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FIREARMS

TOOLMARKS

APPENDICES

FA-I-1

PHYSICAL EXAMINATION and CLASSIFICATION of FIREARMS

1.0 INTRODUCTION

1.1 The initial examination of any firearm will include the completion of a firearm worksheet. This worksheet will include the manufacture data of the firearm and will serve as a source to document the condition of the firearm as received and any tests performed to or with the firearm. (See Appendix 4)

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Pre-Firing Safety Checks

1.2.3 Trigger Pull Examination

1.2.4 Barrel and Overall Length Measurements

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

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

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 A firearm worksheet should be filled out according to Minimum Standards and Controls. This may include determining the following:

6.1.1 Caliber/Gauge

6.1.2 Make/Model

6.1.3 Serial number

6.1.4 Firing mechanics

6.1.5 Type of action

6.1.6 Safeties

6.1.7 Operating condition

6.1.8 Trigger pull

6.1.9 Rifling characteristics

6.1.10 Barrel length

6.1.11 Overall length

6.1.12 Any other data as per Appendix 4

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.12 Worksheets

8.0 REFERENCES

8.1 NONE

FA-I-2

SAFE FIREARM HANDLING

1.0 INTRODUCTION

1 .1 Firearm evidence in the laboratory environment is not dangerous if handled correctly and treated with respect. Occasionally, loaded firearms are received in evidence for a particular examination. These, of course, need very special handling. All firearms must be treated as though they are loaded. This rule cannot be over stressed and must be followed at all times, whether it's in the evidence receiving area, the firearm section, the test firing area, or in court. Safe firearm handling within the laboratory environment corresponds with safe firearm handling in general. The only way to prevent accidents is to practice safety at all times.

1.2 OTHER RELATED PROCEDURES

1.2.1 Physical Examination and Classification of Firearms

1.2.2 Pre-Firing Safety Checks

1.2.3 Trigger Pull Examination

1.2.4 Barrel and Overall Length Measurements

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

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

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

The muzzle of the firearm must always be pointed in a safe direction. Prior to any examination, regardless of which section is receiving the firearm, a competent individual must ascertain the loaded or unloaded condition of the firearm. This process must be accomplished before the firearm is subjected to scientific examination and performed according to each laboratory section's particular guidelines. Test firing or any examination of the firearm that utilizes live ammunition, or a live ammunition component, will only be performed in the Firearm Section or designated test firing areas. A firearm will not be returned to the evidence room or returned to any agency in a loaded condition.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 NONE

8.0 REFERENCES

8.1 "A Guide to Firearms Safety", A Safety and Educational Publication of the National Rifle Association, May 1994.

8.2 "Technical Protocols for the Handling of Firearms and Ammunition", FBI, June 1 992.

FA-I-3

PRE-FIRING SAFETY EXAMINATION

1.0 INTRODUCTION

1 .1 It is the responsibility of the firearm examiner to ensure that all appropriate safety function checks are performed on a firearm or item of ammunition prior to test firing. Following is a list of safety checks, which shall be considered. The examiner must be mindful that individual case situations may require a more extensive function test process than that which is listed here.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

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

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Deciding Whether Or Not A Firearm Can Be Safely Test Fired From The Normal Hand Held Position

6.1.1 Is the chamber/bore clear?

6.1.2 Are there any signs of cracks or weaknesses in major parts of the firearm, such as the frame, slide or barrel?

6.1.3 Does the firearm function, lock-up, or dry fire, as you would expect it to?

6.1.4 Is the correct ammunition being utilized?

6.2 Is It Appropriate to Utilize the Evidence Ammunition?

6.2.1 Are there signs of reloading? If so, reconsider the need to test fire the evidence ammunition.

6.2.2 Are there splits in the cartridge case neck and/or other significant damage to the cartridge case?

6.2.3 Is the ammunition of the correct caliber? This assessment of caliber cannot be based on the head stamp!

6.2.4 Are there existing toolmarks on pertinent surfaces of the ammunition?

6.2.5 Is the ammunition needed for other tests; i.e., range determinations?

6.3 Muzzle Loaders.

6.3.1 Does the chamber/barrel appear sound?

6.3.2 Do the percussion nipples have oversize flash holes?

6.3.3 If a black powder firearm is received in the loaded condition, it must have the bullet and charge removed. It may then be properly loaded prior to test firing.

6.3.4 Is this an "original" muzzleloader or a modern reproduction? "Originals" must always be remote fired.

6.4 INTERPRETATION OF RESULTS:

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

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 NONE

FA-I-4

TRIGGER PULL EXAMINATION - ARSENAL (POSTAL) WEIGHTS

1.0 INTRODUCTION

1.1 One of the routine examinations conducted in a firearm identification examination is determining the trigger pull of a firearm. Trigger pull is defined as the amount of force, which must be applied to the trigger of a firearm to cause sear release. This examination can provide vital information regarding the mechanical operating condition of the firearm. The trigger pull of a firearm can be obtained utilizing arsenal (postal) weights. Insofar as possible, the "official" NRA method of measuring trigger pulls will be utilized. The official method is hereby paraphrased from the NRA Small bore Rifle Rules, NRA Pistol Rules, and NRA High Power Rifle Rules (all Jan. 1, 1999): The firearm shall be held with the barrel perpendicular to the horizontal surface on which the test weights are supported. The rod or hook of the test weights shall rest on the lowest point of the curve in curved triggers or on a point approximately 1/4 to 1/2 inch from the lower end of straight triggers. To pass the weight test, a weight of the correct number of pounds shall be lifted by the firearm trigger while in the cocked position and while all safety devices are in firing positions, from the horizontal surface on which it is resting, until the weight hangs free and without releasing the trigger.

1.2 OTHER RELATED PROCEDURES

1.2.1 Physical Examination & Classification of Firearms

1.2.2 Safe Firearm Handling

1.2.3 Trigger Pull Examination - Spring Gauge

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

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

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Arsenal Weights

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 SINGLE ACTION TRIGGER PULL

6.1.1 Insure that the firearm is unloaded.

6.1.2 Cock the firearm.

6.1.3 Hold the firearm with the muzzle vertical.

6.1.4 Rest the trigger hook of the arsenal (postal) weight hanger on the trigger at the lowest point of the curve of the trigger when the barrel is held vertically, or if this is not possible, on a point approximately 1/4 to 1/2 inch from the lower end of straight triggers, making sure it is not touching any other part of the firearm, with the weights hanging parallel to the bore of the firearm.

6.1.5 Add weights until the sear releases.

6.1.6 Check the trigger pull a sufficient number of times to assure confidence in the figure obtained, resetting the sear connection after each attempt. It is recognized that measuring a trigger pull is not as straightforward as weighing a bullet on an electronic balance. Due to incorrect positioning of the hook, holding the barrel off vertical, or a particularly vigorous lifting of the trigger pull device imparting an inertial skew, several attempts are generally necessary to assure an accurate trigger pull category is assigned. Do NOT record any of these incorrectly obtained measurements. Assign the firearm to the appropriate trigger pull weight category as offered in the Firearm Worksheet. If it is found that a particular trigger "breaks" very near an even pound or half pound (the cutoff between trigger pull categories), continue to repeat the trigger pull test until the appropriate pull category can be assigned with confidence. The fact that the trigger breaks very near the cutoff between trigger pull categories should be noted in the Remarks Section of the Firearm Worksheet. Note any revolver cylinder chamber that alters the trigger pull.

6.1.7 It should be noted that measuring the trigger pull of a rimfire firearm on an empty chamber may result in damage to the chamber of the firearm. If the potential for damage exists from dry firing, then a "dummy" cartridge should be used. The examiner must also take into consideration the potential for damage of a center fire firearm and may wish to use a "dummy" cartridge in this instance as well.

6.3 DOUBLE ACTION TRIGGER PULL

6.3.1 Insure that the firearm is unloaded.

6.3.2 Hold the firearm with the muzzle vertical.

6.3.3 Rest the trigger hook of the arsenal (postal) weight hanger on the trigger at the lowest point of the curve of the trigger when the barrel is held vertically, or if this is not possible, on a point approximately 1/4 to 1/2 inch from the lower end of straight triggers, making sure it is not touching any other part of the firearm, with the weights hanging parallel to the bore of the firearm.

6.3.4 Add weights until the weights pull the trigger through the double action sequence and the sear releases.

6.3.5 Check the trigger pull a sufficient number of times to assure confidence in the figure obtained, resetting the sear connection after each attempt. It is recognized that measuring a trigger pull is not as straightforward as weighing a bullet on an electronic balance. Due to incorrect positioning of the hook, holding the barrel off vertical, or a particularly vigorous lifting of the trigger pull device imparting an inertial skew, several attempts are generally necessary to assure an accurate trigger pull category is assigned. Do NOT record any of these incorrectly obtained measurements. Assign the firearm to the appropriate trigger pull weight category as offered in the Firearm Worksheet. If it is found that a particular trigger "breaks" very near an even pound or half pound (the cutoff between trigger pull categories), continue to repeat the trigger pull test until the appropriate pull category can be assigned with confidence. Again, record only the correct trigger pull category. The fact that the trigger breaks very near the cutoff between trigger pull categories should be noted in the Remarks Section of the Firearm Worksheet. Note any revolver cylinder chamber that alters the trigger pull.

6.3.6 It should be noted that measuring the trigger pull of a rimfire firearm on an empty chamber may result in damage to the chamber of the firearm. If the potential for damage exists from dry firing, then a "dummy" cartridge should be used. The examiner must also take into consideration the potential for damage of a center fire firearm and may wish to use a "dummy" cartridge in this instance as well.

6.4 INTERPRETATION OF RESULTS:

6.4.1 The results acquired are only an approximation and a different technique may lead to a different trigger pull weight. The trigger pull is recorded as a part of a trigger pull category, (such as 4.0 to 4.5 pounds - meaning that 4.0 pounds can be lifted without causing the hammer/striker to fall off sear but 4.5 pounds will cause the hammer/striker to fall). The accumulated trigger pulls form a database which can be used to ascertain whether the status of a particular trigger pull is "lighter than normal," "normal," or "heavier than normal". By applying a rough approximation of one standard deviation to the trigger pull database the status of a particular trigger pull can be determined. Generally, if a trigger pull is determined to be "lighter than normal" this fact should be reflected in the Results Section of the Firearm Worksheet and also in the written Laboratory Report. Because opinions vary between experts on what constitutes a "light," "normal," or "heavy" trigger pull suggested wording of this fact might read something like: The single action trigger pull of Item # I was between 2.5 and 3. 0 pounds. This can be considered a lighter-than-normal trigger pull.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Gamboe, Tom, "MAFS Firearms Workshop: Trigger Pull Methods," AFTE Journal, Vol. 18, No. 3, p. 77.

8.2 Rios, Ferdinand and Thornton, John, "Static vs. Dynamic Determination of Trigger Pull," AFTE

FA-I-5

TRIGGER PULL EXAMINATION - SPRING GAUGE

The State of Alaska Crime Lab does not utilize spring gauges for the testing of trigger pulls.

FA-I-6

BARREL and OVERALL LENGTH MEASUREMENT of a FIREARM

1.0 INTRODUCTION

1.1 One of the routine procedures conducted in a firearm identification examination is determining the barrel length and in some cases the overall length of a firearm. Barrel length is defined as the distance between the end of the barrel and the face of the closed breechblock or bolt for firearms other than revolvers. On revolvers, it is the overall length of the barrel including the threaded portion within the frame. Barrel length normally should include compensators, flash hiders, etc., if permanently affixed. Overall length of a firearm is defined as the dimension measured parallel to the axis of the bore from muzzle to a line at right angles to the axis and tangent at the rearmost point of the butt plate or grip. Removable barrel extensions, poly chokes, flash hiders, etc., are not part of the measured barrel length or overall length.

1.2 OTHER RELATED PROCEDURES

1.2.1 Physical Examination & Classification of Firearms

1.2.2 Uncertainty of Measurement Study of ruler measurement (see Appendix 9).

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

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

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Ruler, and/or

4.2 Tape Measurer, and/or

4.3 Non-marring Dowel

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Care must be taken if any object is placed down the barrel to help facilitate the measurement. Only a non-marring item may be placed down the barrel, and only after all other examinations are performed

6.2 BARREL LENGTH:

6.2.1 REVOLVERS:

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

6.2.1.2 This measurement will be recorded in inches as specified by laboratory policy.

6.2.2 FIREARMS OTHER THAN REVOLVERS:

6.2.2.1 The measuring technique for gun barrel length, a method devised by Forensic Scientist Robert Shem, uses a long wooden dowel with a modified 2 mL plastic microcentrifuge tube positioned to slide along the length of the dowel. The rod slides down the length of the gun barrel and the plastic tube slides down the dowel until it contacts the tip of the barrel. Once the length of the barrel is demarcated on the dowel rod with the plastic tube, the rod is laid on a NIST traceable ruler. If the measurement falls between two of the smallest hash marks on the ruler, the measurement will be rounded up. The process is repeated as a check on the measurer's accuracy. If the 2nd barrel length measurement is the same as the 1st, there is assurance of the barrel length, but if the two measurements differ, the process will be repeated until a consistent result is obtained.

6.3 OVERALL LENGTH:

6.3.1 Measure the distance from the butt to the muzzle. Measurement shall be made parallel to the bore and record in inches as specified by laboratory policy.

6.4 INTERPRETATION OF RESULTS:

6.4.1 Measurements obtained should be considered only approximations based on the device used to obtain the measurements. These measurements are usually measured as specified by laboratory policy.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 "The Proper Method for Measuring Weapons", AFTE Journal, Vo1.14, No. 3, p. 10.

FA-II-1

RUSTY FIREARM EXAMINATION

1.0 INTRODUCTION

1.1 Rusty firearms or those found in water, etc. may be submitted for examination. Immediate attention must be given to wet firearms to prevent further damage to the firearm. The examiner should instruct an agency recovering the firearm in a fluid such as fresh water, to submit the firearm in a container of the fluid. If this is not practical, the firearm can be sprayed with a product that displaces water. In case of firearms being recovered from salt water the examiner should instruct the agency to transport the firearm to the nearest facility where a potentially loaded gun can be handled safely. The gun should be immediately transported while completely submerged in water, either salt or fresh. The firearm should then be completely flushed of any residual salt water and silt. Once the gun is completely free of salt and silt then the procedure outlined in #6 below should be suggested to the agency. The actual procedures offered to the agency may be modified based on Trace evidence, Latent Fingerprint concerns, etc. It should be noted that the firearm may be too rusty to be functional.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Physical Examination & Classification of Firearms

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

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

2.3 Any firearm that cannot be unloaded must be examined in an area designated for firing firearms (preferably a range).

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Determine if the firearm is loaded and if it is, unload the firearm. If it cannot be readily verified to be unloaded it must be examined in an area designated for the firing of firearms.

6.2 An examiner must take all necessary steps to insure that the firearm is unloaded. This may include the necessity of cutting the firearm apart.

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

6.4 Soak the firearm in penetrating oil, de-rusting solvents or similar material.

6.5 Periodically check the firearm until the firearm functions, or the desired information is recovered.

6.6 Clean the firearm with gun cleaning solvent and cleaning patches. Care must be taken if any object is placed down the barrel to help expedite the measurement. Only a non-marring item may be placed down the barrel, and only after all other tests are performed.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Denio, Dominic, "Making a Rusted Gun Functional," AFTE Journal, Vol. 13, No. 3, p. 29

FA-II-2

SILENCER EXAMINATION

1.0 INTRODUCTION

1.1 A silencer or sound suppressor is any device attached to the barrel of a firearm designed to reduce the noise of discharge. Silencers can be commercially produced or homemade. They are typically tubular metal devices, but may vary in shape or form. Even a 2-liter soda bottle can be used as a silencer.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Physical Examination & Classification of Firearms

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

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

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Examine device to determine if it is, or is characteristic of, a silencer or sound suppression device.

6.2 Examiner will document and record his/her findings. After an initial examination, a report can be issued that the device is, or is characteristic of, a silencer or sound suppression device.

6.3 Testing of a firearm and firearm/silencer combination must be conducted in an appropriate setting, usually a range. The report of the firearm discharge with and without the silencer attached will be subjectively assessed while wearing hearing protection. Once it is ascertained that the silencer is capable of attenuating the report to a safe level, additional assessment of the silenced report can be done without hearing protection.

6.4 The examiner must consider assessing multiple reports both with the silencer affixed to the firearm and the firearm alone.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Silencers - A Review and a Look at the State of the Art," AFTE Journal, Vol. 23, No. 2, p. 668.

8.2 Crum, Richard A. and Owen, Edward M., "Silencer Testing," AFTE Journal, Vol. 21, No. 2, p. 433.

FA-II-3

MALFUNCTIONING FIREARM EXAMINATION

1.0 INTRODUCTION

1.1 A firearm examiner may be called upon to examine a firearm to determine if the firearm will malfunction. The majority of these cases deal with the question "Will the firearm fire without pulling the trigger?" In these examinations, it is the goal of the examiner to acquire a detailed account of the incident by thoroughly examining and testing the firearm. This may include external and internal examinations, x-ray examinations, or striking or dropping the firearm in attempts to duplicate the actions of the firearm at the time of discharged. The examiner should attempt to keep the firearm in the same condition as received. However, there may be times that the original condition of the firearm may be altered in attempts to determine the cause of the malfunction. During these times, the examiner must specifically document these changes in his/her notes. The requesting agency officer may or may not be contacted, as this is a routine function for a firearm examiner. See FA-II-5 (Reference Collection) for discussion of the use of reference firearm parts to apply temporary fixes to damaged or incomplete firearms.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Primed Cases

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

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

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 No one procedure can sufficiently outline the steps necessary to examine all firearms for any malfunction. However, the following list of examinations should serve as a guideline for the examiner

6.1.1 Physical Check (Condition of Firearm as Received):

6.1.1.1 Cocked/uncocked

6.1.1.2 Safety position

6.1.1.3 Loaded/unloaded

6.1.1.4 Cartridge position

6.1.1.5 Stuck cartridges/discharged cartridge cases

6.1.1.6 Presence and/or location of flares

6.1.1.7 If the firearm is to be x-rayed, this may be the time to do it.

6.1.2 Visual Abnormalities:

6.1.2.1 Barrel (loose, etc.)

6.1.2.2 Receiver (condition)

6.1.2.3 Slide (condition)

6.1.2.4 Parts broken or missing especially;

6.1.2.4.1 the firing pin,

6.1.2.4.2 the ejector or

6.1.2.4.3 the extractor

6.1.2.5 Screws (loose or missing)

6.1.2.6 Alterations or adaptations

6.1.2.7 Sights

6.1.3 Action (External):

6.1.3.1 Are the relationships of the action parts correct?

6.1.3.2 Is the assembly correct?

6.1.3.3 Does the action lock normally on closing?

6.1.3.4 Cylinder rotation (securely locks).

6.1.3.5 Hand relationship to the ratchet (worn).

6.1.3.6 Trigger (not returning, sticks, broken spring, etc.)

6.1.3.7 Check the trigger pull (single action, double action) and striking of hammer.

6.1.4 Safeties:

6.1.4.1 1/4, 1/2, full cock, seating check (any false seating positions, pull off/push off, etc.)

