Determination (3.10).

3.3 BULLET DEFECT AND RANGE DETERMINATION

The examination of items for projectile defects, impact sites, and subsequent general range determination of a firearm-to-target distance can include the evaluation of gunpowder (presence, distribution, and morphology), lead residue patterns/wipe, copper wipe, and shot patterns.

When a firearm is fired, gunshot residues in the following forms can be discharged from the firearm:

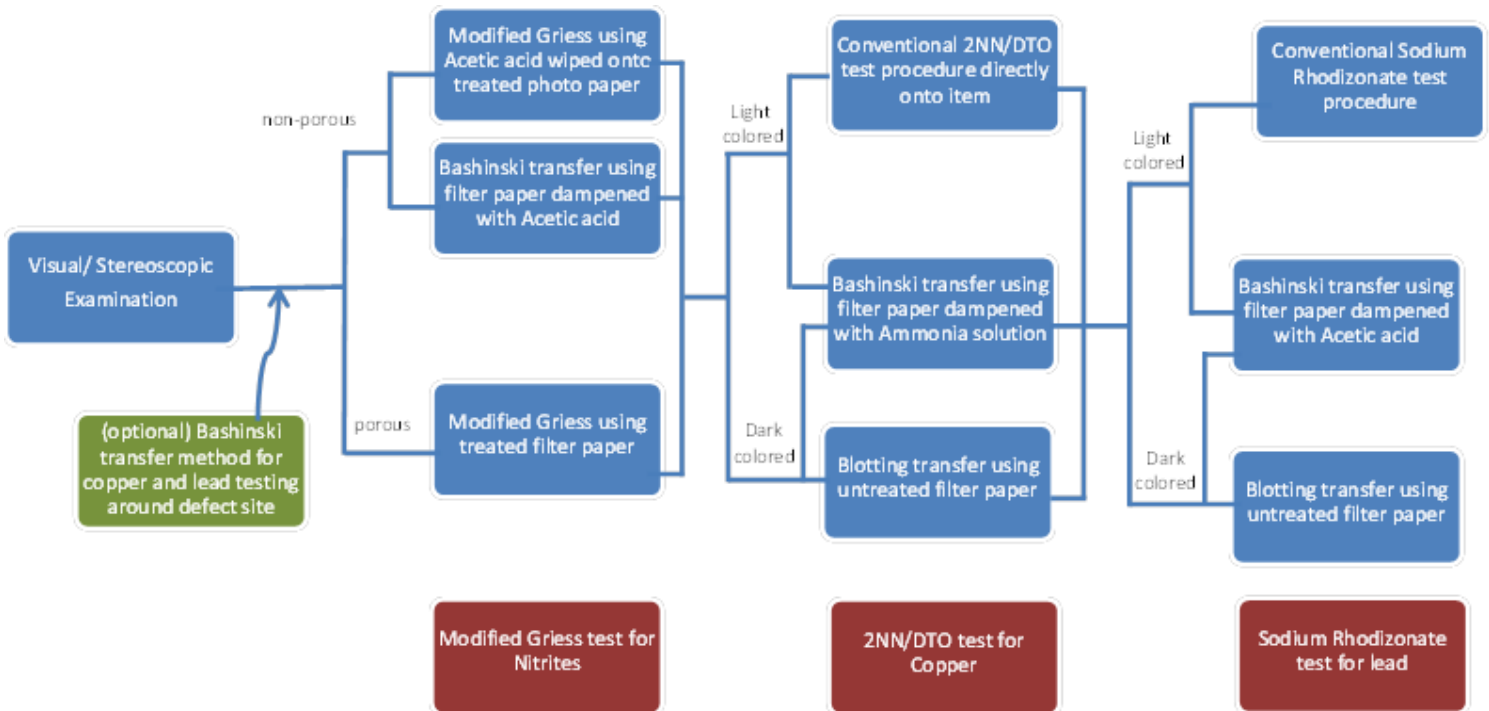
- Burnt gunpowder particles
- Partially burnt gunpowder particles

- Unburnt gunpowder particles
- Nitrite residues
- Vaporous lead and copper
- Particulate metals (lead, copper shavings)

The deposited gunshot residues (distribution and density) along with the morphology of the bullet hole can effectively be used to determine the possible muzzle to target distance.

3.4 GUNSHOT RESIDUE EXAMINATION SEQUENCE

- Visual examination (3.5)
- Microscopic examination (3.5)
- Chemical testing (3.6)
 - Modified Griess Test
 - 2NN/Dithiooxamide (DTO) confirmatory test for copper (Must be done before Sodium Rhodizonate test)
 - Sodium Rhodizonate



3.5 VISUAL AND STEREOSCOPIC EXAMINATION

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

- The presence of soot or powder particles (distribution and density)
- The presence of particulate metals (shavings of lead, copper, brass) on/in the item
- The presence of a visible ring or wipe around the margin of the defect
- The location of all holes, tears, missing buttons, etc.

- A description of the defect (size, intervention by medical personnel, etc.)
- The presence of burning, singeing, or melting
- The presence of any possible masking/altering effects (such as blood staining, rough handling, or clothing damage) or intervening objects
- The direction of artifacts surrounding the defect

Data regarding these physical effects and visible residues should be included in the examiners notes. When examining clothing, available clothing forms shall be used. If applicable, an acetate (plastic) overlay can be made of the pattern. Transparencies marked with stereoscopically identified gunpowder particle locations or a photocopy of the transparency will be retained in the case file. All of these methods can aid in the evaluation of gunshot residue patterns.

Lacking an obvious visual pattern of soot and gunpowder particles around a defect, at least two techniques from the following list will be conducted:

- Stereoscopic Examination
- 2NN / Dithiooxamide (DTO) copper test
- Modified Griess Test
- Infrared Examination
- Sodium Rhodizonate – lead Test

The determination that a defect is consistent with the impact or passage of a bullet can be based on visual and stereoscopic examinations, chemical processing and the examination of supporting photographs or written medical opinions.

The type of clothing (material, style, and other possible masking effects) should be considered when forming conclusions. It should be noted that other factors such as powder deflection, intervening objects, shape of the questioned impact surface, blood/liquid soaking, handling, or moving of an article may affect the powder pattern. An opinion of a proximity range related to firearm muzzle to target distance will be given based on visual, stereoscopic examination, and chemical processing of the evidence item (i.e. target). The opinion shall be limited to contact/near contact, intermediate or distant shot based on residue patterns/documentated damage. If the evidence firearm and ammunition consistent (manufacturer, bullet weight, bullet type, powder type, powder shape, powder charge, etc.) with what was used in the incident is available, drop-off distance may be determined (see 3.11).

The following definitions will be reported for each gunshot residue proximity range conclusion:

- Contact/near contact: The muzzle of the firearm was in contact with or very near the target at the time of discharge with possible sooting, 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.

If an approximate drop-off distance is reported, this wording shall be added to the report:

Testing to determine the approximate drop-off distance was conducted in a laboratory setting. A variety of scenario-based variables may have affected the evidence which could change the drop-off distance greater than any measurement uncertainty in the performed laboratory tests.

3.6 CHEMICAL PROCESSING OF CLOTHING FOR DISTANCE DETERMINATION

Modified Griess, 2NN/DTO and Sodium Rhodizonate Tests

The Modified Griess test is a specific color test for the nitrite-containing compound produced as a combustion product of smokeless powder. The Modified Griess test does not chemically interfere with the 2NN/DTO test for copper residue or the Sodium Rhodizonate test for lead residue. The Griess test must be performed first, since the converse is not true unless the transfer method is used for the 2NN/DTO and Sodium Rhodizonate tests. Then they can precede the Modified Griess test.