6.1.4.2 Grip, magazine, and disconnector: function

6.1.4.3 Thumb/finger - note positions when firearm will fire

6.1.4.4 Rebound hammer or inertia firing pin

6.1.4.4.1 Will firing pin ride on primers?

6.1.4.4.2 Is firing pin frozen or bent?

6.1.4.4.3 (Drop hammer several times to check above safeties.)

6.1.4.5 Does the slide or bolt have to be completely closed to fire?

6.1.4.6 Can the safeties be bypassed?

6.1.4.6.1 Will dropping hammer bypass safeties? (This may require primed cartridge tests.)

6.1.4.6.2 Will a light blow on the rear of the hammer, when it is in battery, discharge the primer?

6.1.4.6.3 Is the firing pin impression significantly off center (both single action and double action operation)?

6.1.5 Action Check:

6.1.5.1 Check feeding

6.1.5.1.1 magazine

6.1.5.1.2 carrier or lifter

6.1.5.1.3 feed ramp

6.1.5.1.4 magazine lips, etc.

6.1.5.2 Will a cartridge fire on closing of the bolt or slide?

6.1.5.3 Extractor and/or ejector markings on evidence cartridges/discharged cartridge cases consistent and/or normal?

6.1.5.4 Unusual marks exhibited on the cartridges/discharged cartridge cases.

6.1.6 Check for any inherent "quirks" known about the particular firearm based on literature or case data.

6.1.7 Test Fire Firearm (note operation, misfires, etc.):

6.1.7.1 Note any operational problems.

6.1.7.2 Ammunition involved (proper cartridge, type, reloads, etc.).

6.1.7.3 Check consistency of the impression on test and evidence.

6.1.8 Special Situational Tests:

6.1.8.1 Discretion should be considered in situational testing if the force needed could disturb the internal action and/or cause changes, which might prevent determining the exact cause of the malfunction.

6.1.9 Action (Internal)

6.1.9.1 Hammer notch(s)

6.1.9.1.1 Worn

6.1.9.1.2 Burrs

6.1.9.1.3 Dirt, etc.

6.1.9.2 Sear

6.1.9.2.1 Worn

6.1.9.2.2 Broken

6.1.9.2.3 Burrs, etc

6.1.9.3 Safeties (relationships and general parts relationship).

6.1.9.4 Springs

6.1.9.4.1 Weak

6.1.9.4.2 Broken

6.1.9.4.3 Altered, etc

6.1.9.5 Signs of any tampering or faulty assembly.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Thompson, Roger C., "Firearms Malfunction Worksheets," AFTE Journal, Vol. 15, No. 1, p. 100.

8.2 American National Standards Institute, Inc., "American National Standard Voluntary Industry Performance Standards Criteria for Evaluation of New Firearms Designs Under Conditions of Abusive Mishandling for the Commercial Manufacturers". (ANSIISAAMI 2299.5-1 985), November 1985.

FA-II-4

BORE CHAMBER CASTING

1.0 INTRODUCTION

1.1 Occasionally, firearms are received for which the caliber may not be known or may be different than is designated on the firearm and in the literature. In order to facilitate firing of test shots that are of the correct caliber for a particular firearm, it may be necessary to make a bore and/or chamber cast. Then, by measuring the cast, the correct cartridge can be determined.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

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

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Casts can be made using various casting materials such as low melting point metals and silicone rubber compounds. The procedure below is for Mikrosil™ and Cerrosafe™.

6.1.1 Insure that the firearm is unloaded.

6.1.2 Open the action and remove the bolt or bolt assembly.

6.1.3 Check the bore to make sure it is clear.

6.1.4 Push a cleaning patch in the barrel, from muzzle end, until it is about ¼ inch from the beginning of the chamber.

6.1.5 Oil the chamber with gun oil or a silicone spray (e.g., WD 40™).

6.1.6 Mix Mikrosil™ as per manufacture instructions or melt Cerrosafe™ and carefully pour into the chamber until full.

6.1.7 Do not allow casting material to flow into breech. It will make extraction difficult.

6.1.8 When casting material is set or cool, depending on type used, gently tap end of cleaning rod to loosen cast from the chamber and remove from the breech.

6.1.9 If the cast, for some reason, cannot be loosened from the chamber, Cerrosafe™ can be melted out of the barrel. This is accomplished by removing the stock and placing breech end in a large container of water and heating to just above its melting temperature.

6.1.10 Cerrosafe™ can be reused as necessary.

6.1.11 Mikrosil™ has to be pushed/forced out and is not reusable. Therefore, it is undesirable to let any more of the casting material than necessary go into the barrel.

6.1.12 The same steps may be used in the casting of the bore. However in bore casting, usually only the last three (3) inches of the bore need to be cast.

6.2 INTERPRETATION OF RESULTS:

6.2.1 The correct caliber of the firearm can be determined by measuring the mouth, base, overall length, rim (if pertinent), and shoulder length of the cast.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 NONE

8.0 REFERENCES

8.1 Striupaitis, Peter P., "Bore Casting Techniques for Caliber Designation of Rifles," AFTE Journal, Vol. 15, No. 2, p. 88.

8.2 Poole, Robert A., "Mikrosil Casting Material Information," AFTE Journal, Vol. 15, No. 2, p. 80.

FA-II-5

FIREARM REFERENCE COLLECTION

1.0 INTRODUCTION

1.1 A Firearm Reference Collection is maintained by the laboratory for various scientific reasons, to include:

1.1.1 To identify the make, model, and source of evidence firearms.

1.1.2 To provide exemplar firearms for various scientific testing purposes which might otherwise compromise an evidence firearm.

1.1.3 To provide an exemplar resource for training new forensic scientists/evidence technicians or in developing new technology for the scientific examination of firearms.

1.1.4 To provide a source of firearms parts for the temporary repair of evidence firearms for test-firing purposes.

1.1.5 To provide a resource for the identification of firearms parts recovered at a crime scene.

1.1.6 To provide a resource for the location and style of firearm serial numbers.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Ammunition Reference Collection

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 A Firearm Reference Collection must be maintained under strict regulations and controls. Firearms which are deemed unsuitable for scientific purposes should be verifiably destroyed. The laboratory and specifically the firearm identification section normally assumes all responsibility for security, control and disposition of these firearms.

6.2 A record should be made as soon as practical after the receipt of a firearm intended for the reference collection, into a "CRIME LAB GUN COLLECTION" log. This entry should include, where applicable;

6.2.1 Lab Log number (each gun added to the collection is given the next sequential number, eg. yyA####, where "yy" is the year, "A" indicates the Anchorage-based Crime Lab location, and "#### is a sequential number, starting with 0001 assigned to the first gun of the year)

6.2.2 Storage location (the specific nail peg, or shelf location, etc.)

6.2.3 Caliber

6.2.4 Make

6.2.5 Model

6.2.6 Serial Number

6.2.7 Gun type

6.2.8 NCIC code

6.2.9 "Status" of the firearm (whether it is currently in the collection or not)

6.2.10 Disposition (once the firearm leaves the collection)

6.2.11 Any previously assigned agency case number.

6.3 The "CRIME LAB FIREARM COLLECTION" log is a computerized database which is tracked in the Crime Laboratory's LIMS (Laboratory Information Management System). The information recorded for each firearm is listed in 6.2 above.

6.4 If the submitting agency does not accompany the firearms with an official transfer form, it is recommended that a receipt be issued for every firearm received for the reference collection or destruction utilizing a standardized form. The respective log number assigned to each firearm should be recorded on this form. Copies of all documents accompanying a firearm will be scanned and stored in the laboratory's LIMS.

6.5 The firearm reference collection should be displayed and maintained in such a manner as to prevent deterioration to the firearms and to facilitate their inventory, safety and control.

6.6 All firearms received for reference or disposal should have their assigned log number inscribed on the frame and/or receiver. Furthermore, all firearms placed in the reference collection should be tagged or marked in such a manner so as to display that firearm's location within the collection.

7.0 7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 NONE

8.0 REFERENCES

8.1 AFTE Glossary, 3rd Edition

FA-II-6

AMMUNITION REFERENCE COLLECTION

1.0 INTRODUCTION

1.1 The Ammunition Reference Collection is defined as a collection or cataloging of both cartridges and components utilized for various scientific reasons, to include:

1.1.1 To identify the manufacturer's cartridge designation and source of evidence ammunition or component parts thereof.

1.1.2 To provide an exemplar resource for training new forensic scientists/evidence technicians or in developing new technology for the scientific examination of firearms.

1.1.3 To provide a resource for the identification of ammunition components recovered at a crime scene.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Firearms Reference Collection

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 The nature of the laboratory's ammunition reference collection will be dictated or limited by the space, storage containers and computer equipment available. However the following should be considered;

6.1.1 Use of architect blue print cabinets or similar style cabinets for storage of the collection.

6.1.2 Use of clear plastic tubes or boxes for storage of each ammunition entry, each entry consisting of at least one whole cartridge and one cartridge broken down into its component parts.

6.1.3 Recording cartridge information such as:

6.1.3.1 Manufacturer

6.1.3.2 Bullet weight

6.1.3.3 Bullet style or configuration

6.1.3.4 Manufacturer's Index

6.1.3.5 Headstamp

6.1.3.6 Other pertinent information

6.1.4 Each item in the Firearms Bullet Collection is to be uniquely identified and documented. The collection will be housed in storage containers utilizing caliber and/or other manufacturer's data as appropriate to organize. When a comparison is made and reported, the specific ammunition reference standard utilized must be identified in the case file.

6.1.5 A spreadsheet will be created that contains a listing of all handgun and long gun ammunition in the collection. This spreadsheet will be routinely maintained to reflect changes.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 NONE

8.0 REFERENCES

8.1 AFTE Glossary, 3rd Edition

FA-III-1

WATER RECOVERY TANK

1.0 INTRODUCTION

1.1 In order to perform a microscopic comparison of a submitted firearm, a minimum of two test shots (or test fires) should be fired and recovered. Recovery methods include the water tank, the cloth 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, rifles, and slugs fired from shotguns.

Test shots or test fires are treated as evidence, and therefore:

- given a unique item number,
- tracked from the time of creation, and
- packaged for return to the agency with the firearm used to produce them.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Remote Firing

1.2.3 Downloading

1.2.4 Primed Cases

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

2.2 Appropriate hearing and eye protection must be used.

2.3 The examiner must consider the practicality and/or desirability of wearing some form of bullet resistant clothing.

2.4 One should be aware of the maximum velocity of the projectile that can be fired into a particular water tank, as well as the proper water depth needed for firing.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 laboratory case number and/or

6.1.2 item number and/or

6.1.3 examiner's markings.

6.2 The examiner should consider indexing and sequencing each shot and perform these functions if necessary.

6.3 Proper hearing and eye protection must be worn.

6.4 Ensure that the water level is appropriate.

6.5 Ensure that all lids or doors of the water recovery tank are closed.

6.6 Ensure that the exhaust fans or system is turned on.

6.7 Ensure that the range door is closed.

6.8 The examiner should consider loading no more than two (2) cartridges into the firearm during the initial testing of the firearm.

6.9 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.

6.10 Recover the bullets using a net, pole, or some other appropriate device.

6.11 Ejected discharged cartridge cases must be retrieved. Devices to catch the discharged cartridge cases are commercially available.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 NONE

8.0 REFERENCES

8.1 "New Ballistics Tank from Detroit-Armor Corporation Allows Fast Recovery Without Projectile Distortion." AFTE Journal, Vol. 16, No. 3, p.106.

8.2 "Bullet and Cartridge Case Recovery", AFTE Journal, Vol. 16, No. 2, p.75.

FA-III-2

CLOTH RECOVERY BOX

1.0 INTRODUCTION

1 .1 In order to perform a microscopic comparison of a submitted firearm, a minimum of two test shots (or test fires) will be fired and recovered. Recovery methods include the water tank, the cloth recovery box, and the bullet trap. The type of firearm and ammunition tested will usually dictate the type of recovery method used. The cloth recovery box is usually used to recover bullets from handguns, rifles, and slugs fired from shotguns.

Test shots or test fires are treated as evidence, and therefore:

- given a unique item number,
- tracked from the time of creation, and
- packaged for return to the agency with the firearm used to produce them.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Remote Firing

1.2.3 Downloading

1.2.4 Primed Cases

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

2.2 Appropriate hearing and eye protection must be used.

2.3 The examiner must consider the practicality and/or desirability of wearing some form of bullet resistant clothing.

2.4 One should be aware of the maximum velocity of the projectile that can be fired into a particular cloth recovery box.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 the laboratory case number and/or

6.1.2 the item number and/or

6.1.3 the examiner's markings.

6.2 The examiner should consider indexing and sequencing each shot and perform these functions if necessary.

6.3 Proper hearing and eye protection must be worn.

6.4 The examiner should consider wetting the first section of cloth in the box.

6.5 The examiner should consider the placement of paper partitions at various points in box to ensure tracking of the test shot, as well as insuring that the cloth is packed down so as not to retain previous bullet paths.

6.6 Ensure that the lid of the box is closed.

6.7 Ensure that the exhaust fans or system is turned on.

6.8 Ensure that the range door is closed.

6.9 The examiner should consider loading no more than two (2) cartridges into the firearm during the initial testing of the firearm.

6.10 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.

6.11 Bullets should be recovered by searching through cloth, using partitions as guides.

6.12 Ejected cartridge cases must be retrieved. Devices to catch the discharged cartridge cases are commercially available.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 NONE

8.0 REFERENCES

8.1 AFTE Journal, February 1973, p.9.

8.2 AFTE Newsletter, 16, p.17.

8.3 "Bullet and Cartridge Case Recovery", AFTE Journal, Vol. 16, No. 2, p.75.

FA-III-3

BULLET TRAP

1.0 INTRODUCTION

1 .1 In order to perform a microscopic comparison of a submitted firearm, a minimum of two test shots or test fires should be fired and recovered. Recovery methods include the water tank, the bullet recovery box (or cotton box), and the bullet trap. The type of firearm and ammunition tested will usually dictate the type of recovery method used. The bullet trap is usually used to test fire firearms when the recovery of the fired projectile(s) is not necessary.

Test shots or test fires are treated as evidence, and therefore:

- given a unique item number,
- tracked from the time of creation, and
- packaged for return to the agency with the firearm used to produce them.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Remote Firing

1.2.3 Downloading

1.2.4 Primed Cases

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

2.2 Appropriate hearing and eye protection must be used.

2.3 The examiner must consider the practicality and/or desirability of wearing some form of bullet resistant clothing.

2.4 One should be aware of the maximum velocity of the projectile that can be fired into a particular bullet trap (the current range backstop is said to be capable of absorbing the impact of a 30-06 caliber lead core bullet. For more powerful loads, testing must be done either at an outdoor range facility or the test fired bullets can be fired into an intermediary material, such as a cardboard box filled with paper, which is placed in front of the backstop. It is advisable to consider test firing through intermediary material whenever testing any centerfire rifle. In no cases should armor-piercing or other ammunition designed for perforating hard materials, such as steel, be fired in the bullet trap).

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 The examiner should consider marking the cartridge case and/or shotshell of each test shot with the:

6.1.1 the laboratory case number and/or

6.1.2 the item number and/or

6.1.3 the examiner's markings.

6.2 The examiner should consider indexing and sequencing each shot and perform these functions if necessary.

6.3 Proper hearing and eye protection must be worn.

6.4 Ensure that the exhaust fans or system is turned on.

6.5 Ensure all warning systems are activated.

6.6 The examiner should consider loading no more than two (2) cartridges into the firearm during the initial testing of the firearm.

6.7 Fire the firearm into the front of the trap. If the firearm is capable of firing both single and double action modes, a minimum of one (1) shot per mode should be obtained.

6.8 Ejected cartridge cases must be retrieved. Devices to catch the discharged cartridge cases are commercially available.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 NONE

8.0 REFERENCES

8.1 McBrayer, William S., "What? Another Water Tank and Bullet Stop!" AFTE Journal, Vol. 10, No. 2, p.90.

8.2 "Bullet and Cartridge Case Recovery", AFTE Journal, Vol. 16, No. 2, p.75

FA-III-4

REMOTE FIRING

1.0 INTRODUCTION

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

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Downloading

1.2.3 Primed Cases

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

2.2 Appropriate hearing and eye protection must be used.

2.3 The examiner must consider the practicality and/or desirability of wearing some form of bullet resistant clothing.

2.4 The examiner must follow all safety recommendations set forth by the manufacturer of the shooting device used.

2.5 Due to the potential hazard of the firearm malfunctioning or undergoing a catastrophic failure, the examiner must be stationed behind a protective shield or at a safe distance from the firearm when discharging the firearm.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 The examiner should consider marking the bullet, cartridge case and/or shotshell of each test shot with the:

6.1.1 laboratory case number and/or

6.1.2 item number and/or

6.1.3 examiner's markings.

6.2 The examiner should consider indexing and sequencing each shot and perform these functions if necessary.

6.3 Proper hearing and eye protection must be worn.

6.4 Set up the chosen remote firing device, as per guidelines set forth by the manufacturer, in front of the appropriate recovery system.

6.5 Place firearm in device. It is recommended that the examiner first dry-fire the firearm in the remote firing device before using live ammunition.

6.6 Ensure that the exhaust fans or system is turned on.

6.7 Ensure that the range door is closed.

6.8 The examiner should consider loading no more than one cartridge into the firearm during the initial testing of the firearm.

6.9 Activate the remote device while standing behind a protective shield or while standing at a safe distance away from the firearm.

6.10 Obtain fired tests.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 NONE

8.0 REFERENCES

8.1 Biasotti, A. A., "Vise/Rest for Remote Firing," AFTE Journal, Vol. 11, No. 4, p.16.

FA-III-5

DOWNLOADING

1.0 INTRODUCTION

1.1 Due to the limitations of the firearm identification section's bullet recovery devices, it may be necessary to reduce or change the powder load of the cartridge in order to obtain a velocity suitable for safely collecting test standards for comparison purposes. Even with a reduced load, it may be necessary to fire the firearm remotely.

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Remote Firing

1.2.3 Primed Cases

1.2.4 Water Tank Recovery

1.2.5 Cotton Waste Recovery Box

1.2.6 Bullet Trap

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

2.2 Appropriate hearing and eye protection must be used.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Pull the bullet of the cartridge using an inertia bullet puller or a reloading press.

6.2 Remove existing powder.

6.3 Weigh the pulled bullet.

6.4 Consult a reloading manual, such as the Speer Reloading Manual which contains data for reduced loads, and obtain the powder charge for the weight of the pulled bullet and the new velocity needed.

6.5 Weigh out the appropriate powder charge and place in existing cartridge case.

6.6 Seat the bullet back into the cartridge case using a mallet or a reloading press.

6.7 If appropriate powder is not available, a reduced load using 50% of the original powder can be used. It should be noted that great care must be taken when performing this type of downloading. 50% downloading CANNOT be used with slow burning powders. 50% downloading CANNOT be used with many non-canister powders. In these situations, a small wad of tissue paper should be placed above the gunpowder to hold the gunpowder against the flash hole.

6.8 When utilizing downloaded ammunition it is imperative that the examiner checks the barrel for obstructions between each firing. The bullet, cartridge case, or shotshell of each test shot should be marked appropriately.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

8.0 REFERENCES

8.1 Lyman Reloading Handbook for Rifle, Pistol and Muzzle Loading, Lyman Gun Sight Products, Middlefield, Conn., 1971.

8.2 "Reduced Powder Loads," AFTE Newsletter, No. 3, p.14.