In general, the chemical reactions that occur in the Modified Griess test involve converting the nitrite compounds on the garment to an orange dye. These dye pigments are preserved in a medium (desensitized photographic paper, filter paper, photographic quality printer paper, or equivalent media to capture the pigmentation) for future side-by-side comparisons with test patterns of known distances.

The process of converting the nitrites is performed by exposing the compounds to vaporous acetic acid using heat (dry iron) to form nitrous acid. This nitrous acid then combines with sulfanilic acid in the test media (photographic paper) to form a diazonium salt of sulfanilic acid. The diazonium salt then binds with alpha-naphthol (1-naphthol), also in the test media, to form the orange azo dye.

The Sodium Rhodizonate test uses a reagent (sodium rhodizonate) to react with any lead on the item which results in a dark pink color being produced. Research has shown the 5% HCl step is not needed to confirm the specificity of lead. The 5% HCl is an optional step to be used at the Examiner's discretion depending on the conditions of the test (background, color response, unforeseen circumstances, etc). The Sodium Rhodizonate test can also be performed using the transfer method. A piece of filter paper or equivalent is moistened with an acetic acid solution and is pressed against the surface of the item being tested. The paper is then treated with the Sodium Rhodizonate solution and a dark pink with an orange background may appear.

Examiners are reminded that they are responsible for knowing the requirements and safety practices outlined in the Crime Laboratory Division Safety Manual and the health hazards involved in the use of the chemicals named above. These chemicals and their hazards can be found in the Safety Data Sheets that are on file in each laboratory.

3.7 BLOOD SOAKED GARMENTS

Dried blood in garments for gunshot residue testing can often interfere with or mask results during the Modified Griess test for nitrites, 2NN/DTO test for copper residue, and Sodium Rhodizonate test for lead. Phosphate buffer, Haema-sol, water, and saline are all accepted solutions for removing blood.

3.8 MARSHALL'S REAGENT

Marshall's Reagent, once considered to be carcinogenic, has been researched and determined to be generally safe for use in testing for the presence of nitrites. Marshall's Reagent is also considered an acceptable reagent for use in the Griess test procedures.

3.9 SHOTGUN RANGE DETERMINATION

Shotgun muzzle to target distances based on the shot pattern can be determined by test-firing the suspect shotgun at known distances from the muzzle with ammunition similar/consistent to the submitted shotshell evidence. In order to properly perform a muzzle-to-target range determination examination, it is necessary to attempt to reproduce the shot patterns present on the evidence item. This reproduction is accomplished by shooting tests (on witness panels) at varying distances until the shot pattern present on the evidence item is reproduced.

The following guidelines should be used when producing test patterns.

- Only one test shot per target media/witness panel.

- Tests should be shot in increasing or decreasing increments until a distance bracket is established, both less and greater than, that reproduces the shot patterns on the evidence item.
- It is recommended that more than one witness panel at the suspected distance be fired to demonstrate reproducibility.
- All range determinations for distances other than contact will be reported using upper and lower limits. It should be noted that other factors such as intervening objects, shape of the questioned impact surface, angle of the shot, handling, or moving of an article may affect the shot pattern.

In most cases proximity analysis requires shooting test patterns with a firearm and ammunition consistent with what was used in the incident. However, under certain circumstances when no firearm is available, a generalized opinion of a proximity range of a firearm can be given but should be limited to contact/near contact, or distance shot based on detected residue and shot pellet pattern dispersion. Care must be taken with such an opinion as many factors can influence proximity. An expressed opinion should contain all of the appropriate caveats (listed above).

3.10 STIPPLING PROXIMITY DETERMINATION

Stippling is referred to the characteristic of powder particles being driven into the skin or object as a result of a firearm discharge. Distance determinations based on stippling and/or tattooing patterns on a victim's skin have been conducted using a wide range of simulant materials. Accepted simulants are pig skin, twill jean cloth, Whatman #1 blotter paper, and Whatman #10 BenchKote.

It is essential to have access to medical examiner's reports or photos/digital images with a scale of the tearing/residue/stippling.

An opinion of a proximity range related to firearm muzzle to target distance will be given based on visual examination of the provided photos/digital images. The opinion shall be limited to contact/near contact, intermediate or distant shot based on residue patterns/documentated damage. If the evidence firearm and ammunition consistent (manufacturer, bullet weight, bullet type, powder type, powder shape, powder charge, etc.) with what was used in the incident is available, drop-off distance may be determined (see 3.11).

The following definitions will be reported for each non-shotgun proximity range conclusion:

- Contact/near contact: The muzzle of the firearm was in contact with or very near the skin at the time of discharge with possible sooting, ripping, tearing, and/or searing of the skin.
- Intermediate: The range at which a firearm and ammunition combination will deposit visible or detectible gunpowder particles or produce stippling on the skin.
- Distant: Only the bullet reaches the target {determined by defect characteristics, or autopsy information}. The only marks left on the skin are those produced by the mechanical action of the bullet during perforation or penetration of the skin.

3.11 DROP-OFF DISTANCE

Considering all of the forensic examinations for distance determination/proximity listed above, there will be a distance where the firearm and ammunition combination will no longer deposit observable/detectible residues on a specific target material; referred to as the Drop-Off Distance. When reporting this distance, the examiner should consider the entire list of variables outlined in previous sections including the dynamics of the shooting incident (environmental factors), the shape and type of the impact surface, factors that may have dislodged particles, as well as the possible presence of an intervening object.

Drop-off distance can be determined by shooting tests (on witness panels) at varying distances until a distance is reached where observable/detectible residues are no longer deposited.

- Only one test shot per target media/witness panel
- It is essential that the suspect firearm and appropriate ammunition be used for this testing.
- It is recommended that more than one witness panel at the suspected distance be fired to demonstrate reproducibility

If an approximate drop-off distance is reported, the wording in section 3.5 shall be added to the report.

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4 TOOL MARK EXAMINATION

4.1 INTRODUCTION

The completion of the procedures in this section requires the skills of a fully trained firearm/tool mark examiner. To be deemed trained in a particular procedure:

- The examiner must have completed an appropriate and approved training program for the procedure.
- A trained examiner must confirm the training was completed and the trainee is able to perform the procedure satisfactorily.

To ensure the accuracy and completeness of case documentation, it is recommended that the AFTE Glossary be used for appropriate definitions and manufacturers' nomenclature be used for describing tool components.

The standard method for associating suspect tools with evidence marks is comparison microscopy using a microscope specifically designed for firearm/tool mark comparison.

Forms/worksheets should be used to ensure evaluation of all pertinent specifics related to the submitted evidence.

The criteria for identification is an acquired skill based on experience and training in observing patterns of individual and class characteristics which results in the formation of an opinion (see 1.22 Range of Conclusions).

4.2 QUALITY ASSURANCE

Examiners are reminded of the importance of quality assurance as discussed in the "Introduction" of this manual and the CLD QOM. It is the responsibility of the firearms examiner that all microscopic examinations be verified.

4.3 TRACE EVIDENCE

Tool mark evidence is often submitted with debris adhering to the questioned tool or tool mark. This debris may consist of paint, metallic fragments, glass, wood, etc. The value of this evidence should be evaluated on an individual case basis and, if deemed necessary, collected according to standard laboratory procedure for trace analysis.

4.4 EVIDENCE MARKING

Any evidence examined by members of the laboratory must be marked in some manner. Items examined must bear the initials of the examining analyst, item number and the laboratory number, if practical. All markings or identifiers will be made in such a manner that the evidentiary value of the item is not compromised. Under the following circumstances, the identifying markings may be placed on the proximal container:

- The evidence is too small for an identifying mark.
- Marking the item will damage the evidence.
- The nature or texture of the item prevents it from being marked.
- Items have irregular or absorbent surfaces.
- Markings may compromise the value of an item that may be returned to the owner, such as stolen property.

Identification marks or initials should be made with a scribe, engraver, permanent tag, waterproof marker on the item, waterproof marker on tape or paint pen. If due to the nature of the evidence, it appears that the initials or marking may be at risk of rubbing off, a piece of clear tape can be placed over the markings.

4.5 TOOL EXAMINATION

The initial examination of the tool should include, at a minimum, the following documentation on the physical description of the tool:

- If any trace material is present.
- The class characteristics of the tool.
- The type of tool.
- The brand name of the tool.
- The size of the tool.
- The condition of the tool.

4.6 TOOL MARK EXAMINATION

The following procedure describes the general methods for working tool mark cases. Because these cases can vary extensively, specificity for any one type is not possible; therefore, this generalization will fundamentally apply to all cases.

The determination of class characteristics (i.e., type of mark, number of marks, size, etc.) is necessary for further comparison or elimination of the suspected tools. While examining for class characteristics, quality of individual characteristics should also be noted for selection of further comparison. Additionally, possible subclass characteristics generated from the manufacturing of the tool shall be evaluated.

4.7 TEST MARKS

In order to compare an evidence tool mark with a suspected tool, test marks are usually made with the tool. An objective while preparing test marks is to attempt to duplicate the manner in which the tool was used to produce the evidence mark. A test mark is considered as a reference and is generally not considered an evidence item. It will normally be returned in the same packaging as the submitted evidence. If the submitted evidence is not sufficiently packaged to permit the addition of the test mark, or if the submitting agency requires, it is permissible to create an evidence item for the test mark and document it accordingly in the case notes and in LIMS.

Test marks are made in a suitable material and marked appropriately (side, edge, or tooth of the tool) and then compared to the submitted marks. The initial test media used for producing test marks should be soft enough to prevent alterations to the working surface of the tool. Subsequent test marks may require the use of a harder test material to better reproduce the evidence mark.

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

- Areas of recent use and trace material locations
- Indexing of test marks, including test marks of all significant working surfaces.

The type of test and the medium used for testing should be documented in the case notes.

4.8 CASTING OF TOOL MARKS

If an item received for tool mark examination is too large for the microscope's stage, a cast can be made of the mark or marks. It will also be necessary to cast the test mark so that the comparison will be oriented similarly (i.e., negative to negative). No matter the type of casting material, the casting procedure is done in a similar manner to all the marks being compared. The casting of tool marks to facilitate comparison is a recognized practice, although the examiner should be aware of the casting material capabilities and limitations. It may be necessary to treat the casts like test marks for return to the submitting agency (see section 4.7).

Mikrosil, Forensic Sil, and silicone rubber are similar products used for this process. Follow the manufacturer's mixing instructions for proper usage.

If appropriate, scaled photomicrographs or images of the tests, casts, and evidence should be included in the case file. These images may be used for reference and/or comparison purposes.

4.9 MAGNESIUM SMOKING

Magnesium smoking is a technique for reducing the glare of a shiny object by lightly coating the surface with fine magnesium smoke. Due to eye and fire hazard, safety is a prime consideration. The use of forceps, proper eye protection, and a leather apron is recommended.

- Place the item in the path of the smoke.
- This process must be done in a properly ventilated area or under a hood.
- Cut short pieces of magnesium metal ribbon off the roll and place the remaining roll in a safe place.
- This technique should be done over a suitable receptacle.
- Never look directly at the magnesium flame! Serious eye damage can occur due to the brilliant white light emitted by the burning magnesium.
- The magnesium flame is very hot and must be kept away from other combustible/flammable substances. An ABC-type fire extinguisher must be kept nearby at all times.

Examiners are reminded that they are responsible for knowing the requirements and safety practices outlined in the Crime Laboratory Division Safety Manual. Examiners are also responsible for knowing the health hazards involved in the use of magnesium. This chemical and its hazards can be found in the Safety Data Sheets that are on file in each laboratory.

4.10 MICROSCOPIC COMPARISONS

The examiner should follow these basic procedural steps to facilitate examinations:

- Ensure the comparison microscope is properly adjusted for equal magnification at both stages.
- Adjust the illumination to fully visualize the microscopic details of the tool marks.
- Compare the test marks to ensure reproducibility of class and individual characteristics prior to comparing them to the evidence marks. Evaluate the possibility of subclass characteristics in the tool mark.
- Adopt a consistent procedure for the handling and documenting of comparison evidence.
- During the comparison, documentation of the phase orientation of the test mark and evidence mark is recommended.

The conclusions reached by an examiner during a microscopic comparison are made based on the Association of Firearm and Tool Mark Examiners (AFTE) Theory of Identification, see 1.21.

All evidentiary identifications, inconclusives, eliminations, (to include differences in class characteristics) and unsuitable for examinations must be verified by another qualified firearms examiner and documented in the case notes with initials and date prior to a report being issued.

4.11 RANGE OF CONCLUSIONS

Examiners will use one of the four conclusions listed in 1.22.

4.12 DOCUMENTATION OF CONCLUSIONS

A photo, along with notes describing how the identification was made, will be taken to document an identification. In cases with multiple items identified to each other, a firearm or tool, a representative photo/digital image will be sufficient.

It is recognized that photos are not typically used to make identifications or comparisons in tool mark cases, but are a means for recording and generally documenting selected portions of an identification.

For unsuitable for examination, inconclusive and elimination conclusions, detailed descriptions will be used to document class characteristics and describe why the sample is unsuitable for examination, inconclusive or an elimination.