PRIMED CARTRIDGE CASE/SHOTSHELL

1.0 INTRODUCTION

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

1.2 OTHER RELATED PROCEDURES

1.2.1 Safe Firearm Handling

1.2.2 Bullet Trap

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered.

2.2 Appropriate hearing and eye protection must be used.

2.3 The examiner must consider the practicality and/or desirability to wear some form of bullet resistant clothing.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Obtain a primed empty cartridge case in the desired caliber or pull the bullet of a live cartridge using an inertia bullet puller or reloading press, retaining only the primed cartridge case. For shotguns, obtain a primed empty shotshell in the desired gauge or cut open a live shotshell removing all components, retaining only the primed shotshell.

6.1.1 Commercial firing pin testing devices are available for shotguns and may be used.

6.2 Proper hearing and eye protection must be worn.

6.3 Ensure that the exhaust fans or system is turned on.

6.4 Ensure that the range door is closed.

6.5 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.

6.6 When utilizing a primed empty it is imperative that the examiner checks the barrel for obstructions between each firing.

6.7 Repeat if the firearm has more than one action.

6.8 Obtain all tests.

7.0 APPROPRIATE APPENDICES

7.1 NONE

8.0 REFERENCES

8.1 NONE

FA-IV-1

CALIBER DETERMINATION

1.0 INTRODUCTION

1 .1 Caliber, or the base diameter, is one of the class characteristics of a fired bullet. The determination of caliber will aid the examiner during the identification or elimination of a suspect firearm. If no firearm is submitted, the bullet's caliber may be used in determining the General Rifling Characteristics of the firearm involved.

1.2 OTHER RELATED PROCEDURES

1.2.1 Trace Material Examination

1.2.2 GRC Utilization

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Comparison Microscope

4.2 Stereomicroscope

4.3 Calipers/Micrometer

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 Compare the base diameter of the evidence bullet directly with known unfired and/or fired test standards.

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

6.1.3 Determine the number and widths of the lands and grooves and compare to Appendix G, Table 6, of the AFTE Glossary (3rd Edition).

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

6.2 INTERPRETATION OF RESULTS:

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

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Mathews, J. Howard, Firearms Identification Vol. 1, 1973.

8.2 Barnes, Frank C., Cartridges of the World, 7th Edition, 1993.

8.3 Association of Firearm and Toolmark Examiners Glossary, 3rd Edition, 1994.

8.4 Lutz, Monty C. and Ward, John G., "Determination of Bullet Caliber from an X-ray," AFTE Journal, Vol. 21, No. 2, p. 168.

FA-IV-2

MEASURING PROJECTION SCOPE

The State of Alaska Crime Lab does not employ a measuring projection scope in the Firearm/Toolmark Section.

FA-IV-3

AIR GAP

1.0 INTRODUCTION

1.1 One of the class characteristics used in the discipline of firearm identification is the width of the land impressions and groove impressions. These measurements aid the examiner during the identification or elimination of a suspect firearm. If no firearm is submitted, these measurements will be used in determining the General Rifling Characteristics of the firearm involved. Several instruments can be used to obtain these measurements. The air gap procedure utilizes a comparison microscope and a micrometer.

1.2 OTHER RELATED PROCEDURES

1.2.1 Trace Material Examination

1.2.2 GRC Utilization

1.2.3 Stereomicroscope - Micrometer

1.2.4 Stereomicroscope - Ruler

1.2.5 Stereomicroscope - Grid

1.2.6 Measuring Projection Scope

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Comparison Microscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 The fired bullet in question is mounted on one stage of the comparison microscope. The digital micrometer is mounted on the other stage. Both stages must be using the same magnification level (objective setting) and be in focus.

6.1.2 Align the image of the measurement gap (opening) of the micrometer with the image of the appropriate land impression being measured and record the measurement to the nearest hundredth or thousandth of an inch or appropriate measurement.

6.1.3 Repeat the above utilizing the groove impression.

6.2 INTERPRETATION OF RESULTS:

6.2.1 It may be necessary to measure several of each land and groove impression in order to record a reliable measurement.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 U.S. Department of Justice, Federal Bureau of Investigation, NCIC, Criminalistics Laboratory Information System (CLIS) Operating Manual, 1978.

8.2 Walsh, J. F., "Accuracy, Speed and Conversion in Rifling Measurements," AFTE Journal, Vol. 9, No. 1, p. 50.

8.3 AFTE Newsletter, No. 4, December 1969, p. 28.

FA-IV-4

STEREOMICROSCOPE – GRID

The State of Alaska Crime Lab does not employ a stereoscope equipped with a grid measuring system in the Firearm/Toolmark Section.

FA-IV-5

STEREOMICROSCOPE – MICROMETER

The State of Alaska Crime Lab does not employ a micrometer-equipped stereomicroscope in the Firearm/Toolmark Section.

FA-IV-6

STEREOMICROSCOPE – RULER

1.0 INTRODUCTION

One of the class characteristics used in the discipline of firearm identification is the width of the land impressions and groove impressions. These measurements aid the examiner during the identification or elimination of a suspect firearm. If no firearm is submitted, these measurements will be used in determining the General Rifling Characteristics of the firearm involved. Several instruments can be used to obtain these measurements. The stereomicroscope - ruler procedure utilizes a stereomicroscope and a hand held ruler.

1.1 OTHER RELATED PROCEDURES

1.1.1 Trace Material Examination

1.1.2 GRC Utilization

1.1.3 Stereomicroscope - Grid

1.1.4 Stereomicroscope - Micrometer

1.1.5 Air Gap

1.1.6 Measuring Projection Scope

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 The fired bullet in question is either held or mounted on a steady surface beneath the stereomicroscope.

6.1.2 The land impression at the base of the fired bullet is placed perpendicular to the scale of the ruler.

6.1.3 Measure the distance between both anchor points of a land impression and record the measurement to the nearest hundredth or thousandth of an inch or appropriate measurement.

6.1.4 Repeat the above utilizing the groove impression.

6.2 INTERPRETATION OF RESULTS:

6.2.1 It may be necessary to measure several of each land and groove impression in order to record a reliable measurement.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 U.S. Department of Justice, Federal Bureau of Investigation, NCIC, Criminalistics Laboratory Information System (CLIS) Operating Manual, 1978.

8.2 Walsh, J. F., "Accuracy, Speed and Conversion in Rifling Measurements," AFTE Journal, Vol. 9, No. 1, p. 50.

8.3 AFTE Newsletter, No. 4, December 1969, p. 28.

FA-IV-7

GRC UTILIZATION

1.0 INTRODUCTION

1 .1 The FBI's General Rifling Characteristics File can be utilized when attempting to determine a list of possible firearms that could have fired an evidence bullet when the correct firearm was not submitted.

1.2 OTHER RELATED PROCEDURES

1.2.1 Trace Material Examination

1.2.2 Stereomicroscope – Ruler

1.2.3 Stereomicroscope – Grid

1.2.4 Stereomicroscope – Micrometer

1.2.5 Air Gap

1.2.6 Measuring Projection Scope

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 The General Rifling Characteristics File can be accessed using the GRC System of the NCIC, the PC software version, or the current printout of the file.

6.2 Follow the operating instructions listed specifically within each of the above systems utilizing the caliber and rifling characteristics of the evidence bullet.

6.3 INTERPRETATION OF RESULTS:

6.3.1 The GRC File is an investigative aid and should not be construed as an all-inclusive list of firearms available with those particular rifling characteristics.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 U.S. Department of Justice, Federal Bureau of Investigation, NCIC, Criminalistics Laboratory Information System (CLIS) Operating Manual, 1978.

8.2 Walsh, J. F., "Accuracy, Speed and Conversion in Rifling Measurements," AFTE Journal, Vol. 9, No. 1, p. 50.

8.3 AFTE Newsletter, No. 4, December 1969, p. 28.

FA-IV-8

WADDING DETERMINATION

1.0 INTRODUCTION

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

1.2 OTHER RELATED PROCEDURES

1.2.1 Trace Material Examination

1.2.2 Stereomicroscope – Ruler

1.2.3 Stereomicroscope – Grid

1.2.4 Stereomicroscope – Micrometer

1.2.5 Air Gap

1.2.6 Measuring Projection Scope

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Comparison Microscope

4.2 Stereomicroscope

4.3 Micrometer

4.4 Caliper

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Determine gauge size by;

6.1.1 Directly comparing of evidence to known laboratory standards of similar manufacture or composition by comparing the base of evidence to the bases of the standards until a similar size is found.

6.1.2 Measuring the base diameter of the wad and comparing these measurements to known measurements may also determine gauge size.

6.2 Measurements may be obtained by utilizing:

6.2.1 A caliper

6.2.2 The air gap

6.2.3 The stereomicroscope with micrometer/caliper

6.2.4 The stereomicroscope with grid

6.2.5 The stereomicroscope and ruler

6.2.6 The measuring projector.

6.3 Manufacturer's data can be determined by locating information stamped into the wad or by comparing the wad to known laboratory standards.

6.4 Microscopic examination may reveal striations suitable for identification of the wad back to the shotgun that fired it.

6.5 If evidence shotshells are submitted, it may be necessary to disassemble one or more for the determination of gauge size or manufacture.

6.6 Record all information on the appropriate worksheet.

6.7 INTERPRETATION OF RESULTS:

6.7.1 If the wad is mutilated or soaked with blood or other body fluids, the examiner may not be able to specifically determine gauge size. The examiner should also recognize that some manufacturers might duplicate the design of another manufacturer.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 NONE

FA-IV-9

SHOT DETERMINATION

1.0 INTRODUCTION

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

1.2 OTHER RELATED PROCEDURES

1.2.1 Trace Material Examination

1.2.2 Stereomicroscope – Ruler

1.2.3 Stereomicroscope – Grid

1.2.4 Stereomicroscope – Micrometer

1.2.5 Air Gap

1.2.6 Measuring Projection Scope

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Comparison Microscope

4.2 Stereomicroscope

4.3 Micrometer

4.4 Caliper

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 Visual/Microscopic Comparison

6.1.1.1 Determine the total number of pellets received.

6.1.1.2 Determine the composition of the pellets.

6.1.1.3 Determine the number of pellets suitable for comparison purposes. Make note if pellet sizes all appear to be similar in size. If several different sizes are present, determine each specific size.

6.1.1.4 Compare laboratory standards of known shot sizes side by side with the evidence pellets until a known shot size is determined. A stereomicroscope may aid in this determination. This can be done one size at a time or several sizes at a time; however, if more than one size is used at a time, care should be taken not to mix up the shot.

6.1.1.5 Record findings on worksheet.

6.1.2 Comparison by Weight

6.1.2.1 Record the total number of pellets received.

6.1.2.2 Determine the composition of the pellets.

6.1.2.3 Determine the number of pellets suitable for weighing. Make note if pellet sizes all appear similar. If several sizes present, determine each specific size.

6.1.2.4 Weigh the pellets in grams or grains.

6.1.2.5 Divide weight of pellets by total number weighed.

6.1.2.6 Consult known pellet weights in Table 1 of Appendix G of the AFTE Glossary (3rd Edition) and determine shot size, which corresponds to evidence shot.

6.1.2.7 Record findings on appropriate worksheet. The weight of the evidence pellets can also be directly compared to weight of standards using the same number of pellets until a similar known weight is obtained.

6.1.3 Measuring Pellet Size

6.1.3.1 Determine the total number of pellets received.

6.1.3.2 Determine the composition of the pellets.

6.1.3.3 Determine the number of pellets suitable for comparison purposes. Make note if pellet sizes all appear to be similar in size. If several different sizes are present, determine each specific size.

6.1.3.4 Choose the best specimen and measure diameter using a caliper and record in hundredths or thousandths of an inch or the appropriate measurement.

6.1.3.5 Consult known pellet sizes in Table 1 of Appendix G of the AFTE Glossary (3rd Edition) and determine shot size, which corresponds to evidence shot.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Association of Firearm and Toolmark Examiners Glossary, 3rd Edition, 1994.

FA-IV-10

PHYSICAL EXAMINATION & CLASSIFICATION OF FIRED BULLETS

1.0 INTRODUCTION

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

1.2 OTHER RELATED PROCEDURES

1.2.1 Trace Material Examination

1.2.2 Stereomicroscope – Ruler

1.2.3 Stereomicroscope – Grid

1.2.4 Stereomicroscope – Micrometer

1.2.5 Air Gap

1.2.6 Measuring Projection Scope

1.2.7 Caliber Determination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a bio-hazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Comparison Microscope

4.2 Stereomicroscope

4.3 Micrometer

4.4 Caliper

4.5 Scale/Balance

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 A worksheet will be filled out according to the appropriate Appendices and individual laboratory policy. This may include noting the following:

6.1.1 If any trace material present.

6.1.2 The caliber.

6.1.3 The bullet weight

6.1.3.1 Recording weight of bullets in grains.

6.1.3.2 Recording weight of slugs in ounces.

6.1.4 The number of lands and grooves on fired bullet.

6.1.5 The direction of twist.

6.1.6 The measured width of the land impressions.

6.1.7 The measured width of the groove impressions.

6.1.8 The composition of bullet.

6.1.9 The bullet style.

6.1.10 The possible manufacturer/marketer of the bullet/projectile.

6.1.11 A description of the base of the bullet.

6.1.12 The type and position of cannelures.

6.1.13 Any extraneous markings to include:

6.1.13.1 Skid Marks

6.1.13.2 Shave Marks

6.1.13.3 Flared Base

6.1.13.4 Other Marks

6.1.14 The presence of gunpowder and/or powder imprints adhering to the base.

6.1.15 The condition of the fired evidence as received.

6.1.16 The suitability of the fired evidence for comparison purposes.

6.2 Additional information about the bullet/projectile can be compiled. See the current worksheet entries for these optional data entries.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

7.3 Appendix 3 - Packaging of Firearm Evidence for Submittal to the Laboratory

8.0 REFERENCES

8.1 Howe, Walter, J., "Laboratory Worksheets" AFTE NEWSLETTER NUMBER TWO, August 1969, p.13.

8.2 Association of Firearm and Toolmark Examiners Glossary, 3rd Edition, 1994.

FA-IV-11

PHYSICAL EXAMINATION & CLASSIFICATION OF FIRED CARTRIDGE CASES

1.0 INTRODUCTION

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

1.2 OTHER RELATED PROCEDURES

1.2.1 Trace Material Examination

1.2.2 Stereomicroscope - Ruler

1.2.3 Stereomicroscope - Grid

1.2.4 Stereomicroscope - Micrometer

1.2.5 Air Gap

1.2.6 Measuring Projection Scope

1.2.7 Caliber Determination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Comparison Microscope

4.2 Stereomicroscope

4.3 Micrometer

4.4 Caliper

4.5 Measuring Projector

4.6 Scale/Balance

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 A worksheet will be filled out according to the appropriate Appendices and individual laboratory policy. This may include noting the following:

6.1.1 If any trace material present.

6.1.2 Caliber

6.1.3 The possible manufacturer/marketer of the item.

6.1.4 Ignition System

6.1.4.1 Centerfire or

6.1.4.2 Rimfire or

6.1.4.3 Other

6.1.5 Shape of cartridge.

6.1.6 Description of cartridge and primer.

6.1.7 Description of head stamp.

6.1.8 Description of Firing Pin Impression.

6.1.9 Description of other markings, to include:

6.1.9.1 Breech Face Markings

6.1.9.2 Extractor

6.1.9.3 Ejector

6.1.9.4 Resizing Marks

6.1.9.5 Chamber Marks

6.1.9.6 Anvil Marks

6.1.9.7 Magazine Marks

6.1.9.8 Ejection Port Markings

6.1.9.9 Other Marks

6.2 Additional information about the cartridge/cartridge case can be compiled. See the current worksheet entries for these optional data entries.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Howe, Walter, J., "Laboratory Worksheets" AFTE NEWSLETTER NUMBER TWO, August 1969, p.13.

8.2 Association of Firearm and Toolmark Examiners Glossary, 3rd Edition, 1994.

FA-IV-12

PHYSICAL EXAMINATION & CLASSIFICATION OF FIRED SHOTSHELLS

1.0 INTRODUCTION

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

1.2 OTHER RELATED PROCEDURES

1.2.1 Trace Material Examination

1.2.2 Stereomicroscope – Ruler

1.2.3 Stereomicroscope – Grid

1.2.4 Stereomicroscope – Micrometer

1.2.5 Air Gap

1.2.6 Measuring Projection Scope

1.2.7 Caliber Determination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Comparison Microscope

4.2 Stereomicroscope

4.3 Micrometer

4.4 Caliper

4.5 Measuring Projector

4.6 Scale/Balance

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 A worksheet will be filled out according to the appropriate Appendices and individual laboratory policy. This may include noting the following:

6.1.1 If any trace material present.

6.1.2 The possible manufacturer/marketer of the item.

6.1.3 Ignition System

6.1.3.1 Centerfire or

6.1.3.2 Rimfire or

6.1.3.3 Other

6.1.4 Shape of shotshell.

6.1.5 Description of shotshell and primer.

6.1.6 Description of head stamp.

6.1.7 Description of Firing Pin Impression.

6.1.8 Description of other markings, to include:

6.1.8.1 Breech Face Markings

6.1.8.2 Extractor

6.1.8.3 Ejector

6.1.8.4 Resizing Marks

6.1.8.5 Chamber Marks

6.1.8.6 Anvil Marks

6.1.8.7 Magazine Marks

6.1.8.8 Ejection Port Markings

6.1.8.9 Other Marks

6.2 Additional information about the shotshell can be compiled. See the current worksheet entries for these optional data entries.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Howe, Walter, J., "Laboratory Worksheets" AFTE NEWSLETTER NUMBER TWO, August 1969, p.13.

8.2 Association of Firearm and Toolmark Examiners Glossary, 3rd Edition, 1994.

FA-IV-13

MICROSCOPIC COMPARISON

1.0 INTRODUCTION

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

1.2 OTHER RELATED PROCEDURES

1.2.1 Examination and Physical Classification of Fired Evidence

1.2.2 Examination and Physical Classification of Fired Cartridge Cases

1.2.3 Examination and Physical Classification of Fired Shotshells

1.2.4 Trace Material Examination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Comparison Microscope

4.2 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

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

6.1.2 Select the correct set of oculars (eyepieces).

6.1.3 The illumination (lights) used must be properly adjusted. Oblique lighting is usually preferred.

6.1.4 Compare unknown fired evidence to either another piece of unknown fired evidence or a known standard by placing the unknown fired evidence on the left hand stage and the other piece of unknown fired evidence or known standard on the right hand stage.

6.1.5 The entire unknown should be considered.

6.1.6 If an identification is not initially made, the examiner should consider the following factors:

6.1.6.1 Angle of lights

6.1.6.2 Type of lights

6.1.6.3 The need for additional known standards

6.1.6.4 The position of the evidence, the tests or both

6.1.6.5 The possibility of using magnesium smoke.

6.1.6.6 The possibility of cleaning the firearm.

6.1.6.7 The possibility that the firearm itself has changed

6.2 INTERPRETATION OF RESULTS:

6.2.1 A sufficient correspondence of individual characteristics will lead the examiner to the conclusion that both items (evidence and tests) originated from the same source.

6.2.2 An insufficient correspondence of individual characteristics but a correspondence of class characteristics will lead the examiner to the conclusion that no identification or elimination could be made with respect to the items examined.