5 INTEGRATED BALLISTIC IDENTIFICATION SYSTEM (IBIS)/ NATIONAL INTEGRATED BALLISTIC INFORMATION NETWORK (NIBIN)

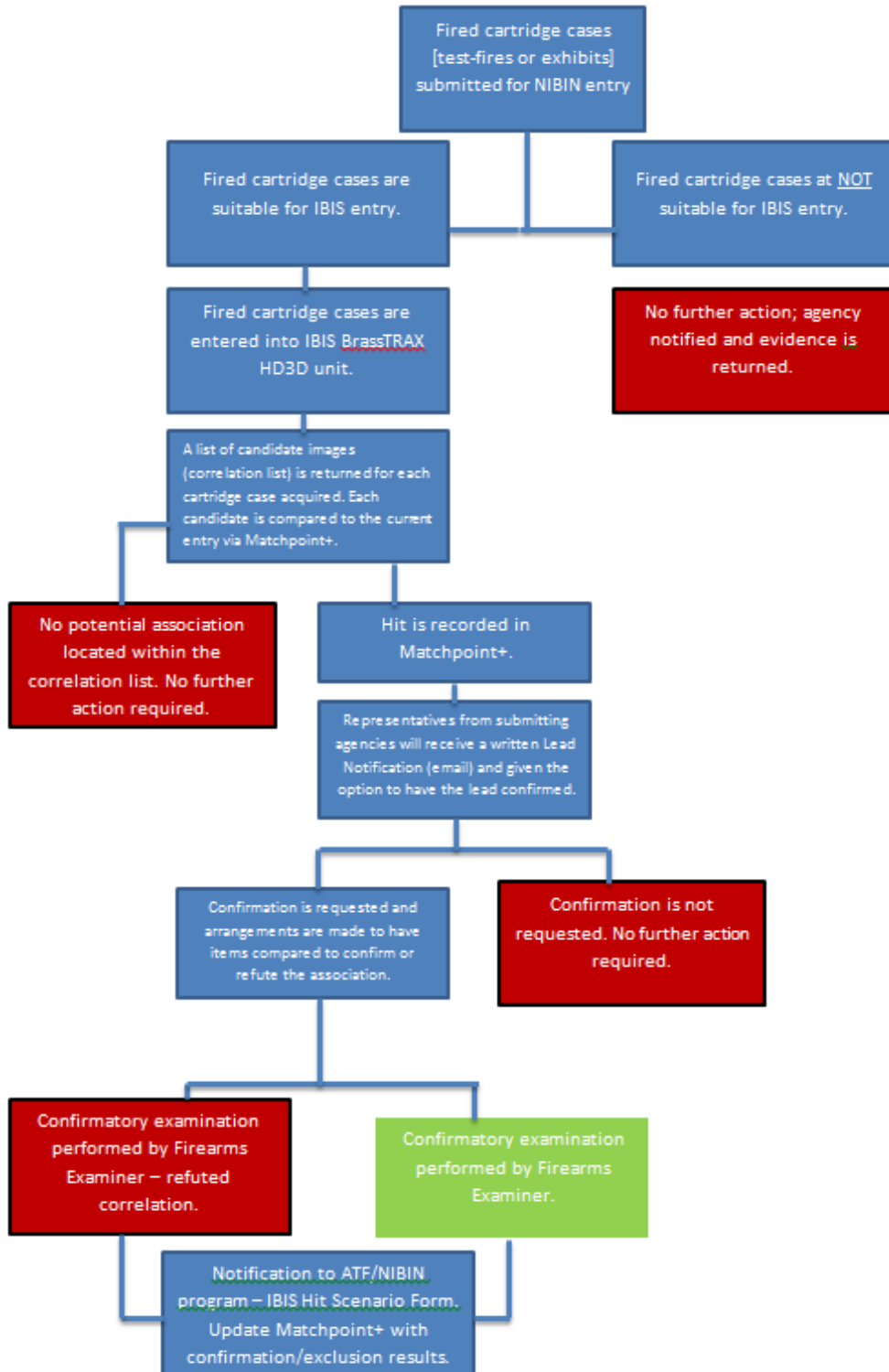
5.1 INTRODUCTION

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.¹ As an ATF-NIBIN partner, the Washington State Patrol Crime Laboratory is committed to assisting the ATF in the NIBIN program.²

Currently the Seattle (site 227), Spokane (site 367), and Tacoma (site 029) Crime Laboratories have IBIS units. 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 users, and is issued by the ATF. Each IBIS user will need to pass a competency test administered by the ATF prior to participating in the NIBIN program.

This is the general workflow of exhibits entered into the IBIS unit:



5.2 TYPES OF IBIS ENTRIES

5.2.1 METHODS OF SUBMISSION

Evidence Cartridge cases to be entered into IBIS will be handled in one of two ways:

- (1) They may be submitted as evidence and will be documented and handled per the Evidence section of the QOM.
- (2) They may be handled as walk-ins and remain in the possession of an agency representative who remains present during entry.

Test fired cartridge cases are treated as exemplars and handled as non-evidence. Test fired cartridge cases can be delivered to the laboratory (e.g. by mail, in person) or created on-site by law enforcement personnel exclusively for IBIS entry, then placed in a location designated by the laboratory and entered into IBIS by any authorized IBIS/NIBIN operator. These test fires will be discarded after entry.

Following IBIS guidelines and ATF IBIS Data Entry Protocol, a case file and corresponding exhibit files are created and entered into the IBIS database. The selected cartridge cases are 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 in Walnut Creek, California, which provides correlations for the area served by the Washington State Patrol Crime Laboratory Division. The highest scoring images are then returned for visual comparison. A manual correlation may be requested from another server as needed.

5.2.2 TEST FIRED CARTRIDGE CASES

Test fires are acquired by firing at least two cartridges with the standard or appropriate ammunition following proper firing procedures found in section 1.13 of this manual. Test fires generated by a law enforcement agency may be submitted by the methods 2 or 3 described above. At this time, it is preferable for agencies to generate their own test fires as it streamlines the process for IBIS entry and shortens the chain of custody for the firearm.

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 headstamps 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 protocol.

Some user agencies require color coded stickers to denote a firearm has been test fired for IBIS entry. Once the firearm(s) have been test fired, a sticker may be adhered to the evidence tag attached to the firearm with the date, initials, and annotation of IBIS entry of the person performing the test fire.

5.2.3 EVIDENCE CARTRIDGE CASES

Evidence cartridge cases for IBIS entry must either be submitted and documented as evidence or handled as walk-in. Evidence cartridge cases must not be submitted to 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, latent prints, or trace evidence 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 based on protocol. If class characteristics vary or ammunition type varies, an exemplar from each group should be entered into IBIS. In the case of a walk-in, if it is not otherwise clear which cartridge case(s) was entered, the cartridge case(s) will be marked or separated in some way to identify which was entered. For casework, this examination will be documented and placed in the WSP case file.

Documentation may include the use of the IBIS Exhibit Examination worksheet. All casework evidence cartridge cases entered are to be documented by case file notes, which may include sketches, photographs, or printouts from the IBIS instrument. All evidence cartridge cases are entered into the IBIS instrument following ULTRA ELECTRONICS guidelines and ATF/IBIS Data Entry Protocol.

For user agencies not submitting items directly to the laboratory for examination and having fired cartridge cases directly entered into IBIS (i.e. walk-in's or non-WSP IBIS users), a sticker denoting the item has previously been entered into IBIS shall be affixed to the outside of the evidence packaging with the date, initials, and notation of IBIS entry by the person performing the acquisition. This serves as a signal to laboratory personnel and other IBIS users that the item has been previously opened and examined for triage/IBIS entry.

5.2.4 IBIS REPORTS

Reports regarding only fired cartridge cases requested to be entered into the IBIS/NIBIN database are not required. This does not preclude a report from being issued in select circumstances.

- For agency generated test fired cartridge cases submitted to the laboratory, under the drop box process for IBIS/NIBIN entry, no report will be issued. These agency generated test fired cartridge cases will not be returned to the agency.
- For evidence cartridge cases submitted to the laboratory for IBIS/NIBIN entry, using an RFLE, the above RFLE label and "Case Information" printout will be used to confirm cartridge cases were entered in IBIS. Additional notes created during the evaluation and entry of the evidence cartridge case(s) will also be included in the case file. This documentation requires technical and administrative review. The technical and administrative review may be performed by the same person concurrently. A copy of the RFLE with label stating items entered, date, and initials of the examiner who entered the items in the IBIS/NIBIN database will be returned to the submitting agency.

5.3 **CORRELATIONS**

Correlations should be checked daily. Correlation requests are completed by the system and returned, generally, within 24 hours to the MATCHPOINT+ system and are visually evaluated by the IBIS operator. The IBIS/NIBIN database correlation server compares and scores the digital signatures of entries by offense date, type of offense, acquired images, and caliber. It returns the images of the cartridge case exhibits with the highest scores appearing in descending order alongside the reference image. Correlation results can be filtered. At least the top 30 images should be viewed and evaluated for possible similarities. After the correlations have been viewed and any possible hits have been initiated, delete all correlations or make them previously viewed and delete them as soon as they are no longer needed.

Should similarities be seen between the reference image and a test image, a side by side image on the correlation screen will be marked as a hit on the database of the unit. This action creates an "Unconfirmed Hit" on the MATCHPOINT+ system. Prior to marking the correlation as an "Unconfirmed Hit," a lead number is generated by the IBIS user with the following format: TAC/SEA year-hit number (for example – SEA 15-100). The IBIS operator should first identify if either case number has previously been established as a lead. Verifying if a lead has been

previously identified can be completed by accessing the “Hits” screen on MATCHPOINT+ and sorting the hits by case numbers. If the IBIS operator verifies the case number has not been established as a previous lead (or the new lead is of a different caliber/firing pin type from previous lead), the new lead can be given a new lead number. If one of the case numbers has been established as a previous hit, the newest is numbered as a supplement (for example - SEA 15-100, supplement 1). Once the user has assessed whether the case numbers and/or calibers have been marked as previous hits in MATCHPOINT+, the user is to initial and date on the Lead Notification Form. Upon establishing a hit in MATCHPOINT+, a Lead Notification Form is generated by the user establishing the MATCHPOINT+ hit. The MATCHPOINT+ operator is required to have a second on-screen peer review conducted by an examiner or MATCHPOINT+ operator and provide a second set of initials on the Lead Notification Form prior to the Lead Notification Form being distributed. A digital signature (/s/____) and date is permitted for these purposes. A Lead Notification form is generated and sent to the submitting agencies and the appropriate ATF staff. This generated form should be stored digitally so that it can be accessed at a later date if necessary. If a lead confirmation is requested by a submitting agency, the evidence not physically in the crime lab will be requested from the appropriate agency/agencies for lead confirmation purposes. When a lead confirmation is completed, a copy of the Lead Notification and the hit images from IBIS will be included in the case files, along with any communications requesting confirmation. Confirmations are not required for all unconfirmed hits and will generally not be done unless requested by the submitting agency. If the lead includes cases with a WSP lab number, the lead should be indicated in LIMS, either by linking cases with a note including the lead number and/or a note in Case Info. If the agency/agencies indicate that they do not need the lead confirmed, this may also be noted in LIMS.

If, after comparison by a firearms examiner, the cartridge cases are determined to have been fired in the same firearm, the cases are logged into the respective laboratory’s current year Confirmed Lead binder (Lead Notification form, IBIS images, IBIS Hit Scenario sheet, and a copy of the lab report), ATF is notified using the IBIS Hit Scenario sheet, and the matching cases are marked as confirmed hit in the MATCHPOINT+ database according to ULTRA ELECTRONICS protocol. The database will require the date when the hit is confirmed to be entered on the “hits” screen. Once the lead is marked confirmed, it is at this point that the “hit” cannot be deleted unless FTI and ATF are contacted. If the firearms examiner determines that the cases are inconclusive or were not fired in/from the same firearm, the “Unconfirmed Hit” must be removed from the IBIS hits file on the unit and the cases should be unlinked in LIMS. Once a lead is confirmed, the cases involved should be linked in LIMS with a note including the lead number. If the cases were previously linked and the note is being changed, this may require changing it for each case.

5.4 MONTHLY STATISTICS

A WSPCL IBIS user will be assigned the task of generating the monthly statistics. The number of cartridge cases entered into IBIS/NIBIN each month, along with the number of leads (confirmed and unconfirmed) that are confirmed for that month, will be entered into a monthly report and sent to relevant laboratory managers, firearms section supervisors, firearms FS4, and the firearms section management liaison/ IBIS/NIBIN Coordinator for the CLD within the first week of the following month.

The following definitions will be used to distinguish hits:

Hit or Lead – A connection made between different agency cases where previously there had been no connection. IBIS establishes the connection.

Warm lead – A connection made between firearms and/or fired cartridge cases when investigators have prior knowledge that they might be connected. IBIS connects what the agency previously suspected.

5.5 IBIS UNIT

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 ULTRA ELECTRONICS and approved by ATF. All persons using the IBIS/NIBIN system must have an ULTRA ELECTRONICS generated password and security clearance granted by the ATF.

5.6 TRAINING

At this time, initial IBIS training mandated by the ATF can be conducted on-site by ULTRA ELECTRONICS personnel, at the ATF NIBIN Correlations Center, or by a qualified IBIS user with the approval of the ATF. As part of the ATF/ULTRA ELECTRONICS training program, a competency test is administered by the ULTRA ELECTRONICS representative or ATF designees. This competency is monitored by the ATF IBIS personnel, and is a graded exercise in entering and correlating a cartridge case. Successful completion of this competency test provides the user with ULTRA ELECTRONICS and ATF certificates of completion and independent access to the IBIS instrument with a username and password.

Additionally, per the CLD QOM, the new IBIS user should complete an in-house proficiency test, and written tests based on the casework and general knowledge required to do IBIS case entry.

Additional training and competencies may be administered by CLD staff/supervisors including but not limited to the following areas:

- Reports/Report writing
- LIMS case management
- Evidence management
- Evidence packaging/seals
- Safe practices when handling evidence
- Supervised casework
- Courtroom testimony training and moot court
- Associate Membership for AFTE recommended

Any additional training such as this may or may not be required depending on the employee's training and development plan.

For IBIS MATCHPOINT+ correlations training, a two week course is offered at the ATF NIBIN Correlations Center. Alternatively IBIS MATCHPOINT+ can be trained in-house by a qualified MATCHPOINT+ user with the approval of the ATF. The training shall include:

- Review of the IBIS MATCHPOINT+ training guide
- Supervised correlations
- Review and create High-Confidence Hit(s) in MATCHPOINT+
- Generate a High-Confidence Lead Notification report(s) and corresponding supporting paperwork. Notify submitting agencies of High-Confidence Lead.
- Review and demonstrate the procedures for Lead confirmation. And reporting of Lead confirmation(s) to ATF.

IBIS users may also be required to comply with any additional training needed for updates and program changes as directed by ULTRA ELECTRONICS/ATF. Failure to adhere to updated training announcements per ULTRA ELECTRONICS may result in suspended access to IBIS until training is completed.

For any non-WSP person that is trained on IBIS/NIBIN, correlations should be used to monitor the quality of the non-WSP user's entries. In the event that the quality of entries does not meet the standards set forth in the BRASSTRAX Training Guide and BRASSTRAX User Guide provided by FTI, the following sequence should be taken:

Inform the supervisor who will develop a course of action which may include the following and inform the laboratory manager and management liaison at an appropriate time:

- 1 – Inform the user of the problem. Make sure they understand the standards that they need to meet. Document the contact, problem, and any clarifications given to the user.
- 2 – If the problem continued procedural or image quality issue persists, offer re-training of the user. The user should understand that if the standards and common practices are not met, the user may not be allowed access to the system/facility. It is preferred that this is done via email or some other method that creates a record that the user was warned that access could be revoked.
- 3 – If the problems are not resolved, then laboratory management will consult with the ATF regarding the next course of action which may include revoking access to the facility and the system.