6.2.3 A disagreement of class characteristics will lead the examiner to the conclusion that both items (evidence and tests) did not originate from the same source.

6.2.4 A significant disagreement of individual characteristics will lead the examiner to the conclusion that both items (evidence and tests) did not originate from the same source.

6.2.5 A lack of suitable microscopic characteristics will lead the examiner to the conclusion that the items are not suitable for comparison.

6.2.6 All identifications must be documented by either:

6.2.6.1 The identification indexed (for example, with a Sharpie marker) and notes referencing these indexing marks are taken, or

6.2.6.2 Notes taken indicating what area(s) of the item displayed the identifying correspondence.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 - Range of Conclusions

7.2 Section 5.5.2 Calibration Standards

7.3 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Howe, Walter, J., "Laboratory Worksheets" AFTE NEWSLETTER NUMBER TWO, August 1969, p.13.

8.2 Association of Firearm and Toolmark Examiners Glossary, 3rd Edition, 1994.

8.3 DeForest, Gaensslen, and Lee, Forensic Science: An Introduction to Criminalistics, McGraw- Hill, New York, 1983.

FA-IV-14

TRACE MATERIAL EXAMINATION

1.0 INTRODUCTION

1.1 Fired Evidence recovered during an investigation may contain trace material transferred from the crime scene. This trace material may be in the form of blood, tissue, plaster, paint, hairs, fibers, glass, etc. The examiner needs to evaluate the importance of this evidence and, if further examination of the trace material is necessary, remove and preserve a sample of the trace material present. Removal of trace material may also be necessary to allow the proper examination of the fired evidence.

1.2 OTHER RELATED PROCEDURES

1.2.1 Examination and Physical Classification of Fired Evidence

1.2.2 Examination and Physical Classification of Fired Cartridge Cases

1.2.3 Examination and Physical Classification of Fired Shotshells

1.2.4 Microscopic Comparison

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 NFPA Listings

NFPA LISTING				
CHEMICAL	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
15% Acetic Acid	2	2	3	
10% Bleach	2	0	1	
Methanol	1	3	0	
Acetone	1	3	0	

2.4 WARNING! Acetone is flammable and can pose a SEVERE FLAMMABILITY HAZARD

2.5 WARNING! Methanol is flammable and can pose a SEVERE FLAMMABILITY HAZARD

2.6 WARNING! Acetic acid is capable of detonation and can pose a SEVERE REACTIVITY HAZARD

2.7 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

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

3.1.1 15% Acetic Acid Solution:

3.1.1.1 Prepare a 15% Acetic Acid Solution utilizing concentrated Glacial Acetic Acid and distilled water.

3.1.2 10% Bleach Solution:

3.1.2.1 Prepare a Bleach Solution utilizing Bleach and distilled water

4.0 INSTRUMENTATION

4.1 Scale/Balance

4.2 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Examine the fired evidence visually and microscopically for any trace material and record in notes.

6.2 Determine if further examination of trace material is necessary.

6.2.1 If further examination of trace material IS necessary;

6.2.1.1 If necessary, consult the appropriate section prior to the removal of any trace evidence.

6.2.1.2 Remove material being careful not to damage the fired evidence.

6.2.1.3 Place the removed trace material in a suitable container/packaging for submission to the appropriate section for further examination.

6.2.2 If the trace material is not going to be retained for further examination, proceed with the following steps that are applicable.

6.2.2.1 For evidence containing blood, tissue or other biohazards, soak the evidence for at least one (1) minute in a 10% bleach solution.

6.2.2.2 Remove loose material by rinsing the fired evidence with methanol or water.

6.2.2.3 Remove plaster by rinsing the fired evidence in a 15% acetic acid solution.

6.2.2.4 Remove paint by soaking the fired evidence in alcohol or acetone.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Howe, Walter, J., "Laboratory Worksheets" AFTE NEWSLETTER NUMBER TWO, August 1969, p.13.

8.2 Association of Firearm and Toolmark Examiners Glossarv, 3rd Edition, 1994.

8.3 DeForest, Gaensslen, and Lee, Forensic Science: An Introduction to Criminalistics, McGraw-Hill, New York, 1983.

FA-IV-15

OPEN CASE/UNSOLVED CASE FILE

Open case/unsolved case evidence retained for future comparisons, if present in the lab, would be maintained by the Firearm and Toolmark unit of the laboratory.

FA-IV-16

INTEGRATED BALLISTIC IDENTIFICATION SYSTEM

NOTE: The NIBIN Section was officially suspended in February of 2009. The instrumentation and data linkage to ATF was removed early in 2010. Submission of fired evidence for inclusion in the NIBIN database is the responsibility of the agency possessing the evidence.

RD-I-1

VISUAL EXAMINATION

1.0 INTRODUCTION

1.1 When a firearm is fired, gunshot residues in the following forms are discharged from the firearm:

1.1.1 burnt gun powder particles

1.1.2 partially burnt gun powder particles

1.1.3 unburnt gun powder particles

1.1.4 vaporous lead

1.1.5 particulate metals

1.2 These gunshot residues along with the morphology of the bullet hole can effectively be used in determining the possible muzzle to target distance.

1.3 OTHER RELATED PROCEDURES

1.3.1 Microscopic Examination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 The presence of vaporous lead (smoke)

6.1.2 The presence of particulate metals (shavings of lead, copper, brass)

6.1.3 The presence of partially burnt and/or unburnt gunpowder

6.1.4 The presence of melted adhering gunpowder

6.1.5 A hole in the item

6.1.6 The presence of a visible ring around the perimeter of holes

6.1.7 The location of all holes, tears, missing buttons, etc.

6.1.8 The presence of burning or singeing or melting

6.1.9 The presence of any possible masking effects

6.1.10 The direction of artifacts surrounding the hole

6.2 Data regarding these physical effects and visible residues must be included in the examiner’s notes.

6.3 INTERPRETATION OF RESULTS:

6.3.1 Indicative of/ Consistent with the Discharge of a Firearm.

6.3.1.1 Vaporous Lead (smoke)

6.3.1.2 Particulate Metals (shavings of lead, copper, brass)

6.3.1.3 Unburned Gunpowder (morphology)

6.3.1.4 Melted Adhering Gunpowder

6.3.2 Indicative of/ Consistent with the Passage of a Bullet.

6.3.2.1 A hole in the item

6.3.2.2 Visible ring around the perimeter of holes

6.3.2.3 Location of all holes, tears, missing buttons, etc.

6.3.3 Indicative of/ Consistent with a Contact Shot

6.3.3.1 Ripping or Tearing

6.3.3.2 Burning or Singeing

6.3.3.3 Melted Artificial Fibers

6.3.3.4 Heavy Vaporous Lead Residues

6.3.3.5 Location of all holes, tears, missing buttons, etc.

6.3.4 Possible Masking Effects

6.3.4.1 Dark Background Color

6.3.4.2 Blood Staining

6.3.5 If the above observations support the findings of a “contact shot” no comparison is necessary.

6.3.6 If the observations do not support a “contact shot” finding, a working hypothesis will be formed based on the above observations. This hypothesis will be utilized in the comparison procedure.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Anonymous, (1970). "Gunshot Residues and Shot Pattern Test", F.B.I. Law Enforcement Bulletin, Vol. 39, No. 9, p.7.

8.2 Dillon, John, H., "A Protocol for Gunshot Residue Examinations in Muzzle-To-Target Distance Determinations", AFTE Journal, Vol. 22, No.3, p.32.

RD-I-2

MICROSCOPIC EXAMINATION

1.0 INTRODUCTION

1.1 When a firearm is fired, gunshot residues, in the following forms are discharged from the firearm;

1.1.1 burnt gun powder particles

1.1.2 partially burnt gun powder particles

1.1.3 unburnt gun powder particles

1.1.4 vaporous lead

1.1.5 particulate metals

1.2 These gunshot residues along with the morphology of the bullet hole can effectively be used in determining the possible muzzle to target distance.

1.3 OTHER RELATED PROCEDURES

1.3.1 Visual Examination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may also involve hazardous materials to include evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised.

2.3 The use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 The presence of vaporous lead (smoke)

6.1.2 The presence of particulate metals (shavings of lead, copper, brass)

6.1.3 The presence of partially burnt and/or unburnt gunpowder

6.1.4 The presence of melted adhering gunpowder

6.1.5 A hole in the item

6.1.6 The presence of a visible ring around the perimeter of holes

6.1.7 The location of all holes, tears, missing buttons, etc.

6.1.8 The presence of burning or singeing or melting

6.1.9 The presence of any possible masking effects

6.1.10 The direction of artifacts surrounding the hole

6.2 Data regarding these physical effects and visible residues must be included in the examiner's notes.

6.3 INTERPRETATION OF RESULTS:

6.3.1 Indicative of/ Consistent with the Discharge of a Firearm.

6.3.1.1 Vaporous Lead (smoke)

6.3.1.2 Particulate Metals (shavings of lead, copper, brass)

6.3.1.3 Unburned Gunpowder (morphology)

6.3.1.4 Melted Adhering Gunpowder

6.3.2 Indicative of/ Consistent with the Passage of a Bullet.

6.3.2.1 A hole in the item

6.3.2.2 Visible ring around the perimeter of holes

6.3.2.3 Location of all holes, tears, missing buttons, etc.

6.3.3 Indicative of/ Consistent with a Contact Shot

6.3.3.1 Ripping or Tearing

6.3.3.2 Burning or Singeing

6.3.3.3 Melted Artificial Fibers

6.3.3.4 Heavy Vaporous Lead Residues

6.3.3.5 Location of all holes, tears, missing buttons, etc.

6.3.4 Possible Masking Effects

6.3.4.1 Dark Background Color

6.3.4.2 Blood Staining

6.3.5 If the above observations support the findings of a "contact shot" no comparison is necessary.

6.3.6 If the observations do not support a "contact shot" finding, a working hypothesis will be formed based on the above observations. This hypothesis will be utilized in the comparison procedure.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Anonymous, (1970). "Gunshot Residues and Shot Pattern Test", F.B.I. Law Enforcement Bulletin, Vol. 39, No. 9, p.7.

8.2 Dillon, John, H., "A Protocol for Gunshot Residue Examinations in Muzzle-To-Target Distance Determinations", AFTE Journal, Vol. 22, No.3, p.32.

RD-II-1

MODIFIED GRIESS - DIRECT APPLICATION TECHNIQUE (DAT)

1.0 INTRODUCTION

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

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

1.2.1 First- Modified Griess or Simplified Griess

1.2.2 Second- Sodium Rhodizonate

1.2.3 Third- Dithiooxamide

1.3 OTHER RELATED PROCEDURES

1.3.1 Modified Griess- Reversed Application Technique

1.3.2 Sodium Rhodizonate Procedure- Bashinski Transfer Technique

1.3.3 Sodium Rhodizonate Procedure- Direct Application Technique

1.3.4 Dithiooxamide

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to dangerous chemicals. Consult the appropriate Material Safety Data Sheet (MSDS) for each chemical prior to use.

2.3 NFPA Listings

	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
Sulfanic Acid	3	3	1	CORROSIVE
Alpha Napthol	3	1	1	
Dihydrochloride	2	1	1	OXY
Methanol	1	3	0	
Sodium Nitrate	1	0	0	
Glacial Acetic Acid	1	3	1	

2.4 Chemical Warnings

2.4.1 WARNING! Sulfanilic Acid is toxic and can pose a SEVERE HEALTH HAZARD.

2.4.2 WARNING! Sulfanilic Acid is flammable and can pose a SEVERE FLAMMABILITY HAZARD.

2.4.3 WARNING! Sulfanilic Acid is a strong corrosive and can pose a SEVERE CONTACT HAZARD.

2.4.4 WARNING! Alpha Naphthol is toxic and can pose a SEVERE HEALTH HAZARD.

2.4.5 WARNING! Dihydrochloride is a strong oxidizer and can pose a SEVERE CONTACT HAZARD.

2.4.6 WARNING! Methanol is flammable and can pose a SEVERE FLAMMABILITY HAZARD.

2.4.7 WARNING! Glacial Acetic Acid is flammable and can pose a SEVERE FLAMMABILITY HAZARD

2.5 The examiner must use eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

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

3.2 Sensitized Blank:

3.2.1 Add 0.75 grams of Sulfanilic Acid to 150 milliliters of distilled water and mix.

3.2.2 Add 0.42 grams of Alpha Napthol to 150 milliliters of methanol and mix.

3.2.3 Once both the solutions in step 1 & 2 are prepared mix them together in a clean photo tray.

3.2.4 Saturate pieces of filter paper or desensitized photo paper in this solution.

3.2.5 Once the sensitized blanks are dry, store in an airtight plastic container.

3.2.6 Utilizing these proportions, mix the quantity desired

3.3 Acetic Acid Solution:

3.3.1 Mix a 15% Glacial Acetic Acid solution.

3.4 Nitrite Test Strips:

3.4.1 Dissolve 0.6 grams of Sodium Nitrite in 100 milliliters of distilled water.

3.4.2 Saturate pieces of filter paper or cotton swabs in this mixture.

3.4.3 Store in an airtight plastic container.

3.5 NOTE: LABEL **ALL** CONTAINERS WITH:

3.5.1 Name of solution

3.5.2 Date of preparation

3.5.3 Initials of Preparer

3.5.4 Expiration date, if applicable

3.6 Document newly made solutions in the Firearm/Toolmark Reagent Log.

4.0 INSTRUMENTATION

4.1 Scale/Balance

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 The Minimum Analytical Standards & Controls for the Modified Griess-DAT procedure consists of placing a test mark, utilizing a Nitrite Test Strip, on one of the sensitized blanks being used. An immediate orange color should appear on the sensitized blank. This color shift indicates that the sensitized blank is sensitive to the presences of nitrites.

6.0 PROCEDURE or ANALYSIS

6.1 Place the sensitized blank (photo paper - emulsion side down or sensitized filter paper) over the area to be tested.

6.2 Soak a piece of nitrite free cheesecloth or filter paper with the acetic acid solution, and place this over the reverse side of the evidence.

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

6.4 INTERPRETATION OF RESULTS:

6.4.1 Any orange, orange-red indications on the paper are the results of the chemically specific test for the presence of nitrite residues

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 APPROVED SUPPLIERS

8.1 VWRSP.com

9.0 REFERENCES

9.1 Dillon, John, "The Modified Griess Test: A Chemically Specific Chromophoric Test for Nitrate Compounds in Gunshot Residues", AFTE Journal, Vol. 22, No. 3, p.248.

9.2 Anonymous, (1970). "Gunshot Residues and Shot Pattern Test", F.B.I. Law Enforcement Bulletin, Vol. 39, No. 9, p.7.

9.3 Fiegel, F. and Anger, V., (1972). Spot Tests in lnorganic Analysis, 6th Ed., Elsevier Publishing Co., New York, New York.

RD-II-2

MODIFIED GRIESS - REVERSE APPLICATION TECHNIQUE (RAT)

1.0 INTRODUCTION

1 .1 The Modified Griess-Reverse Application Technique (RAT) is used independently and/or in conjunction with other tests in range determinations. The Modified Griess-RAT test utilizes a color chemistry reaction to help distinguish obscure or faint gunpowder patterns. This test detects **nitrites**, a product of the incomplete burning of gunpowder, by reacting with acetic acid to form nitrous acid. This acid combines with alpha-naphthol and produces an orange-red color reaction.

1.2 It should be noted that if multiple chemical examinations are going to be performed on an item they must follow a specific order.

1.2.1 First- Modified Griess or Simplified Griess

1.2.2 Second- Sodium Rhodizonate

1.2.3 Third- Dithiooxamide

1.3 OTHER RELATED PROCEDURES

1.3.1 Modified Griess- Direct Application Technique

1.3.2 Sodium Rhodizonate Procedure- Bashinski Transfer Technique

1.3.3 Sodium Rhodizonate Procedure- Direct Application Technique

1.3.4 Dithiooxamide

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to dangerous chemicals. Consult the appropriate Material Safety Data Sheet (MSDS) for each chemical prior to use.

2.3 NFPA Listings

2.3 NFPA Listings

	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
Sulfanic Acid	3	3	1	CORROSIVE
Alpha Napthol	3	1	1	
Dihydrochloride	2	1	1	OXY
Methanol	1	3	0	
Sodium Nitrate	1	0	0	
Glacial Acetic Acid	1	3	1	

2.4 Chemical Warnings

2.4.1 WARNING! Sulfanilic Acid is toxic and can pose a SEVERE HEALTH HAZARD.

2.4.2 WARNING! Sulfanilic Acid is flammable and can pose a SEVERE FLAMMABILITY HAZARD.

2.4.3 WARNING! Sulfanilic Acid is a strong corrosive and can pose a SEVERE CONTACT HAZARD.

2.4.4 WARNING! Alpha Naphthol is toxic and can pose a SEVERE HEALTH HAZARD.

2.4.5 WARNING! Dihydrochloride is a strong oxidizer and can pose a SEVERE CONTACT HAZARD.

2.4.6 WARNING! Methanol is flammable and can pose a SEVERE FLAMMABILITY HAZARD.

2.4.7 WARNING! Glacial Acetic Acid is flammable and can pose a SEVERE FLAMMABILITY HAZARD

2.5 The examiner must use eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

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

3.2 Sensitized Blank:

3.2.1 Add 0.75 grams of Sulfanilic Acid to 150 milliliters of distilled water and mix.

3.2.2 Add 0.42 grams of Alpha Naphthol to 150 milliliters of methanol and mix.

3.2.3 Once both the solutions in step 1 & 2 are prepared mix them together in a clean photo tray.

3.2.4 Saturate pieces of filter paper or desensitized photo paper in this solution.

3.2.5 Once the now sensitized blanks are dry, store in an airtight plastic container.

3.2.6 Utilizing these proportions, mix the quantity desired

3.3 Acetic Acid Solution:

3.3.1 Mix a 15% Glacial Acetic Acid solution.

3.4 Nitrite Test Strips:

3.4.1 Dissolve 0.6 grams of Sodium Nitrite in 100 milliliters of distilled water.

3.4.2 Saturate pieces of filter paper or cotton swabs in this mixture.

3.4.3 Store in an airtight plastic container.

3.5 NOTE: LABEL **ALL** CONTAINERS WITH:

3.5.1 Name of solution

3.5.2 Date of preparation

3.5.3 Initials of Preparer

3.5.4 Expiration date, if applicable

3.6 Document newly made solutions in the Firearm/Toolmark Reagent Log.

4.0 INSTRUMENTATION

4.1 Scale/Balance

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 The Minimum Analytical Standards & Controls for the Modified Griess-RAT procedure consists of placing a test mark, utilizing a Nitrite Test Strip, on one of the sensitized blanks being used. An immediate orange color should appear on the sensitized blank. This color shift indicates that the sensitized blank is sensitive to the presences of nitrites

6.0 PROCEDURE or ANALYSIS

6.1 Wipe the side of the sensitized blank that will be in contact with the questioned area with the acetic acid solution.

6.2 Place the sensitized blank (photo paper - emulsion side down or filter paper) over the area to be tested.

6.3 Place a piece of filter paper or nitrite free cheese cloth over the either the sensitized blank or evidence depending on what is being used for a blank.