Although the NIBIN system is the property of the ATF, WSP crime laboratory personnel are compelled to monitor acquisition protocols for items that are entered into instruments on the premises. This ensures the highest probability of success for the NIBIN program.

5.7 WSP CRIME LAB IBIS ACQUISITION

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

5.7.1 CASE MAINTENANCE

In addition to the IBIS training guide:

Case ID – All case identification begins with WSP and is followed by the laboratory case number consisting of the first three case digits of the lab number followed by a dash and then the last four digits of the laboratory case number.

Example: WSP307-1010

All exhibits from this 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 cases that do not have a lab number (for example, walk-ins), case identification should use an abbreviation for the submitting agency and the agency case number.

Example: WSPTPD16-123-12345

Comment – This area is used to document case information. Any necessary information that is not provided in another field should go in this field. Type and condition of evidence packaging may be entered here. Example: Items received in a sealed zip lock bag containing two taped manila envelopes marked MC 1 and MC 2. When printed, this field may act as case notes in a case file. This printed page will include all the comments and entered case information.

Whenever possible, all fields should be filled, with the Case Supervisor and Comment fields being optional. At a minimum the agency representative's email address should be typed in the

Originating Agency Contact field. Additional originating agency's contact information (contact name, telephone number, etc.) may be included in the Originating Agency Contact or Comments field if known. If this acquisition turns out to be a possible match in another lab, this box will provide enough information to the other lab to be able to call for the evidence to be submitted to that lab directly from the agency.

5.7.2 FIREARMS MAINTENANCE

In addition to the IBIS training guide:

Exhibit number – User should enter Gun 1, Gun 2, or Gun followed by the Item number from the RFLE 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"

5.7.3 CARTRIDGE CASE MAINTENANCE

In addition to the IBIS training guide:

Exhibit number - Evidence exhibits should begin with EX. After EX enter any identifiers that apply to the exhibit such as EX3-1 or EXMC10. Test fire exhibits should begin with TF. Test fires should be entered as TF 1, TF 2 and so on.

5.8 **CASE MANAGEMENT**

To make the NIBIN system more successful, ATF has suggested four key factors^{1,3} to increase the effectiveness of the IBIS/NIBIN system. The WSPCL is committed to assisting the ATF with their goals.

- "Comprehensive data collection - the non-fatal/injury shootings previously having low priority are as important as the fatalities/injuries because they represent "misses" more often than not."

The WSPCL will increase the priority of exhibit-only no suspect cases, and will communicate with agencies the importance of submitting no suspect fired cartridge cases. The WSPCL will also assist the regional ATF Taskforce with communication and strategies to increase fired cartridge case submissions.

- "Timeliness - NIJ report demonstrated that value of output drops precipitously after only one week delay; in this instance timeliness turns into a quality issue because delays = less useful intelligence"

The WSPCL will prioritize fired cartridge cases submitted shortly after an incident occurred. A goal of 72 hours for IBIS entry after submission will be attempted if agency submits the evidence in a timely manner and the case does not need DNA or latent print examination conducted by the WSPCL.

- "Investigative follow-up – actively following up on NIBIN leads for the purpose of identifying and targeting active shooters; can also include analytics to help facilitate the work of investigators freeing them up to focus on doing actual interviews"

High-Confidence Lead Notification reports will be generated as soon as possible and communicated to the submitting agencies.

- “Feedback - reduces frustration of sites who wonder whatever becomes of their efforts and also provides fuel to motivate increased funding”

The WSPCL will work closely to the regional ATF Task Force to continue to get feedback from user agencies and evaluate the IBIS/NIBIN system and protocols.

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

6 CONDUCTED ELECTRICAL WEAPONS - CEW (TASER)

6.1 INTRODUCTION

The procedures in this section require the skills of a firearm examiner trained in the area of Conducted Electrical Weapons (including TASERS, and will be referred to as CEW for the purposes of this document). These devices are categorized as 'less-lethal' systems designed to fire metallic probes with attached wires to deliver an incapacitating shock in an effort to control a non-compliant subject. There are civilian and law enforcement versions of these devices and the examiner shall be familiar with the types, brands, and configurations that may be submitted to the crime laboratory. CEWs for the purposes of crime laboratory analysis shall include STUN-GUN devices which do not fire probes and require direct contact to the subject.

To be considered fully trained and able to analyze/review evidence related to CEW events, the examiner shall complete an appropriate AXON-TASER instructor certification course. It is strongly recommended that the examiner attend other courses offered by the manufacturer and review the scientific and medical research concerning these devices. Examiners can refer to the Association of Firearm and Tool mark Examiners (AFTE) Journal for forensic TASER articles. The examiner must also complete an approved competency examination and perform at least one supervised case prior to performing independent casework.

To ensure the accuracy and completeness of case documentation and analysis, the most current instructional materials from the manufacturer should be used for appropriate curriculum, manufacturers' nomenclature, design and procedures. Training bulletins on the TASER.com website should also be reviewed prior to any new examination. Other manufacturers of CEWs should also be referenced.

Forms/worksheets should be used to ensure evaluation of all pertinent facts related to the submitted evidence. Forms/worksheets will be posted on the FLSB SharePoint site. The following procedures are the TASER X26, but can be applied to newer models such as the TASER x26P, TASER X2, and the TASER 7 (released 2018). TASER devices are the most likely CEW to be encountered in casework. Other submitted CEWs may require different or additional procedures to determine functionality.

6.2 QUALITY CONTROL PROCEDURES

Examiners are reminded of the importance of quality control procedures as discussed in the Introduction of this manual and the CLD QOM. It is the responsibility of the firearms examiner that all test results performed are verified by another qualified examiner. Firearm examiners will follow performance check procedures and chemical logs as specified in the CLD QOM.

6.3 SAFE CEW HANDLING IN THE LABORATORY

6.3.1 SAFETY CHECKS

Evidence should be photographed when received. CEW evidence in the laboratory is not dangerous if handled correctly. In extremely rare occurrences, a malfunctioning unit may discharge unintentionally, melt, smoke, or shock the user when held.

CEWs will be handled similar to firearms upon receipt in the laboratory. Firearm examiners will perform a safety check which will ensure that the safety is turned on (unit power is off) and that no live cartridge is in the port. In the event an examiner (or trained designee) is not available to perform the check, the submitted CEW shall be placed in a box or other designated area and marked appropriately.

The power source should remain in the unit as critical data will be lost if the power source is removed for an extended period of time. For the TASER X26 (now discontinued) model, a "safety clip" can be installed prior to submission to the laboratory, but all models must have a means to prevent the power switch from activating (i.e. the device zip tied in a box or the safety switch

secured). If stability of the unit is in question or if the unit is submitted wet, the power source can be removed and dried using recommendations from the manufacturer.

Unfired CEW cartridges (that fire the probes) contain a highly compressed air cylinder and electronically activated primers. Care should be taken to avoid a static electricity discharge. Such a discharge could cause serious injury. Plastic safety clips may be installed on the unfired cartridges if deemed necessary.

Safety Considerations for TASER Weapons

CEWs to be test-fired will be loaded and unloaded in a safe direction (preferably inside the firing range). Hands should be clear of the blast doors (front) of the cartridge during loading and unloading. Although the weapons system is considered less-lethal, care should be taken to avoid an accidental discharge or impact of the probes in a non-designated area. If this occurs, the section supervisor shall be notified.