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

6.5 INTERPRETATION OF RESULTS:

6.5.1 Any orange, orange-red indications on the paper are the results of the chemically specific test for the presence of nitrite residues

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 APPROVED SUPPLIERS

8.1 VWRSP.com

9.0 REFERENCES

9.1 Dillon, John, "The Modified Griess Test: A Chemically Specific Chromophoric Test for Nitrate Compounds in Gunshot Residues", AFTE Journal, Vol. 22, No. 3, p.248.

9.2 Anonymous, (1970). "Gunshot Residues and Shot Pattern Test", F.B.I. Law Enforcement Bulletin, Vol. 39, No. 9, p.7.

9.3 Fiegel, F. and Anger, V., (1972). Soot Tests in Inorganic Analysis, 6th Ed., Elsevier Publishing Co., New York, New York.

RD-II-3

SODIUM RHODIZONATE - BASHINSKI TRANSFER TECHNIQUE (BTT)

1.0 INTRODUCTION

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

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

1.2.1 First- Modified Griess or Simplified Griess

1.2.2 Second- Sodium Rhodizonate

1.2.3 Third- Dithiooxamide

1.3 OTHER RELATED PROCEDURES

1.3.1 Modified Griess - Direct Application Technique

1.3.2 Modified Griess - Reverse Application Technique

1.3.3 Sodium Rhodizonate Procedure- Direct Application Technique

1.3.4 Dithiooxamide

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to dangerous chemicals. Consult the appropriate Material Safety Data Sheet (MSDS) for each chemical prior to use.

2.3 NFPA Listings

2.3 NFPA Listings

	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
Sodium Rhodizonate	2	0	0	
Hydrochloric Acid	3	0	0	
Sodium Bitartrate	1	0	0	
Tartaric Acid	0	1	0	
Glacial Acetic Acid	2	2	3	

2.4 Chemical Warnings

2.4.1 WARNING! Hydrochloric Acid is toxic and can pose a SEVERE HEALTH HAZARD.

2.4.2 WARNING! Glacial Acetic Acid is capable of detonation and can pose a SEVERE REACTIVITY HAZARD

2.5 The examiner must use eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

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

3.2 Sodium Rhodizonate Solution:

3.2.1 Prepare a saturated Sodium Rhodizonate solution.

3.3 Hydrochloric Acid Solution:

3.3.1 Prepare a 5% Hydrochloric Acid solution.

3.4 Buffer Solution:

3.4.1 Dissolve 1.9 grams of Sodium Bitartrate and 1.5 grams of Tartaric Acid in 100 milliliters of distilled water.

3.4.2 This usually requires both heat and agitation to complete in a reasonable amount of time.

3.5 Acetic Acid Solution

3.5.1 Prepare a 15% Acetic Acid solution.

3.6 NOTE: LABEL **ALL** CONTAINERS WITH:

3.6.1 Name of solution

3.6.2 Date of preparation

3.6.3 Initials of Preparer

3.6.4 Expiration date, if applicable

3.7 Document newly made solutions in the Firearm/Toolmark Reagent Log.

4.0 INSTRUMENTATION

4.1 Scale/Balance

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 The Standards & Controls for the Sodium Rhodizonate test consists of first analyzing a control cloth swatch containing known gun smoke (soot) and partially burned gunpowder on one of the sensitized blanks being used. By performing the Sodium Rhodizonate procedure on this control sample the examiner can determine if in fact the Sodium Rhodizonate solution is reacting.

5.2 An alternative set of Standards & Controls for the Sodium Rhodizonate test consists of utilizing cotton swabs dampened with a 5% Hydrochloric acid solution. One of the treated swabs is rubbed against a piece of known lead. This swab is then processed with the Sodium Rhodizonate test to insure that the test is reacting properly. Another treated swab is rubbed on the item to be tested. This must be well away from any holes examined. This swab is then processed with the Sodium Rhodizonate test to insure that the item being tested will not produce a false positive.

6.0 PROCEDURE or ANALYSIS

6.1 Uniformly dampen a piece of filter paper with the Acetic Acid Solution.

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

6.3 Place an additional paper over the first and apply moderate pressure or apply a hot iron for approximately 5 seconds.

6.4 Remove these pieces of paper and spray the Sodium Rhodizonate Solution on to the tested area of the filter paper.

6.5 Spray the tested area of the filter paper with the Buffer Solution (this step is optional).

6.6 Spray the tested area of the filter paper with the Hydrochloric Acid Solution.

6.7 Repeat this process on all holes/areas to be tested. Both sides of a hole should be tested if there is a question of entrance vs. exit.

6.8 INTERPRETATION OF RESULTS:

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

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 APPROVED SUPPLIERS:

8.1 VWRSP.com

9.0 REFERENCES

9.1 Dillon, John, "The Modified Griess Test: A Chemically Specific Chromophoric Test for Nitrate Compounds in Gunshot Residues", AFTE Journal, Vol. 22, No. 3, p.248.

9.2 Anonymous, (1970). "Gunshot Residues and Shot Pattern Test", F.B.I. Law Enforcement Bulletin, Vol. 39, No. 9, p.7.

9.3 Fiegel, F. and Anger, V., (1 972). Spot Tests in Inorganic Analysis, 6th Ed., Elsevier Publishing Co., New York, New York.

RD-II-4

SODIUM RHODIZONATE - DIRECT APPLICATION TECHNIQUE (DAT)

1.0 INTRODUCTION

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

1.2 It should be noted that if multiple chemical examinations are going to be performed on an item they must follow a specific order.

1.2.1 First- Modified Griess or Simplified Griess

1.2.2 Second- Sodium Rhodizonate

1.2.3 Third- Dithiooxamide

1.3 OTHER RELATED PROCEDURES

1.3.1 Modified Griess - Direct Application Technique

1.3.2 Modified Griess - Reverse Application Technique

1.3.3 Sodium Rhodizonate Procedure- Bashinski Transfer Technique (BTT)

1.3.4 Dithiooxamide

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to dangerous chemicals. Consult the appropriate Material Safety Data Sheet (MSDS) for each chemical prior to use.

2.3 NFPA Listings

2.3 NFPA Listings

	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
Sodium Rhodizonate	2	0	0	
Hydrochloric Acid	3	0	0	
Sodium Bitartrate	1	0	0	
Tartaric Acid	0	1	0	
Glacial Acetic Acid	2	2	3	

2.4 Chemical Warnings

2.4.1 WARNING! Hydrochloric Acid is toxic and can pose a SEVERE HEALTH HAZARD.

2.4.2 WARNING! Glacial Acetic Acid is capable of detonation and can pose a SEVERE REACTIVITY HAZARD

2.5 The examiner must use eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

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

3.2 Sodium Rhodizonate Solution:

3.2.1 Prepare a saturated Sodium Rhodizonate solution.

3.3 Hydrochloric Acid Solution:

3.3.1 Prepare a 5% Hydrochloric Acid solution.

3.4 Buffer Solution:

3.4.1 Dissolve 1.9 grams of Sodium Bitartrate and 1.5 grams of Tartaric Acid in 100 milliliters of distilled water.

3.4.2 This usually requires both heat and agitation to complete in a reasonable amount of time.

3.5 Acetic Acid Solution:

3.5.1 Prepare a 15% Acetic Acid solution.

3.6 NOTE: LABEL **ALL** CONTAINERS WITH:

3.6.1 Name of solution

3.6.2 Date of preparation

3.6.3 Initials of Preparer

3.6.4 Expiration date, if applicable

3.7 Document newly made solutions in the Firearm/Toolmark Reagent Log.

4.0 INSTRUMENTATION

NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 The Standards & Controls for the Sodium Rhodizonate test consists of first analyzing a control cloth swatch containing known gun smoke (soot) and partially burned gunpowder on one of the sensitized blanks being used. By performing the Sodium Rhodizonate procedure on this test mark the examiner can determine if in fact the Sodium Rhodizonate solution is reacting properly.

5.2 An alternative set of Standards & Controls for the Sodium Rhodizonate test consists of utilizing cotton swabs dampened with a 5% Hydrochloric acid solution. One of the treated swabs is rubbed against a piece of known lead. This swab is then processed with the Sodium Rhodizonate test to insure that the test is reacting properly. Another treated swab is rubbed on the item to be tested. This must be well away from any holes examined. This swab is then processed with the Sodium Rhodizonate test to insure that the item being tested will not produce a false positive.

6.0 PROCEDURE or ANALYSIS

6.1 Spray the Sodium Rhodizonate Solution on to the questioned area.

6.2 Spray the tested area with the Buffer Solution.

6.3 Spray the tested area with the Hydrochloric Acid Solution.

6.4 Repeat this process on all holes/areas to be tested. Both sides of a hole should be tested if there is a question of entrance vs. exit.

6.5 INTERPRETATION OF RESULTS:

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

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 APPROVED SUPPLIERS:

8.1 VWRSP.com

9.0 REFERENCES

9.1 Dillon, John, "The Modified Griess Test: A Chemically Specific Chromophoric Test for Nitrate Compounds in Gunshot Residues", AFTE Journal, Vol. 22, No. 3, p.248.

9.2 Anon., (1970). "Gunshot Residues and Shot Pattern Test", F.B.I. Law Enforcement Bulletin, Vol. 39, No. 9, p.7.

9.3 Fiegel, F. and Anger, V., (1972). Spot Tests in Inorganic Analysis, 6th Ed., Elsevier Publishing Co., New York, New York.

RD-II-5

DITHIOOXAMIDE (DTO)

1.0 INTRODUCTION

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

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

1.2.1 First- Modified Griess or Simplified Griess

1.2.2 Second- Sodium Rhodizonate

1.2.3 Third- Dithiooxamide

1.3 OTHER RELATED PROCEDURES

1.3.1 Modified Griess - Direct Application Technique

1.3.2 Modified Griess - Reverse Application Technique

1.3.3 Sodium Rhodizonate Procedure- Bashinski Transfer Technique (BTT)

1.3.4 Sodium Rhodizonate Procedure- Direct Application Technique (DAT)

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to dangerous chemicals. Consult the appropriate Material Safety Data Sheet (MSDS) for each chemical prior to use.

2.3 NFPA Listings

2.3 NFPA Listings

NFPA LISTING				
CHEMICAL	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
Dithiooxamide	2	1	1	oxy
Ammonia	3	1	0	
Ethanol	0	3	0	

2.4 Chemical Warnings

2.4.1 DANGER! Dithiooxamide is a strong oxidizing agent and can pose an EXTREME CONTACT HAZARD.

2.4.2 WARNING! Ammonia is toxic and can pose a SEVERE HEALTH HAZARD.

2.4.3 WARNING! Ethanol is flammable and can pose a SEVERE FLAMMABILITY HAZARD.

2.5 The examiner must use eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

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

3.2 Dithiooxamide Solution:

3.2.1 Prepare a 0.2% Dithiooxamide solution in ethanol.

3.3 Ammonia Solution:

3.3.1 Prepare a 2:5 ammonia solution in distilled water

3.4 NOTE: LABEL **ALL** CONTAINERS WITH:

3.4.1 Name of solution

3.4.2 Date of preparation

3.4.3 Initials of Preparer

3.4.4 Expiration date, if applicable

3.5 Document newly made solutions in the Firearm/Toolmark Reagent Log.

4.0 INSTRUMENTATION

4.1 Scale/Balance

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 The Standards & Controls for the DTO test consists of testing a piece of known copper. A piece of filter paper dampened with an aqueous solution of Ammonium Hydroxide (25%) is applied to a known source of copper. By performing the DTO procedure on this control sample the examiner can determine if in fact the DTO test is reacting.

5.2 An alternative set of Standards & Controls for the DTO test consists of utilizing cotton swabs dampened with the ammonia solution. One of the treated swabs is rubbed against a piece of known copper. This swab is then processed with the DTO test to insure that the test is reacting properly.

6.0 PROCEDURE or ANALYSIS

6.1 Place several drops of the ammonia solution on a piece of filter paper.

6.2 Place the ammonia treated filter paper over the hole to be tested.

6.3 Place a second piece of filter paper over the first and apply moderate pressure for approximately 5 seconds.

6.4 Remove both pieces of filter paper and place several drops of the Dithiooxamide Solution to the tested area of the filter paper.

6.5 Repeat this process on all holes to be tested. Both sides of a hole should be tested if there is a question of entrance vs. exit.

6.6 INTERPRETATION OF RESULTS:

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

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 APPROVED SUPPLIERS

8.1 VWRSP.com

9.0 REFERENCES

9.1 Lekstrom, J.A. and Koons, R.D., "Copper and Nickel Detection on Gunshot Targets by Dithiooxamide Test", Journal of Forensic Sciences, Vol. 31, No.4, p. 1283.

9.2 Steinberg, M., Leist, Y., and Tassa, M., "A New Field Kit for Bullet Hole Identification", Journal of Forensic Sciences, Vol. 29, No. 1, p. 169.

9.3 Fiegel, F. and Anger, V., (1972). Spot Tests in Inorganic Analysis, 6th Ed., Elsevier Publishing Co., New York, New York.

RD-II-6

SIMPLIFIED GRIESS AND SODIUM RHODIZONATE

1.0 INTRODUCTION

1 .1 The Simplified Griess and Sodium Rhodizonate test is used independently and/or in conjunction with other tests in range determinations. The Simplified Griess and Sodium Rhodizonate test utilizes color chemistry reactions to help distinguish obscure or faint gunpowder and lead patterns. The Griess portion of the test detects **nitrites**, a product of the incomplete burning of gunpowder, by reacting with acetic acid to form nitrous acid. This acid combines with Marshall's Reagent and produces a brownish-red color reaction. The follow-up Sodium Rhodizonate portion of the test detects lead. The lead present combines with the reagent to produce a magenta color reaction.

1.2 It should be noted that if multiple chemical examinations are going to be performed on an item they must follow a specific order.

1.2.1 First- Modified Griess or Simplified Griess

1.2.2 Second- Sodium Rhodizonate

1.2.3 Third- Dithiooxamide

1.3 OTHER RELATED PROCEDURES

1.3.1 Modified Griess- Direct Application Technique

1.3.2 Sodium Rhodizonate Procedure- Bashinski Transfer Technique

1.3.3 Sodium Rhodizonate Procedure- Direct Application Technique

1.3.4 Dithiooxamide

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to dangerous chemicals. Consult the appropriate Material Safety Data Sheet (MSDS) for each chemical prior to use.

2.3 NFPA Listings

2.3 NFPA Listings

	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
Sulfanic Acid	3	3	1	CORROSIVE
Marshall's Reagent	3	1	1	
Hydrochloric Acid	3	0	1	OXY
Methanol	1	3	0	
Sodium Nitrate	1	0	0	
Glacial Acetic Acid	1	3	1	

2.4 Chemical Warnings

2.4.1 WARNING! Sulfanilic Acid is toxic and can pose a SEVERE HEALTH HAZARD.

2.4.2 WARNING! Sulfanilic Acid is flammable and can pose a SEVERE FLAMMABILITY HAZARD.

2.4.3 WARNING! Sulfanilic Acid is a strong corrosive and can pose a SEVERE CONTACT HAZARD.

2.4.4 WARNING! Marshall's Reagent is toxic and can pose a SEVERE HEALTH HAZARD.

2.4.5 WARNING! Hydrochloric acid is a strong oxidizer and can pose a SEVERE CONTACT HAZARD.

2.4.6 WARNING! Methanol is flammable and can pose a SEVERE FLAMMABILITY HAZARD.

2.4.7 WARNING! Glacial Acetic Acid is flammable and can pose a SEVERE FLAMMABILITY HAZARD

2.5 The examiner must use eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

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

3.2 Sensitized Blank:

3.2.1 Add 5.0 grams of Sulfanilic Acid to one liter of distilled water and mix.

3.2.2 Add 5.0 grams of Marshall's Reagent to one liter of methanol and mix.

3.2.3 Once both the solutions in step 1 & 2 are prepared mix them together in a clean photo tray with Glacial Acetic Acid in a ratio of 7:7:1 (Sulfanilic/Marshall's/Acetic).

3.2.4 Saturate pieces of filter paper or desensitized photo paper in this solution in a suitable container, such as a photo tray.

3.2.5 The blanks are ready to use after the excess liquid is allowed to drip back into the photo tray.

3.3 Nitrite and Lead Test Fabric Swatches:

3.3.1 Test fire a firearm into typical fabric material at a close range where visible gunpowder and sooty lead residues are noted.

3.3.2 Cut small swatches of this fabric. Typically four small one inch by one inch swatches can be obtained by cutting the close range pattern into quadrants.

3.3.3 Store in a bulk container.

3.4 Sodium Rhodizonate test solutions:

3.4.1 Prepare a fresh stock of solution by dissolving a small amount of Sodium Rhodizonate in approximately 50 milliliters of water. Add the Sodium Rhodizonate in tiny increments until the solution is saturated and will dissolve no more of the solid.

3.4.2 Allow the solution to sit several minutes and decant the dark tea-colored liquid into a clean container.

3.4.3 The Sodium Rhodizonate solution must not be stored overnight as it loses efficacy.

3.4.4 Prepare a 5 percent Hydrochloric Acid solution by pouring 50 milliliters of concentrated HCl into one liter of distilled water.

3.5 NOTE: LABEL **ALL** CONTAINERS WITH:

3.5.1 Name of solution

3.5.2 Date of preparation

3.5.3 Initials of Preparer

3.5.4 Expiration date, if applicable (No date indicates indefinite expiration.)

4.0 INSTRUMENTATION

4.1 Scale/Balance

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 The Minimum Analytical Standards & Controls for the Simplified Griess and Sodium Rhodizonate procedure consists of processing a Nitrite and Lead Test Fabric Swatch. An immediate brownish-red color should appear on the sensitized blank for the Griess portion of the exam. This color shift indicates that the sensitized blank is sensitive to the presence of nitrites. A follow up spraying of the sensitized blank with the Sodium Rhodizonate solution and 5 percent Hydrochloric Acid solution should reveal a magenta color. This color shift indicates that the sensitized blank is sensitive to the presence of lead.

6.0 PROCEDURE or ANALYSIS

6.1 Place the sensitized blank (photo paper - emulsion side down or filter paper) over the area to be tested.

6.2 Place the test area with the sensitized blank in a “sandwich” of clean, standard (NOT acid- free) parcel wrapping paper. Two layers or more on top and below the test materials is sufficient.

6.3 Apply heat and pressure with an iron or photo mounting heat press until the acetic acid solution treated paper is dry. Optimum results with the heat press can be obtained by 225 degree heat and pressure for 30 seconds.

6.4 It is recommended that photographs be taken of the controls, evidence test sheets, and known test sheets immediately after removing them from the heat press.

6.5 If no reaction is noted on the test sheets allow them to sit overnight and reexamine. A second set of photos is recommended.

6.6 Follow up by spraying the sheets with the Sodium Rhodizonate solution. Spray until the papers are covered with an even yellow color.

6.7 It is recommended that photographs be taken of the sheets at this time.

6.8 Next spray the sheets with the 5 percent HCl solution. Spray until the yellow background color disappears.

6.9 It is recommended that photographs be taken of the sheets at this time.

6.10 INTERPRETATION OF RESULTS:

6.10.1 Any brownish-red indications on the paper are the results of the chemically specific test for the presence of nitrite residues

6.10.2 Any magenta indications on the paper are the results of the chemically specific test for the presence of lead residues.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 APPROVED SUPPLIERS:

8.1 VWRSP.com

9.0 REFERENCES

9.1 Dillon, John, "The Modified Griess Test: A Chemically Specific Chromophoric Test for Nitrate Compounds in Gunshot Residues", AFTE Journal, Vol. 22, No. 3, p.248.

9.2 Shem, Robert J. “A Simplified Griess and Sodium Rhodizonate Test,” AFTE Journal, Winter 2001, Vol. 33, No. 1, pp. 37-39.

9.3 Anonymous, (1970). "Gunshot Residues and Shot Pattern Test", F.B.I. Law Enforcement Bulletin, Vol. 39, No. 9, p.7.

9.4 Fiegel, F. and Anger, V., (1972). Soot Tests in Inorganic Analysis, 6th Ed., Elsevier Publishing Co., New York, New York.

RD-III-1

NON-SHOT PELLET TEST PATTERN PRODUCTION

1.0 INTRODUCTION

1.1 In order to properly perform a muzzle-to-target range determination examination, it is usually necessary to attempt to reproduce the gunshot residue patterns present on the suspect item. This reproduction is accomplished by shooting tests at varying distances until the gunshot residue pattern present on the suspect item is reproduced. It is an essential prerequisite that the suspect firearm and ammunition consistent with the suspect ammunition be utilized.

1.2 OTHER RELATED PROCEDURES

1.2.1 Shotgun Test Pattern Production Procedure

1.2.2 Safe Firearm Handling

2.0 SAFETY CONSIDERATIONS

2.1 This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to any and all Firing Range rules must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

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

3.0 PREPARATION

3.1 Test Target Media

3.1.1 Attach appropriate size pieces of cotton twill material, material similar to the evidence material, or a piece of the evidence material to a nitrite free cardboard backing board.

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Tests generally should be shot one per piece of target media.

6.2 Tests should be shot in increasing or decreasing range increments until a distance is established, both shorter and longer than, that reproduces the gunshot residue patterns on the suspect item. It is essential that the suspect firearm and appropriate ammunition be used for these tests.

6.3 INTERPRETATION OF RESULTS:

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

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Anon., (1970). "Gunshot Residues and Shot Pattern Test", F.B.I. Law Enforcement Bulletin, Vol. 39, No. 9, p.7.

8.2 Dillon, John, H., "A Protocol for Gunshot Residue Examinations in Muzzle-To-Target Distance Determinations", AFTE Journal, Vo1.22, No.3, p.257.

RD-III-2

SHOT PELLET TEST PATTERN PRODUCTION

1.0 INTRODUCTION

1.1 In order to properly perform a muzzle-to-target range determination examination involving a shotgun, it is usually necessary to attempt to reproduce the shot patterns present on the suspect item. This reproduction is accomplished by shooting tests at varying distances until the shot pattern present on the suspect item is reproduced. It is an essential prerequisite that the suspect firearm and ammunition consistent with the suspect ammunition be utilized.

1.2 OTHER RELATED PROCEDURES

1.2.1 Non Shot Pellet Test Pattern Production Procedure

1.2.2 Safe Firearm Handling

2.0 SAFETY CONSIDERATIONS

2.1 This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.2 Proper caution to include strict adherence to any and all Firing Range rules must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

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

3.0 PREPARATION

3.1 Test Target Media

3.1.1 The test media for shot pellet test patterns is an appropriate sized piece of poster board, heavy paper, etc.

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Tests generally should be shot one per piece of target media.

6.2 Tests should be shot in increasing or decreasing range increments until a distance is established, both shorter and longer than, that reproduces the shot patterns on the suspect item. It is essential that the suspect firearm and appropriate ammunition be used for these tests.

6.3 INTERPRETATION OF RESULTS:

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

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Anon., (1970). "Gunshot Residues and Shot Pattern Test", F.B.I. Law Enforcement Bulletin, Vol. 39, No. 9, p.7.

8.2 Dillon, John, H., "A Protocol for Gunshot Residue Examinations in Muzzle-To-Target Distance Determinations", AFTE Journal, Vo1.22, No.3, p.257.

8.3 Dillon, John, H. "A Protocol for Shot Pattern Examinations in Muzzle-to-Target Distance Determinations", AFTE Journal, Vol. 23, No. 1, p.49.

TM-I-1

EXAMINATION AND PHYSICAL CLASSIFICATION – TOOL

1.0 INTRODUCTION

1.1 The initial examination of a tool will include the completion of a laboratory worksheet. This worksheet will include the physical description of the tool. It will also serve as a source to document the condition of the evidence as received and any tests or comparisons performed with the tool.

1.2 OTHER RELATED PROCEDURES

1.2.1 Trace Material Examination

1.2.2 Test Standards

2.0 SAFETY CONSIDERATIONS

This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 A laboratory worksheet utilized for a tool examination should be filed out. This may include noting the following.

6.1.1 If any trace material is present.

6.1.2 The class characteristics of the tool

6.1.3 The type of tool

6.1.4 The brand name of tool

6.1.5 The size of the tool

6.1.6 The condition of the tool

6.1.7 Type of tests conducted (if any)

6.1.8 The medium used for testing

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 DeForest, Gaensslen, and Lee, Forensic Science: An Introduction to Criminalistics, McGraw- Hill, New York, 1983

TM-I-2

TRACE MATERIAL EXAMINATION – TOOL

1.0 INTRODUCTION

1.1 Tools recovered during an investigation may contain trace material transferred from the crime scene. This trace material may be in the form of blood, tissue, plaster, paint, hairs, fibers, glass, etc. The examiner needs to evaluate the importance of this evidence and, if further examination of the trace material is necessary, remove and preserve a sample of the trace material present. Removal of trace material may also be necessary to allow the proper examination and testing of a tool

1.2 OTHER RELATED PROCEDURES

1.2.1 Examination and Physical Classification – Tool

2.0 SAFETY CONSIDERATIONS

2.1 This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

2.2 NFPA Codes

CHEMICAL	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
15% Acetic Acid	2	2	3	
10% Bleach	2	0	1	
Methanol	1	3	0	
Acetone	1	3	0	

2.3 Chemical Warnings

2.3.1 WARNING! Acetic acid is capable of detonation and can pose a SEVERE REACTIVITY HAZARD.

2.3.2 WARNING! Methanol is flammable and can pose a SEVERE FLAMMABILITY HAZARD.

2.3.3 WARNING! Acetone is flammable and can pose a SEVERE FLAMMABILITY HAZARD

2.4 The examiner must use eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

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

3.2 15% Acetic Acid Solution:

3.2.1 Prepare a 15% Acetic Acid Solution utilizing Concentrated Glacial Acetic Acid and distilled water.

3.3 10% Bleach Solution:

3.3.1 Prepare a 10% Bleach Solution utilizing Bleach and distilled Water

4.0 INSTRUMENTATION

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Examine the tool visually and microscopically for any trace material and record in notes.

6.2 Determine if further examination of trace material is necessary.

6.3 If further examination of trace material IS necessary;

6.3.1 If necessary, consult the appropriate section prior to the removal of any trace evidence.

6.3.2 Remove material being careful not to damage the tool.

6.3.3 Place the removed trace material in a suitable container/packaging for submission to the appropriate section for further examination.

6.4 If the trace material is not going to be retained for further examination, proceed with the following steps that are applicable.

6.4.1 For evidence containing blood, tissue or other biohazards, soak the evidence for at least one (1) minute in a 10% bleach solution.

6.4.2 Remove loose material by rinsing the tool with methanol or water.

6.4.3 Remove plaster by soaking the tool in a 15% acetic acid solution.

6.4.4 Remove paint by soaking the tool in alcohol or acetone.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 DeForest, Gaensslen, and Lee, Forensic Science: An Introduction to Criminalistics, McGraw- Hill, New York, 1983

TM-I-3

TEST STANDARDS

1.0 INTRODUCTION

1 .1 In order to compare a questioned toolmark with a suspect tool, test standards or marks are usually made with the suspect tool. The basic objective in preparing test standards is to attempt to duplicate the manner in which the tool was used to produce the evidence or questioned toolmark.

1.2 OTHER RELATED PROCEDURES

1.2.1 Examination and Physical Classification – Tool

1.2.2 Trace Material Examination-Tool

1.2.3 Physical Examination & Classification-Toolmark

1.2.4 Trace Material Examination-Toolmark

1.2.5 Evidence Evaluation

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may involve hazardous materials, operations and/or equipment. Some component parts of a cylinder and/or lock are under spring tension and may present a missile hazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

2.2 The examiner should consider using eye protection.

3.0 PREPARATION

3.1 Test Media:

3.1.1 The initial test media must be soft enough to prevent alterations of the tool's working surface.

3.1.2 Lead is usually the material utilized.

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

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 Areas of recent use on the tool in question.

6.1.2 Direction of use.

6.1.3 Indexing of test standards/marks.

6.2 INTERPRETATION OF RESULTS:

6.2.1 See Microscopic Comparison Procedure

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 DeForest, Gaensslen, and Lee, Forensic Science: An Introduction to Criminalistics, McGraw- Hill, New York, 1983

TM-II-1

EXAMINATION AND PHYSICAL CLASSIFICATION – TOOLMARK

1.0 INTRODUCTION

1.1 In order to compare a questioned toolmark with a suspect tool, it is necessary to evaluate the toolmark. This evaluation will consist of a physical evaluation and classification of the toolmark. This evaluation will help determine what course the rest of the examination should take. The basic objective in evaluating a questioned toolmark is to determine the suitability and classification of the toolmark.

1.2 OTHER RELATED PROCEDURES

1.2.1 Examination and Physical Classification – Tool

1.2.2 Trace Material Examination-Tool

1.2.3 Test Standards

1.2.4 Trace Material Examination-Toolmark

2.0 SAFETY CONSIDERATIONS

2.1 This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 A systematic approach should be used for the physical examination and classification of questioned toolmarks. Consideration should be given to:

6.1.1 The suitability of the toolmark for comparison purposes.

6.1.2 Class of tool that made the toolmark.

6.1.3 Major and minor classes of toolmarks

6.1.4 Physical characteristics of toolmarks

6.1.5 Direction of toolmark.

6.2 INTERPRETATION OF RESULTS:

6.2.1 If the toolmark is suitable for comparison the examination may continue.

6.2.2 If the toolmark has the same class characteristics as the suspect tool the examination may continue

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 DeForest, Gaensslen, and Lee, Forensic Science: An Introduction to Criminalistics, McGraw- Hill, New York, 1983

TM-II-2

TRACE MATERIAL EXAMINATION – TOOLMARK

1.0 **INTRODUCTION**

1.1 Toolmarks recovered during an investigation may contain trace material transferred from the crime scene. This trace material may be in the form of blood, tissue, plaster, paint, hairs, fibers, glass, etc. The examiner needs to evaluate the importance of this evidence and, if further examination of the trace material is necessary, remove and preserve a sample of the trace material present. Removal of trace material may also be necessary to allow the proper examination and testing of a toolmark.

1.2 OTHER RELATED PROCEDURES

1.2.1 Examination and Physical Classification – Toolmark

1.2.2 Microscopic Comparison

2.0 SAFETY CONSIDERATIONS

2.1 This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution to include strict adherence to Universal Precautions and the Blood Borne Pathogen Plan must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

2.2 NFPA Codes

CHEMICAL	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
15% Acetic Acid	2	2	3	
10% Bleach	2	0	1	
Methanol	1	3	0	
Acetone	1	3	0	

2.3 Chemical Warnings

2.3.1 WARNING! Acetic acid is capable of detonation and can pose a SEVERE REACTIVITY HAZARD.

2.3.2 WARNING! Methanol is flammable and can pose a SEVERE FLAMMABILITY HAZARD.

2.3.3 WARNING! Acetone is flammable and can pose a SEVERE FLAMMABILITY HAZARD

2.4 The examiner must use eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

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

3.2 15% Acetic Acid Solution:

3.2.1 Prepare a 15% Acetic Acid Solution utilizing Concentrated Glacial Acetic Acid and distilled water.

3.3 10% Bleach Solution:

3.3.1 Prepare a 10% Bleach Solution utilizing Bleach and distilled Water

4.0 INSTRUMENTATION

4.1 Scale/Balance

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Examine the tool visually and microscopically for any trace material and record in notes.

6.2 Determine if further examination of trace material is necessary.

6.3 If further examination of trace material IS necessary;

6.3.1 If necessary, consult the appropriate section prior to the removal of any trace evidence.

6.3.2 Remove material being careful not to damage the tool.

6.3.3 Place the removed trace material in a suitable container/packaging for submission to the appropriate section for further examination.

6.4 If the trace material is not going to be retained for further examination, proceed with the following steps that are applicable.

6.4.1 For evidence containing blood, tissue or other biohazards, soak the evidence for at least one (1) minute in a 10% bleach solution.

6.4.2 Remove loose material by rinsing the tool with methanol or water.

6.4.3 Remove plaster by soaking the tool in a 15% acetic acid solution.

6.4.4 Remove paint by soaking the tool in alcohol or acetone.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration Standards

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 DeForest, Gaensslen, and Lee, Forensic Science: An Introduction to Criminalistics, McGraw- Hill, New York, 1983

TM-II-3

MICROSCOPIC COMPARISON

1.0 INTRODUCTION

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

1.2 OTHER RELATED PROCEDURES

1.2.1 Examination and Physical Classification

1.2.2 Trace Material Examination

1.2.3 Test Standards

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may involve hazardous materials, operations and/or equipment. Some component parts of a cylinder and/or lock are under spring tension and may present a missile hazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

2.2 The examiner should consider using eye protection.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Comparison Microscope

4.2 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 Select the correct objective (magnification) setting and ensure that the objectives are locked in place. Select the correct set of oculars (eyepieces).

6.1.2 The illumination (lights) used must be properly adjusted. Oblique lighting is usually preferred.

6.1.3 Compare the unknown toolmark to either another unknown toolmark or a known standard by placing the unknown toolmark on the left hand stage and the other unknown toolmark or known standard on the right hand stage.

6.1.4 The entire toolmark must be considered.

6.1.5 If an identification is not initially made, the examiner should consider the following factors:

6.1.5.1 Angle of lights

6.1.5.2 Type of lights

6.1.5.3 The need for additional known standards

6.1.5.4 The position of the evidence, the tests or both.

6.1.5.5 The possibility of using magnesium smoke.

6.1.5.6 The possibility of cleaning the tool.

6.1.5.7 The possibility that the tool itself has changed

6.2 INTERPRETATION OF RESULTS:

6.2.1 A sufficient correspondence of individual characteristics will lead the examiner to the conclusion that both items (evidence and tests) originated from the same source.

6.2.1.1 This is defined as an **Identification** by the AFTE Glossary.

6.2.2 An insufficient correspondence of individual characteristics but a correspondence of class characteristics will lead the examiner to the conclusion that no identification or elimination was made with respect to the items examined.

6.2.2.1 This is defined as an **Inconclusive** by the AFTE Glossary. An inconclusive can be further defined as:

6.2.2.1.1 **Inconclusive A**: Some agreement of individual characteristics and all discernible class characteristics, but insufficient for an identification.

6.2.2.1.2 **Inconclusive B**: Agreement of all discernible class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility.

6.2.2.1.3 **Inconclusive C**: Agreement of all discernable class characteristics and disagreement of individual characteristics, but insufficient for an elimination.

6.2.3 A disagreement of class characteristics will lead the examiner to the conclusion that both items (evidence and tests) did not originate from the same source.

6.2.3.1 This is defined as an **Elimination** by the AFTE Glossary.

6.2.4 A lack of suitable microscopic characteristics will lead the examiner to the conclusion that the items are not suitable for comparison.

6.2.5 All identifications must be documented by either:

6.2.5.1 Verification by a second examiner.

6.2.5.2 Photomicrograph

6.2.5.3 The identification indexed and sufficient notes referencing these indexing marks are taken.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Range of Conclusions

7.2 Section 5.5.2 Calibration Standards

7.3 Section 4.13.2.1 Worksheets

7.3 Section 4.13.2.12 Verifications

8.0 REFERENCES

8.1 DeForest, Gaensslen, and Lee, Forensic Science: An Introduction to Criminalistics, McGraw- Hill, New York, 1983

8.2 AFTE GLOSSARY 5th Edition Section 1- Firearms Identification

TM-III-1

MAGNESIUM SMOKING

1.0 INTRODUCTION

1.1 Magnesium smoking is a technique of reducing the glare of a shiny object by lightly coating the surface with fine magnesium smoke.

1.2 This smoking is traditionally done manually, however a diode sputtering system used for coating Scanning Electron Microscopy (SEM) specimens might also be used.

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions. Consult the appropriate MSDS for each product prior to use.

2.2 NFPA

CHEMICAL	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
Magnesium Ribbon	1	4	3	

2.3 DANGER! Magnesium Ribbon is highly flammable and can pose an EXTREME FLAMMABILITY HAZARD.

2.4 WARNING! Magnesium Ribbon is capable of detonation and can pose a SEVERE REACTIVITY HAZARD.

2.5 The examiner must consider the use eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator, gloves, and an apron

3.0 PREPARATION

3.1 Cut short strips of magnesium ribbon off the roll.

3.2 Both the roll and the strips should be stored properly based on the NFPA code

4.0 INSTRUMENTATION

4.1 Diode Sputtering System (if used)

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 MANUAL SMOKING:

6.1.1 The short pieces of magnesium ribbon are lit.

6.1.2 The object to be smoked is passed over the smoke generated by the burning magnesium.

6.1.3 If the object collects too much smoke, wipe the smoke off and repeat the process.

6.1.4 The coating should be light enough to see the color of the item smoked through the coating of smoke.

6.2 AUTOMATED SMOKING:

6.2.1 The appropriate instructions for the particular instrument should be followed.

6.2.2 These techniques simply reduce the glare of an object under examination and are non-destructive, non-invasive techniques.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Janelli, R., and Geyer, G., "Smoking a Bullet", AFTE Journal, Vol. 9, No. 2, p. 128

TM-III-2

CASTING

1.0 INTRODUCTION

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

1.2 OTHER RELATED PROCEDURES:

1.2.1 Test Standards

1.2.2 Microscopic Comparison

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions. Consult the appropriate MSDS for each product prior to use.

2.2 The examiner must consider the use eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator, gloves, and an apron

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Prepare the casting material as per manufacturer's specifications.

6.2 Cascade the casting material over the toolmark to be cast.

6.3 Allow the cast the appropriate amount of time to cure.

6.4 Gently lift the cast off the toolmark.

6.5 Consideration must be given to placing identifying marks as well as orientation marks on the back of the cast.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 ANON., "Mikrosil Casting Material Information" AFTE Journal, Vo1.15, No. 2, p. 80.

8.2 Barber, D.C. and Cassidy, F.H., "A New Dimension with 'Mikrosil' Casting Material", AFTE Journal, Vol. 19, No. 3, p.328

TM-IV-1

MISCELLANEOUS CYLINDER EXAMINATION

1.0 INTRODUCTION

1.1 The forensic application of locksmithing can play an important part in criminal investigations and yield a wealth of valuable toolmark evidence. The examination of physical security devices (locks) may lead the investigators to new avenues of investigation in their case.