Eye protection must be worn by all persons present during live firing as many types of projectiles are discharged during firing. Appropriate notice (i.e., verbal) shall be given prior to test-firing. After all examinations are completed, the CEW shall be returned in a safe condition following laboratory protocols established by the WSP QOM.

6.4 TRACE EVIDENCE

CEW related evidence may be submitted with debris that might offer clues to aid in the reconstruction of events. This debris might consist of blood, tissue, paint, fibers, glass, etc. The value of this evidence must be considered during this examination. Trace evidence and biohazardous materials should be collected or preserved in compliance with standard laboratory procedure. If a biohazard is present, the examiner must follow safety and decontamination (if applicable) procedures outlined in the CLD Safety Plan.

6.5 DNA/LATENT PRINT EXAMINATION

Refer to Section 1.4 of this manual.

6.6 SPARK TESTING/MECHANICAL AND ELECTRICAL OPERABILITY

It is the responsibility of the firearms examiner to ensure that appropriate safety function checks are performed on a CEW prior to test-firing. Examiners should be careful not to lose or destroy trace evidence while performing the safety check.

An established list of safety checks shall be considered for every CEW examination, which is common practice for every trained/certified CEW instructor to diagnose device functionality. This is not a performance check of the internal electronic systems (ie. power output).

SPARK TESTING/OPERABILITY CHECKS FOR most CEWs:

- Is the unit unloaded? (Remove cartridge, even if previously fired)
 - Note orientation of fired CEW cartridges
 - Note serial number of CEW cartridges
 - Preserve integrity of any coiled wire remaining in the cartridge
- Safety/Power switch functional?
 - Both sides of the ambidextrous safety attached?
 - Does device power up? (Should display current battery %)
 - Does battery need replaced?
 - Display functioning properly?
- Is there a battery in place? What type of power source?
 - Document battery percentage

- Note error codes
- Are there any signs of damage, cracks, or weaknesses in the frame of the CEW?
- Are there any loose, damaged or missing parts?
- Is the laser/display/light activated with power?
- Does the unit pass a spark test (clear consistent arcing between terminals) when the trigger is pulled?
 - Test with one trigger pull (automatic 5 second cycle)
 - Test at 1-4 seconds (manually turn off)
 - Test at 5-9 seconds (release trigger after 5)
 - Test at 10 seconds to evaluate spark rate and quality
- Does the unit cycle at a spark rate within manufacturer's specifications?
 - Compare to control units or high speed video
- Does the unit stop cycling when turned off or timed out?
- Does the unit require power output testing (out-sourced)?
- Are there any recall notices that must be considered?

6.7 BATTERY INSTALLATION

It may be necessary for the firearms examiner to replace the battery prior to examination. The battery or power source is an essential component of the CEW. The power source contains not only batteries, but houses circuitry essential for its operation and data collection. Circuit boards in the power source interface with the main unit, such as firmware, firing data, device health monitoring, etc. The incorrect selection or installation of the power source could alter the device. Care must be taken to preserve pre-submission condition of the evidence. If a replacement power source is required, install only the same generation (color, model, or firmware version) that was submitted with the device. This can be done by requesting a current and correct battery from the submitting agency (or in rare cases, the manufacturer) to ensure the correct power source used for CEW evaluation. The power source (circuitry/firmware) is not analyzed.

6.8 CEW RELATED INFORMATION AND CONSIDERATIONS

- What model of CEW was submitted?
- Was the unit firing data previously downloaded by the submitting agency?
- What is the type of cartridge submitted? Note generation of cartridge and probes
- Are the wires and probes recovered? intact?
- Trace evidence observed and documented?
- Were the AFID tags (small paper disks with serial number), blast doors, etc. collected?
- Was the subject's clothing submitted to examine for presence of probes or probe impacts?
- Are there photos of wounds?
- All evidence/packaging to be marked according to accepted guidelines in the CLD QOM.

6.9 CEW-TASER DATA DOWNLOAD

Most modern CEW units are equipped with memory that stores data of all firings and other operational data. The download is typically performed by replacing the power source with a hardware interface. Procedures for the download can be accessed from AXON (formerly TASER International) or other manufacturer resources (evidence.com). This type of download is similar to reading data off of a compact disk of data. The download is used to collect and document the data that was captured by the device and cannot be manipulated by the user/scientist. If applicable, the examiner shall document the software version/method used and save the data as part of the case file. TASERs have an internal clock that may differ from actual time. The examiner should make note of any time adjustments made by the download software. It is recommended that any deviation in the time records be included in the case documentation, although the newer versions of the download software will include this in the printout.

The examiner shall spark test the device once before any download is performed, as the download software may correct an erratic spark rate. Note time and date of that spark test, then perform a download of the firing data and save the file. The examiner should then perform at least three spark tests, noting the time and duration of each trigger pull to evaluate the shutoff functions and downloaded for a second time. The spark test data shall be compared to the printout. The examiner shall note on the data download printout which firing data they generated.

6.10 TYPES OF CEW RELATED EXAMINATIONS

1. CEW basic function (as defined in 6.7 above)
2. Spark testing (a portion of 6.7 above)
3. Power output testing (outsource)
4. Firing data download (software and hardware)
 - a. Internal memory integrity (documented by the download of the data in 6.10 above)
 - b. Proper record of incident CEW deployment? Correct date?
 - c. Document spark testing by examiner
5. Distance determination - must know type/generation of cartridge
 - a. Clothing examination to determine spread of probes versus distance of deployment
 - b. Other items with potential probe strikes/impacts
6. Cause of field failure (based on physical observations and comparison to known samples)
 - a. Unit examination (trace evidence and damage observed)
 - b. Power source examination (signs of damage and correct source for the unit)
 - c. Probe examination (trace evidence and observed damage)
 - d. Wire examination (physical observations and damage)
 - e. Cartridge examination (serial number, trace evidence and any observed damage)
7. Examination of Probe/wire junction to determine electrical duration through probe (based on comparison to known durations)
8. Examination of cartridge terminals to document observations of electrical arcing (pitting/charing)
9. Wound observations (document location of relative probe impacts)
10. Event reconstruction

6.11 TECHNICAL REVIEW OF CEW (TASER) RELATED EXAMINATIONS

Forensic Scientists involved with technical review shall complete a CEW instructor course given by a Master Instructor. Training should be supplemented by a qualified CEW instructor with understanding of forensic CEW application and analysis. The technical reviewer should have participated in the testing and downloading of CEW units.

6.12 TRAINING OUTLINE FOR QUALIFIED CASEWORK TECHNICAL REVIEW OF CEW CASES:

1. Completion of instructor level course on CEW
2. Written test on CEW devices from a qualified instructor; 80% or better to pass
3. Examiner shall study the most up to date training from the manufacturer.
4. Further practical training in laboratory:
 - a. Nomenclature
 - b. Operation description
 - c. Power source replacement
 - d. Pulse rate
 - e. Electrical waveform
 - f. Tour facility and review procedure for power testing CEW
 - g. Field deployment familiarization
 - h. Firing data download and interpretation
 - i. Cartridges, probes, wires
 - j. Microscopic examination
 - k. Live fire
 - l. Evidence collection and preservation
5. Assist with testing and download of CEW
6. Function testing of units
7. Failure troubleshooting
8. Forensic analysis of CEW
9. Cartridge, Wire, Probe Analysis
10. Documentation with standard worksheets and report writing
11. Review medical and scientific literature
 - a. AFTE articles on CEW
12. Distance determination
13. Review WSP Forensic CEW checklists
14. Complete competency on TASER operation

6.12.1 SUPERVISED WORK OF AT LEAST ONE CASE

6.13 NEW TASER DEVICES

Examiners should be aware of emerging technology, such as new models from Axon TASER International. These devices should be researched prior to any examination.

6.14 REFERENCES:

6.14.1 WEB RESOURCES:

TASER.COM, Evidence.com

TASER INTERNATIONAL INC, 7860 East McClain Ave, Scottsdale, Arizona:
Training materials
Instructor certification Courses

Braidwood Inquiry www.braidwoodinquiry.ca

- **Phase1 “RESTORING PUBLIC CONFIDENCE** Restricting the Use of Conducted Energy Weapons in British Columbia” **556 pages**
- **Phase 2 “WHY? The Robert Dziekanski Tragedy” 470 pages**

Carleton University: Power Output Testing Procedures for CEW-TASERS
curve.carleton.ca/papers/2010/CEW-Test-Procedure-2010-ver1.1.pdf

R.T. Wyant, M.S. “The Advanced TASER M26, X26: Forensic Considerations” AFTE Journal, Volume 36, Number 4, Fall 2004

P. Wolslagel, E. Brown “Distance Determination Angle and Performance of the TASER International Model X26” AFTE Journal, Volume 37 Number 3 Summer 2005

Ashley Kido, R.T. Wyant, M.S. “Analyzing Electronic Control Device (TASER) Wire to Determine Duration of Short Circuit”, AFTE Journal, Volume 40, Number 4, Fall 2008

K.M. Geil, R.T. Wyant. M.S. “Examination of the Probe-Knot Junction to Estimate Duration of Electronic Control Device (TASER) Exposures” AFTE Journal, Volume 42, Number 3, Summer 2010

R.T. Wyant, B.J. Smelser, “Comparison Qualities of the Wireless TASER (XREP) and the Mossberg X12 LLS” AFTE Journal, Volume 42, Number 3, Summer 2010

R.T. Wyant, T. Burns, K. Geil “Crime Scene Considerations: Electronic Control Device (TASER) Deployment” Association of Crime Scene Reconstruction, Volume 17, Issue 3, Summer 2011

R.T. Wyant “Basic Function Tests of Electronic Control Devices (TASER) for Firearms Examiners” AFTE Journal, Volume 44, Number 1, Winter 2012

R.T. Wyant “Atlas of Conducted Energy Weapons and Forensic Analysis” Editors Ho, Dawes, Kroll Springer press 2012. Authored Chapter 10 “Post Event Conducted Electrical Weapon Wire and Probe Analysis”

R.T. Wyant “CEW-TASER FORENSICS: simple considerations to improve investigations” Tactical Edge, Winter 2017

6.14.2 PRESENTATIONS:

R.T. Wyant, M.S. “TASER- A new blast from the past” Association of Firearm and Tool mark Examiners Conference, Newport Beach, CA July 2001

R.T. Wyant, M.S. “TASER- Revisited” Association of Firearm and Tool mark Examiners Conference, San Antonio, TX May 2002

R.T. Wyant “Forensic Analysis of Electronic Control Devices”, Tactical TASER Conference Fountain Springs AZ July 2009

R.T. Wyant, T. Burns “Forensic Investigation of Electronic Control Devices (TASER)”-Workshop Association of Firearm and Tool mark Examiners Conference, San Francisco, CA May 2007 Association of Firearm and Tool mark Examiners Conference, Henderson, NV May 2010

7 FIREARMS REFERENCE COLLECTIONS

7.1 POLICY

The CLD Firearms collections maintained for reference purposes, housed in individual laboratories, shall be tracked on a firearms database. Reference firearms shall be kept in secure areas. Access to firearms is limited to Firearms Section personnel, laboratory management, and designated auditors. Firearms are considered controlled items that are subject to annual audits. At a minimum, every other year will be a 100% audit. The other years can be as low as 10% of the collection. Firearms will be audited yearly by the Standards and Accountability Section or designee; a report will be issued to the CLD Commander and WSP Risk Management Division.

7.2 RECEIPT

Firearms received into the CLD after March 1, 2008, must be accompanied by a written record of the transaction, signed and dated by an employee of the receiving laboratory. At least one of the following must be included in the written record:

- A court order signed by a Judge, or authorization from the Prosecuting Attorney, directing the surrender of the firearm to the Laboratory or Division, or the sale or destruction of the firearm;
- A document releasing the firearm to the Division or Laboratory, signed by the head of a police force or police agency or his/her assigned representative, who is authorized to use, sell or destroy the firearm;
- A signed statement by a private citizen releasing the firearm to the Division or Laboratory;
- Firearms purchased by the laboratory will have a record of the purchase transaction according to Property Acquisition.

All new weapons received into the collection will be checked through LEDS/NCIC by the donating Agency to determine if stolen. All discrepancies will be resolved before accepting the weapon. A hard copy print out of the results of the weapon check will be attached to the paperwork on the weapon. Retention of this paperwork will be the same as the other paperwork on the weapon as outlined in this procedure. The laboratory that initially receives a firearm into its collection shall retain the above-required paperwork as long as the laboratory holds the firearm. Weapons received prior to March 1, 2008, should comply with this requirement as thoroughly as possible realizing some records from years ago may not be available or reproducible.

7.3 FIREARM COLLECTIONS INVENTORY CONTROL PROCEDURE

Each firearm in the laboratory collection shall be assigned, clearly marked and tagged with a distinct and permanent inventory number and listed in the Laboratory Firearms database. Employees should ensure that all firearms are returned to their proper storage locations after use.

Each laboratory shall maintain records for each firearm in its collection, documenting the following by inventory number in the laboratory database:

- A description of the firearm, including make, model, caliber and serial number.
- The date the firearm was added to the laboratory's firearm collection (if known)
- The date the firearm is destroyed, transferred or released from the collection, by whom, and the disposition.

7.4 AUDITS

The Standards and Accountability Section or designee shall conduct a physical inventory of the laboratory firearm collection to verify the accuracy of the laboratory records and correct any discrepancies in the firearms database. The laboratory firearms collection inventory will be conducted annually.

A copy of the verified inventory shall be retained for review during the annual audit for that laboratory.

7.5 TRANSFER

Firearms transferred permanently within the Division, from one laboratory collection to another, shall be accompanied by a document listing the date of transfer, the laboratory inventory number(s), description of the firearm(s) and serial number(s), and signed by an employee of the originating lab. An employee of the receiving laboratory shall sign the transfer document and return a copy of the signed document to the originating laboratory. Both laboratories shall maintain a copy of the transfer document. The CLD Firearms database will also be updated with the transfer information.

7.6 DISPOSAL/PERMANENT RELEASE

Destruction of firearms shall be accomplished through the WSP Supply section. The disposal or permanent release of any firearm from the Laboratory firearm collection must be authorized by a document signed by two Division employees, one of whom shall be a CLD supervisor. The document shall identify the firearm(s) released, including the serial number and state the intended disposition of the firearm(s). The Division Commander will have prior information of the action. The document will also act as a receipt when signed by the person receiving the weapon.

7.7 RECORDS RETENTION

Records of the receipt, transfer and disposal of all firearms in the Division collection will be retained, and readily available, in accordance with Agency records retention policies.

7.8 AMMUNITION

Ammunition collections maintained for reference purposes shall be kept in secure areas. Powder and ammunition stores shall be kept in cool, dry locations.