1.2 OTHER RELATED PROCEDURES:

1.2.1 Lock Set Examination Procedure

1.2.2 Key Examination Procedure

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may involve hazardous materials, operations and/or equipment. Some component parts of a cylinder and/or lock are under spring tension and may present a missile hazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards

2.2 The examiner should consider using eye protection.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 MISCELLANEOUS CYLINDER EXTERNAL EXAMINATION:

6.1.1 Examine and note the overall condition of the cylinder.

6.1.2 Examine and note the threaded area of the cylinder and any cylinder retaining screw marks in the retaining groove.

6.1.3 Examine the cylinder face and edge.

6.1.4 Note the position of the cam.

6.1.5 Examine the plug face and the keyway entrance.

6.1.6 If a key is submitted with the cylinder, check and note the operating condition of the cylinder.

6.2 MISCELLANEOUS CYLINDER INTERNAL EXAMINATION:

6.2.1 Disassemble cylinder

6.2.2 Microscopically examine the combination pins.

6.2.3 Microscopically examine the plug.

6.3 **INTERPRETATION OF RESULTS:**

6.3.1 Inappropriate marks on the combination pins would indicate that an instrument other than a key had been used.

6.3.2 Inappropriate marks in the plug would indicate that an instrument other than a key had been used.

6.3.3 The presence of master pins in the cylinder would indicate that the cylinder is part of a master system.

6.3.4 The presence of pick resistant driver(s) would indicate that the cylinder would be harder to compromise.

6.3.5 Inappropriate marks on the combination pins would indicate that the marks are a disguise to conceal something else.

6.3.6 Inappropriate marks in the plug would indicate that the marks are a disguise to conceal something else.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Robinson, Robert L., "Complete Course in Professional Locksmithing" Chicago, Illinois: Nelson-Hall, 1983

TM-IV-2

KEY EXAMINATION

1.0 INTRODUCTION

1.1 The forensic application of locksmithing can play an important part in criminal investigations and yield a wealth of valuable toolmark evidence. The examination of physical security devices (locks) may lead the investigators to new avenues of investigation in their case.

1.2 OTHER RELATED PROCEDURES:

1.2.1 Lock Set Examination

1.2.2 Miscellaneous Lock Cylinder Examination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may involve hazardous materials, operations and/or equipment. Some component parts of a cylinder and/or lock are under spring tension and may present a missile hazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards

2.2 The examiner should consider using eye protection.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 KEY EXAMINATION

6.1.1 Examine and note the overall condition of the key.

6.1.2 Examine and note any signs of key fatigue.

6.1.3 Note whether the key is duplicate or original.

6.1.4 Note the information on the key bow.

6.1.5 Examine and note number of combination cuts.

6.1.6 Examine and note what type of machine made the combination cuts.

6.2 INTERPRETATION OF RESULTS:

6.2.1 The condition of the key may indicate the amount of use the key has been exposed to.

6.2.2 The information stamped on the bow of a duplicated key may indicate the name and location of the cutter.

6.2.3 If a punch type-cutting machine is used, striae may be compared with other key(s) or with the cutter.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Robinson, Robert L., "Complete Course in Professional Locksmithing" Chicago, Illinois: Nelson-Hall, 1983

TM-IV-3

LOCK SET EXAMINATION

1.0 INTRODUCTION

1.1 The forensic application of locksmithing can play an important part in criminal investigations and yield a wealth of valuable toolmark evidence. The examination of physical security devices (locks) may lead the investigators to new avenues of investigation in their case.

1.2 OTHER RELATED PROCEDURES:

1.2.1 Key Examination

1.2.2 Miscellaneous Lock Cylinder Examination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may involve hazardous materials, operations and/or equipment. Some component parts of a cylinder and/or lock are under spring tension and may present a missile hazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards

2.2 The examiner should consider using eye protection.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 LOCKSET EXTERNAL EXAMINATION:

6.1.1 Examine and note the overall condition of the lockset.

6.1.2 Examine and note all the functions of the lockset.

6.1.3 Examine and note the wear on the bolt, spring bolt, anti-shim device or anti-friction device.

6.2 LOCKSET INTERNAL EXAMINATION:

6.2.1 Examine and note the overall condition of the Interior of the lockset.

6.2.2 Examine and note worn, altered, damaged or missing parts.

6.2.3 Examine and note the operation of the lockset to see if it functions as designed

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Robinson, Robert L., "Complete Course in Professional Locksmithing" Chicago, Illinois: Nelson-Hall, 1983

TM-IV-4

SAFE TYPE EXAMINATION

1.0 INTRODUCTION

1.1 The forensic examination of a safe can play an important part in a criminal investigation. This type of examination may have to be done in the field because of the size and weight of a safe.

1.2 There are numerous factors to be considered when performing a safe examination.

1.2.1 Many safes are repaired after a burglary and the examination must be done prior to any safe repair.

1.2.2 What appears to be an actual safe burglary may prove to be staged.

1.3 Results of a safe examination may aid detectives in establishing a crime pattern.

1.4 OTHER RELATED PROCEDURES:

1.4.1 Safe External Examination

1.4.2 Safe Internal Examination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may involve hazardous materials, operations and/or equipment. Some component parts of a cylinder and/or lock are under spring tension and may present a missile hazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

2.2 A burglarized safe may have some jagged pieces of metal.

2.3 The examiner should consider using eye protection.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 In order to determine the type of safe being examined, the examiner must look for or consider the following:

6.1.1 Manufacturer's Identification Label or Tag

6.1.2 Underwriters Laboratories Classification label.

6.1.3 Safe Manufacturers National Association, Inc. Classification label.

6.1.3.1 Note: This association is no longer in existence.

6.1.4 Configuration and features of the safe.

6.2 INTERPRETATION OF RESULTS:

6.2.1 Safes generally fall into one of six categories, these being:

6.2.1.1 The unit is a burglary resistant money safe.

6.2.1.2 The unit is a fire resistant safe.

6.2.1.3 The unit is a composite safe, which has both fire and burglary resistant qualities.

6.2.1.4 The unit is an encased/cladded money safe (money safe encased in concrete and steel outer lining).

6.2.1.5 The unit is a combination safe, such as a fire resistant safe with money safe inside.

6.2.1.6 The unit is a floor safe.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Robinson, Robert L., "Complete Course in Professional Locksmithing" Chicago, Illinois: Nelson-Hall, 1983

8.2 Paholke, Arthur R., SAFE RECOGNITION, Association of Firearm and Tool Mark Examiners 1970 Conference.

8.3 Paholke, Arthur R., PHYSICAL SECURITY DEVICES Part IV and Part V, Chicago Police Department Training Bulletin Volume XVI, Number 1 (1975)

TM-IV-5

EXTERNAL SAFE EXAMINATION

1.0 INTRODUCTION

1.1 The forensic examination of a safe can play an important part in a criminal investigation. This type of examination may have to be done in the field because of the size and weight of a safe.

1.2 There are numerous factors to be considered when performing a safe examination.

1.2.1 Many safes are repaired after a burglary and the examination must be done prior to any safe repair.

1.2.2 What appears to be an actual safe burglary may prove to be staged.

1.3 Results of a safe examination may aid detectives in establishing a crime pattern.

1.4 OTHER RELATED PROCEDURES:

1.4.1 Safe Type Examination

1.4.2 Safe Internal Examination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may involve hazardous materials, operations and/or equipment. Some component parts of a cylinder and/or lock are under spring tension and may present a missile hazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

2.2 A burglarized safe may have some jagged pieces of metal.

2.3 The examiner should consider using eye protection.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 The steps below do not have to be performed in the order listed; however, all steps should be considered and/or addressed. Note, photograph and/or sketch any damage to the outside surfaces of the safe body and/or door. Measure the diameter of any and all holes; triangulate their location on the sketch of the safe. Note, photograph and/or sketch any reference mark(s) that could have been made during the compromise of the safe. Note, photograph and/or sketch any toolmarks on the exterior surfaces of the safe.

6.2 INTERPRETATION OF RESULTS:

6.2.1 Although no final determination should be made until both an internal and external examination has been completed, the following information can be determined from these types of examinations.

6.2.1.1 The damage to the exterior surfaces of the safe was sufficient to allow unauthorized entry.

6.2.1.2 The damage to the exterior surfaces of the safe was insufficient to allow unauthorized entry.

6.2.1.3 The lack of damage to the safe would indicate that the safe was entered by normal means.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Robinson, Robert L., "Complete Course in Professional Locksmithing" Chicago, Illinois: Nelson-Hall, 1983

8.2 Paholke, Arthur R., SAFE RECOGNITION, Association of Firearm and Tool Mark Examiners 1970 Conference.

8.3 Paholke, Arthur R., PHYSICAL SECURITY DEVICES Part IV and Part V, Chicago Police Department Training Bulletin Volume XVI, Number 1 (1975)

TM-IV-6

INTERNAL SAFE EXAMINATION

1.0 INTRODUCTION

1.1 The forensic examination of a safe can play an important part in a criminal investigation. This type of examination may have to be done in the field because of the size and weight of a safe.

1.2 There are numerous factors to be considered when performing a safe examination.

1.2.1 Many safes are repaired after a burglary and the examination must be done prior to any safe repair.

1.2.2 What appears to be an actual safe burglary may prove to be staged.

1.3 Results of a safe examination may aid detectives in establishing a crime pattern.

1.4 OTHER RELATED PROCEDURES:

1.4.1 Safe Type Examination

1.4.2 Safe External Examination

2.0 SAFETY CONSIDERATIONS

2.1 This procedure may involve hazardous materials, operations and/or equipment. Some component parts of a cylinder and/or lock are under spring tension and may present a missile hazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

2.2 A burglarized safe may have some jagged pieces of metal.

2.3 The examiner should consider using eye protection.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Stereomicroscope

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

6.1.1 Note, photograph and/or sketch any damage to the inside surfaces of the safe body and/or door.

6.1.2 Note, photograph and/or sketch the position of the lock box, bolt works, cam and relockers.

6.1.3 Note, photograph and/or sketch any toolmarks on the interior surfaces of the safe.

6.2 INTERPRETATION OF RESULTS:

6.2.1 Although no final determination should be made until both an internal and external examination has been completed, the following information can be determined from these types of examinations.

6.2.1.1 The damage to the interior surfaces of the safe was sufficient to allow unauthorized entry.

6.2.1.2 The damage to the interior surfaces of the safe was insufficient to allow unauthorized entry.

6.2.1.3 The lack of damage to the safe would indicate that the safe was entered by normal means.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 5.5.2 Calibration

7.2 Section 4.13.2.1 Worksheets

8.0 REFERENCES

8.1 Robinson, Robert L., "Complete Course in Professional Locksmithing" Chicago, Illinois: Nelson-Hall, 1983

8.2 Paholke, Arthur R., SAFE RECOGNITION, Association of Firearm and Tool Mark Examiners 1970 Conference.

8.3 Paholke, Arthur R., PHYSICAL SECURITY DEVICES Part IV and Part V, Chicago Police Department Training Bulletin Volume XVI, Number 1 (1975)

TM-V-1

POLISHING

1.0 INTRODUCTION

1.1 Many valuable items manufactured today have serial numbers for identification. These numbers are usually die stamped. This process produces a compression of the metal or plastic in the area immediately surrounding and a short distance below the penetration of the die. Serial numbers are removed and/or obliterated in a variety of ways. The serial number may be restored if the removal/obliteration is not taken past the previously mentioned compression zone.

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

1.3 OTHER RELATED PROCEDURES:

1.3.1 Chemical

1.3.2 Electro-Chemical

1.3.3 Magnetic

1.3.4 Heat

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions.

2.2 The examiner should consider the use of eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Note and record any visible characters prior to polishing.

6.2 Polish the area of the obliteration using either a:

6.2.1 Dremel type tool with a sanding/polishing disc.

6.2.2 Fine grit sand paper.

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

6.4 INTERPRETATION OF RESULTS:

6.4.1 If any characters become visible note these characters.

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

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

7.2 Appendix 1 - Serial Number Restoration

8.0 REFERENCES

8.1 Treptow, Richard, S., Handbook of Methods for the Restoration of Obliterated Serial Numbers, NASA, 1978.

8.2 Polk, Donald, E. and Giessen, Bill, C. "Metallurgical Aspects of Serial Number Recovery", AFTE Journal Vol. 21, No. 2, p.174.

8.3 Bureau of Alcohol, Tobacco and Firearms Laboratory, Serial Number Restoration Handbook, 1999.

TM-V-2

CHEMICAL RESTORATION

NOTE: See Appendix 6 for serial number restoration on firearms.

1.0 INTRODUCTION

1.1 Many valuable items manufactured today have serial numbers for identification. These numbers are usually die stamped. This process produces a compression of the metal or plastic in the area immediately surrounding and a short distance below the penetration of the die. Serial numbers are removed and/or obliterated in a variety of ways. The serial number may be restored if the removal/obliteration is not taken past the previously mentioned compression zone.

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

1.3 OTHER RELATED PROCEDURES:

1.3.1 Polishing

1.3.2 Electro-Chemical

1.3.3 Magnetic

1.3.4 Heat

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions. Consult the appropriate MSDS for each chemical prior to use

2.2 NFPA Codes

	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
Cupric Chloride	3	0	0	
Hydrochloric Acid	3	0	0	
Ethyl Alcohol	0	3	0	
Nitric Acid	3	0	0	OXY
Ferric Chloride	2	0	0	
Sodium Hydroxide	3	0	1	

2.3 Chemical Warnings

2.3.1 WARNING! Chloride is toxic and can pose a SEVERE HEALTH HAZARD.

2.3.2 WARNING! Hydrochloric Acid is toxic and can pose a SEVERE HEALTH HAZARD.

2.3.3 WARNING! Nitric Acid is toxic and can pose a SEVERE HEALTH HAZARD.

2.3.4 WARNING! Nitric Acid is a strong solvent possessing oxidizing properties that can pose a SEVERE HEALTH HAZARD.

2.3.5 WARNING! Sodium Hydroxide is toxic and can pose a SEVERE HEALTH HAZARD

2.3.6 WARNING! Ethyl Alcohol is highly flammable and can pose a SEVERE SAFETY HAZARD

2.4 The examiner should consider the use of eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

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

3.2 Fry's Reagent

3.2.1 90 grams Cupric Chloride ($CuCl_2$)

3.2.2 120 mL Hydrochloric Acid (HCl)

3.2.3 100 mL distilled water (H_20)

3.3 Turner's Reagent

3.3.1 2.5 grams Cupric Chloride ($CuCl_2$)

3.3.2 40 mL Hydrochloric Acid (HCl)

3.3.3 25 mL Ethyl Alcohol

3.3.4 30 mL distilled water (H_20)

3.4 Davis Reagent

3.4.1 5 grams Cupric Chloride ($CuCl_2$)

3.4.2 50 mL Hydrochloric Acid (HCl)

3.4.3 50 mL distilled water (H_20)

3.5 25% Nitric Acid

3.5.1 25 mL Nitric Acid ($HN0_3$)

3.5.2 75 mL distilled water (H_20)

3.6 Acidic Ferric Chloride

3.6.1 25 grams Ferric Chloride ($FeCl_3$)

3.6.2 25 mL Hydrochloric Acid (HCl)

3.6.3 100 mL distilled water (H_20)

3.7 Ferric Chloride

3.7.1 25 grams Ferric Chloride ($FeCl_3$)

3.7.2 100 mL distilled water (H_20)

3.8 10% Sodium Hydroxide

3.8.1 10 grams Sodium Hydroxide (NaOH)

3.8.2 100 mL distilled water (H_20)

4.0 INSTRUMENTATION

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Initial inspection of the serial number area for coatings, trace material or any character remnants as well as possibly determining the method of obliteration

6.2 Utilize the "Polishing Procedure" if necessary.

6.3 Determine the serial number medium's physical properties, i.e. magnetic or non-magnetic

6.4 Utilize appropriate chemical reagent

6.4.1 Magnetic Media

6.4.1.1 Fry's Reagent

6.4.1.2 Turner's Reagent

6.4.1.3 Davis Reagent

6.4.1.4 25% Nitric Acid

6.4.2 Non-Magnetic Media

6.4.2.1 Ferric Chloride

6.4.2.2 Acidic Ferric Chloride

6.4.2.3 25% Nitric Acid

6.4.2.4 10% Sodium Hydroxide

6.4.2.5 Diluted Fry's Reagent

6.5 Apply the chemical solution to the area of obliteration utilizing cotton tip applicators or swabs that have been moistened with the chemical solution.

6.6 INTERPRETATION OF RESULTS:

6.6.1 If any characters become visible note these characters

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

7.2 Appendix 1 - Serial Number Restoration

8.0 REFERENCES

8.1 Treptow, Richard, S., Handbook of Methods for the Restoration of Obliterated Serial Numbers, NASA, 1978.

8.2 Polk, Donald, E. and Giessen, Bill, C. "Metallurgical Aspects of Serial Number Recovery", AFTE Journal Vol. 21, No. 2, p.174.

8.3 Bureau of Alcohol, Tobacco and Firearms Laboratory, Serial Number Restoration Handbook, 1999.

TM-V-3

HEAT

1.0 INTRODUCTION

1.1 Many valuable items manufactured today have serial numbers for identification. These numbers are usually die stamped. This process produces a compression of the metal or plastic in the area immediately surrounding and a short distance below the penetration of the die. Serial numbers are removed and/or obliterated in a variety of ways. The serial number may be restored if the removal/obliteration is not taken past the previously mentioned compression zone.

1.2 The Heat procedure is suitable for restoration of serial numbers in plastic. The die stamping or embossing process is a form of "coldworking" plastic. A side effect of cold working is the decrease of that item's ability to resist heat. Therefore the utilization of this procedure will affect the compressed area of the obliterated number faster and to a greater degree than the non cold-worked area surrounding it. This procedure, in conjunction with the polishing procedure, is an effective way to restore an obliterated serial number in heat.

1.3 OTHER RELATED PROCEDURES:

1.3.1 Polishing

1.3.2 Electro-Chemical

1.3.3 Magnetic

1.3.4 Chemical

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions. Consult the appropriate MSDS for each chemical prior to use

2.2 The examiner should consider the use of eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 NONE

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

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

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

6.3 INTERPRETATION OF RESULTS:

6.3.1 If any characters become visible note these characters.

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

7.2 Appendix 1 - Serial Number Restoration

8.0 REFERENCES

8.1 Treptow, Richard, S., Handbook of Methods for the Restoration of Obliterated Serial Numbers, NASA, 1978.

8.2 Polk, Donald, E. and Giessen, Bill, C. "Metallurgical Aspects of Serial Number Recovery", AFTE Journal Vol. 21, No. 2, p.174.

8.3 Bureau of Alcohol, Tobacco and Firearms Laboratory, Serial Number Restoration Handbook, 1999.

8.4 Roberts, Van, "Restoration of Serial Numbers in Plastic", AFTE Journal ,Vol. 13, No. 4, p. 40.

TM-V-4

MAGNETIC

1.0 INTRODUCTION

1.1 Many valuable items manufactured today have serial numbers for identification. These numbers are usually die stamped. This process produces a compression of the metal or plastic in the area immediately surrounding and a short distance below the penetration of the die. Serial numbers are removed and/or obliterated in a variety of ways. The serial number may be restored if the removal/obliteration is not taken past the previously mentioned compression zone.

1.2 The Magnaflux® technique is used by metallurgists to detect surface or subsurface flaws in iron or steel. Magnetic particles, applied to a magnetized specimen, outline the obliterated characters in a successful restoration. A side effect of cold working is the increase of that item's magnetism. Therefore, the utilization of this method will affect the compressed area of the obliterated number rather than the non cold-worked area surrounding it. This procedure, in conjunction with the polishing procedure, is an effective way to restore an obliterated serial number in nonmagnetic metal. The Magnaflux® technique is nondestructive, and can be applied without hindering other restoration methods.

1.3 OTHER RELATED PROCEDURES:

1.3.1 Polishing

1.3.2 Electro-Chemical

1.3.3 Heat

1.3.4 Chemical

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions. Consult the appropriate MSDS for each chemical prior to use.

2.2 NFPA Codes

	HEALTH HAZARD	FLAMMABILITY HAZARD	REACTIVITY HAZARD	CONTACT HAZARD
9CM Prepared Bath	1	4	0	
7HF Prepared Bath	1	4	0	
14AM Prepared Bath	1	4	0	
SKC-S Cleaner/Remover	1	3	0	OXY

2.3 Chemical Warnings

2.3.1 WARNING! 9Cm Prepared Bath is highly flammable and can pose a SEVERE SAFETY HAZARD

2.3.2 WARNING! 7 HF Prepared Bath is highly flammable and can pose a SEVERE SAFETY HAZARD

2.3.3 WARNING! 14 AM Prepared Bath is highly flammable and can pose a SEVERE SAFETY HAZARD

2.3.4 WARNING! SKC-S Cleaner Remover is highly flammable and can pose a SEVERE SAFETY HAZARD

2.4 The examiner should consider the use of eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

2.5 If the UV light source is being used, the examiner must protect against exposure to the eyes and minimize exposure to the skin.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 UV light source (if 14AM Prepared Bath is being used).

4.2 Yoke magnets

4.3 Y-7 AC/DC Yoke electromagnet

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Ascertain whether the specimen is suitable for testing with Magnaflux® by placing a magnet on the area of obliteration. The specimen is suitable if it can be magnetized.

6.2 Clean the area of obliteration with the SKC-S Cleaner/Remover by spraying this onto the surface and wiping. Allow this to dry before proceeding.

6.3 Apply Prepared Bath to the area of obliteration with a disposable pipet.

6.4 Place the magnet behind the area of obliteration, with the poles on either side of the area. This placement may be adjusted to reveal more or different areas of the obliteration.

6.5 If 14AM (Fluorescent) Prepared Bath is being used, observe the characters under a black light.

6.6 INTERPRETATION OF RESULTS:

6.6.1 Note any characters that become visible prior to proceeding with each step.

6.6.2 If any characters do not become visible, proceed to the appropriate chemical restoration procedure

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

7.2 Appendix 1 - Serial Number Restoration

8.0 REFERENCES

8.1 Treptow, Richard, S., Handbook of Methods for the Restoration of Obliterated Serial Numbers, NASA, 1978.

8.2 Polk, Donald, E. and Giessen, Bill, C. "Metallurgical Aspects of Serial Number Recovery", AFTE Journal Vol. 21 , No. 2, p. 1 74.

8.3 Bureau of Alcohol, Tobacco and Firearms Laboratory, Serial Number Restoration Handbook, 1999.

8.4 O'Reilly, W.E. Magnetic Restoration of Serial Number. AFTE Journal 7: 26-27.

8.5 Schaefer, Jeffrey. Serial Number Restoration Observations. AFTE Journal 19(3): 276-278.

8.6 Turley, Dennis M. Restoration of Stamp Marks on Steel Components by Etching and Magnetic Techniques. JFS 32(3): 640-649.

TM-V-5

ELECTROCHEMICAL

1.0 INTRODUCTION

1.1 Many valuable items manufactured today have serial numbers for identification. These numbers are usually die stamped. This process produces a compression of the metal or plastic in the area immediately surrounding and a short distance below the penetration of the die. Serial numbers are removed and/or obliterated in a variety of ways. The serial number may be restored if the removal/obliteration is not taken past the previously mentioned compression zone.

1.2 The electrochemical technique using the standard chemical etchants is an enhanced form of chemical restoration, in which the application of a voltage potential assists the oxidation of the specimen. The die stamping process is a form of "cold-working" metal. A side effect of cold working is the decrease of that item's ability to resist chemical attack. Therefore, the utilization of this method will affect the compressed area of the obliterated number faster and to a greater degree than the non cold-worked area surrounding it. This procedure, in conjunction with the polishing procedure, is an effective way to restore an obliterated serial number in magnetic metal.

1.3 OTHER RELATED PROCEDURES:

1.3.1 Polishing

1.3.2 Magnetic

1.3.3 Heat

1.3.4 Chemical

2.0 SAFETY CONSIDERATIONS

2.1 This procedure involves hazardous materials, operations and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to hazardous conditions. Consult the appropriate MSDS for each chemical prior to use.

2.2 The examiner should consider the use of eye protection, and work within a fume hood or utilize a spot vent. The examiner may wish to consider wearing a respirator and gloves.

3.0 PREPARATION

3.1 NONE

4.0 INSTRUMENTATION

4.1 Power source

5.0 MINIMUM ANALYTICAL STANDARDS and CONTROLS

5.1 NONE

6.0 PROCEDURE or ANALYSIS

6.1 Attach the specimen to the positive terminal of the power supply via an alligator clip.

6.2 Thoroughly soak the cotton tip of an applicator with the appropriate chemical enchant and attach this to the negative terminal of the power supply via an alligator clip, being certain to do so on a moistened area at the base of the cotton tip.

6.3 Turn on the power supply and adjust the voltage to 6V.

6.4 Wipe the area of obliteration, being careful to not touch the surface of the specimen with the alligator clip.

6.5 INTERPRETATION OF RESULTS:

6.5.1 Note any characters that become visible prior to proceeding with each step, as well as during the wiping process

7.0 APPROPRIATE SECTION IN FIREARMS/TOOLMARK MANUAL

7.1 Section 4.13.2.1 Worksheets

7.2 Appendix 1 - Serial Number Restoration

8.0 REFERENCES

8.1 Treptow, Richard, S., Handbook of Methods for the Restoration of Obliterated Serial Numbers, NASA, 1978.

8.2 Polk, Donald, E. and Giessen, Bill, C. "Metallurgical Aspects of Serial Number Recovery", AFTE Journal Vol. 21, No. 2, p.174.

8.3 Bureau of Alcohol, Tobacco and Firearms Laboratory, Serial Number Restoration Handbook, 1999.

8.4 Turley, Dennis M. Restoration of Stamp Marks on Steel Components by Etching and Magnetic Techniques. JFS 32(3): 640-649.

8.5 Deats, Marcellus. Serial Number Restoration Information. AFTE Journal l2 (3): 82-83.

8.6 Matthews, J. Howard. Firearms Identification. Volume I, pp. 77-80. Charles C. Thomas. Springfield, Illinois. 1962.

8.7 Miller, Ken E., Current Assist for Die Stamp Impression Restoration, AFTE Journal 4(3): 38.

APPENDIX 1: SERIAL NUMBER RESTORATION

The Bureau of Alcohol, Tobacco and Firearms have provided the following information. It details the method that they and several other laboratories are utilizing to categorize their serial number restoration analysis.

Guide To Illegal Firearms Trafficking Investigations

Section 2

Serial Number Removal

Definitions and Codes

Serial Number Removal Definitions and Codes

Page -11
Drilled/Cutting Device - DRI
The serial number is drilled out by using various types and sizes of drill bits or milling cutters. Individ[ual] drill impressions may be classified (round base or triangle base). Additionally, individual marks on other firearms or comparative test samples conducted with the suspect drill bit may be positively identified through comparative analysis and tool mark identification (casting).

Page -12
Engraved/Electric Scribe - ELS
An electric scribe or power assisted pointed engraving tool is used to obliterate or disfigure the stamped or engraved depression of the serial number and the surrounding by making several passes over the area or pressing the scriber into each element of the serial number until it is unreadable.

Page -13
Ground/Abrasive Grinding Device/Coarse Surface - GRC
The stamped or engraved depression of the serial number and surrounding area is ground or sanded to a common plane and the resulting relieved surface area is characteristically coarse. This type of mark is consistent in alterations produced with the edge of a course abrasive wheel applied in an angular or bias position which produces an easily discerned "Cross-grain" or "Angular" grinding signature.

Page -14
Ground/Abrasive Grinding Device/Smooth Surface - GRS
The stamped or engraved depression of the serial number and surrounding area is ground or sanded to a common plane and the resulting relieved surface area is characteristically smooth. This type of mark is consistent in alterations produced with the edge of a fine abrasive wheel applied in the same plane of the wheel's rotation which produces an "In-line" grinding signature.

Page -15
Ground/Abrasive Grinding Device/Concave Surface - GRV
The area containing the serial number is ground concave. This type of obliteration mark is consistent in alterations produced with a bench grinder or hand-held motorized grinding tool. The characteristic concave relief is achieved using an abrasive wheel or rotary file cutting in the same plane of the wheel's rotation which produces an "In-line" grinding signature.

Page -16
Peened/Compression Device/Hammer - PND
A series of manually applied impact depressions (peening marks) administered repetitively with a hammer or similar tool over and around the serial number to render it unreadable.

Page -17
Punched/Compression Device/Punch - PUN
A series of manually applied impact depressions (punch marks or holes) administered at random or in a pattern over and around the serial number to render it unreadable. Individual punch marks may be classified by style of tip. Additionally, similar marks on other firearms or comparative test samples conducted with the suspect punch may be positively identified through comparative analysis and tool mark identification (casting).

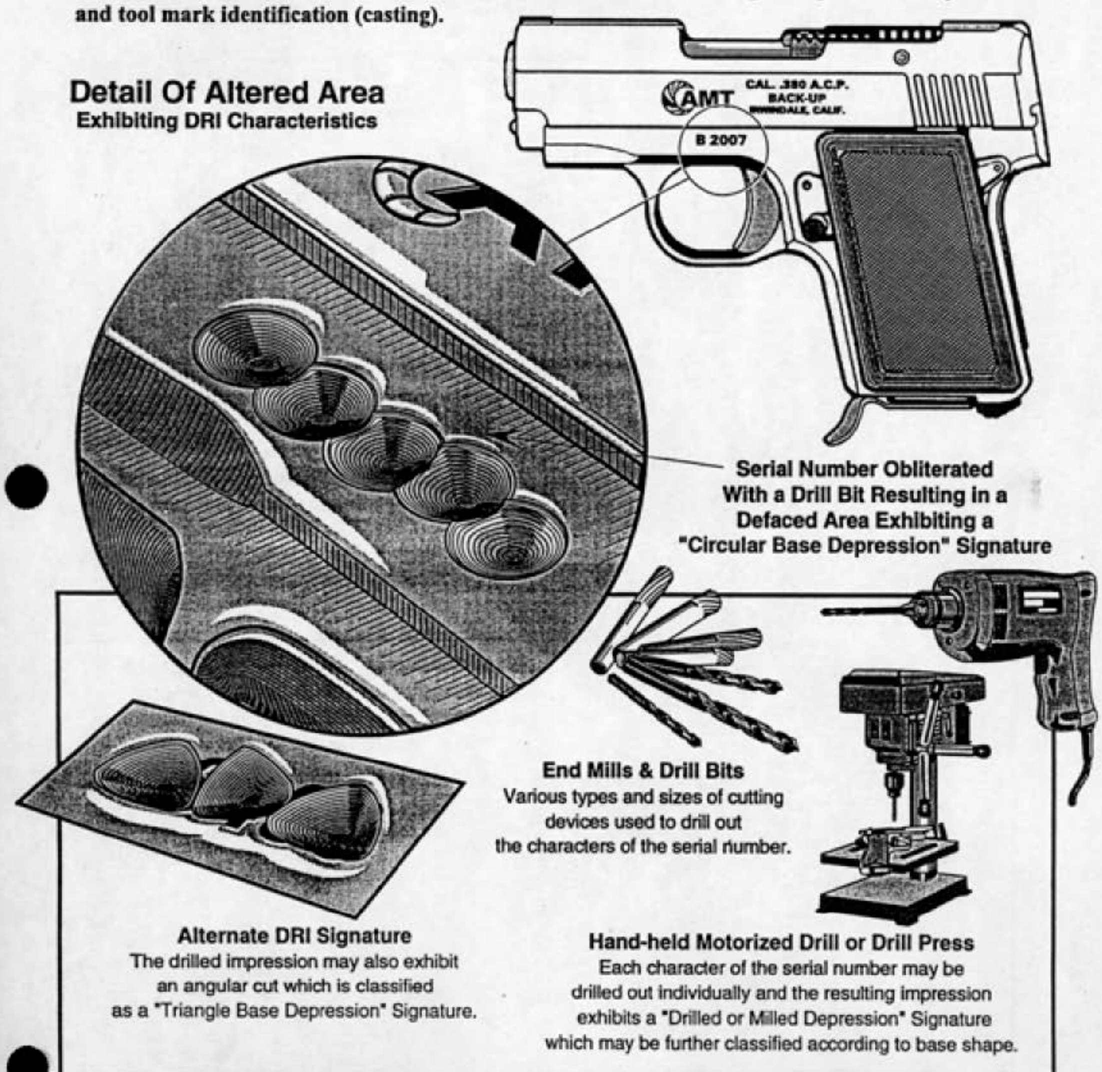
Page -18
Scratched/Broad Tipped Hand Tool - SCB
A broad tipped hand tool such as a chisel or standard blade screwdriver is used to repeatedly scratch the stamped or engraved depression of the serial number and the surrounding area until the number is unreadable.

Page -19
Scratched/Pointed Hand Tool - SCN
A pointed hand tool similar to an awl or scribe is used to repeatedly scratch the stamped or engrave[d] depression of the serial number and the surrounding area until the number is unreadable.

Serial Number Removal Definitions and Codes

Drilled/Cutting Device - DRI

The serial number is drilled out by using various types and sizes of drill bits and milling bits. The resulting individual drill impressions may be classified (circular base or triangular base). Additionally, similar individual impressions on other firearms or on comparative test samples conducted with the suspect drill bit may be positively identified through comparative analysis and tool mark identification (casting).



Cutting Devices used in Serial Number Removal that produce the DRI characteristics

Serial Number Removal Definitions and Codes

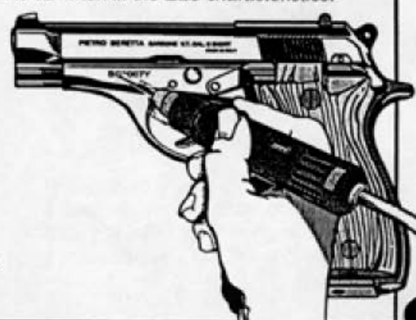
Engraved/Electric Scribe - ELS

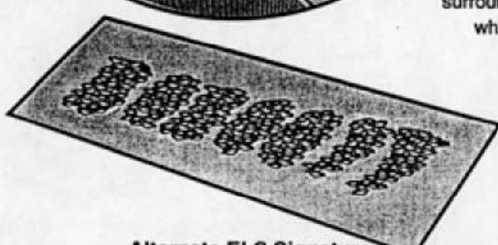
A power-assisted pointed engraving tool is used to obliterate or disfigure the stamped or engraved depression of the serial number and the surrounding by making several passes over the area or pressing the scriber into each element of the serial number until the it is unreadable.

Detail Of Altered Area
Exhibiting ELS Characteristics

Serial Number Is Obliterated by Making Multiple Passes with an Electric Scribe or Engraver Resulting in a Defaced Area Exhibiting a "Concentrated-Impact" Etched Signature

Power-Assisted Electric Scribe or Engraver
As the scriber is applied to serial number and surrounding area it produces a stippled appearance which is common in the ELS characteristics.





Alternate ELS Signature
Inserting the power assisted scriber into each element of the serial number produces individually defaced characters and renders the entire serial number unreadable.

Engraving Devices used in Serial Number Removal that produce the ELS characteristics

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Serial Number Removal Definitions and Codes

Ground/Abrasive Grinding Device/Coarse - GRC

The stamped or engraved depression of the serial number and surrounding area is ground or sanded to a common plane and the resulting relieved surface area is characteristically coarse. This type of mark is consistent in alterations produced with the edge of a course abrasive wheel applied in an angular or bias position which produces an easily discerned "Cross-grain" or "Angular" grinding signature.

Abrasive Grinding Devices used in Serial Number Removal that produce the GRC characteristics

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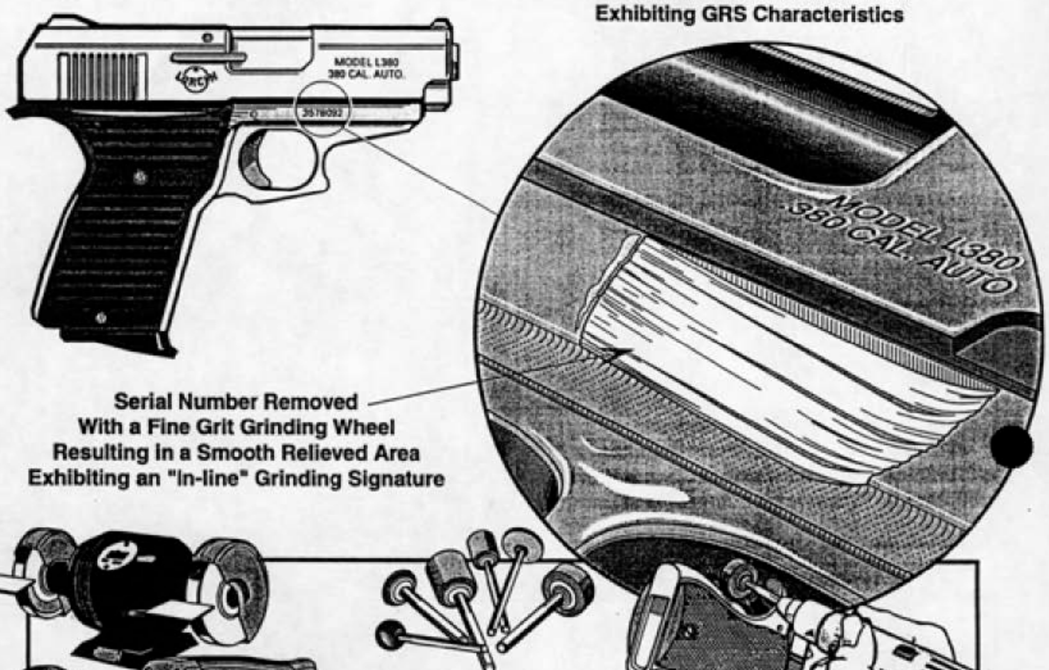
Serial Number Removal Definitions and Codes

Ground/Abrasive Grinding Device/Smooth - GRS

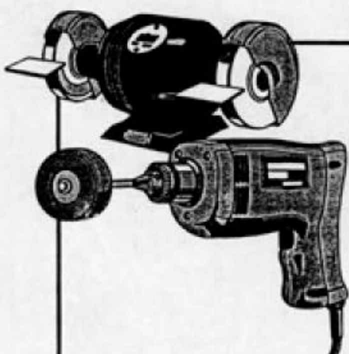
The stamped or engraved depression of the serial number and surrounding area is ground or sanded to a common plane and the resulting relieved surface area is characteristically smooth. This type of mark is consistent in alterations produced with the edge of a fine abrasive wheel applied in the same plane of the wheel's rotation which produces an "In-line" grinding signature.

Detail Of Altered Area

Exhibiting GRS Characteristics

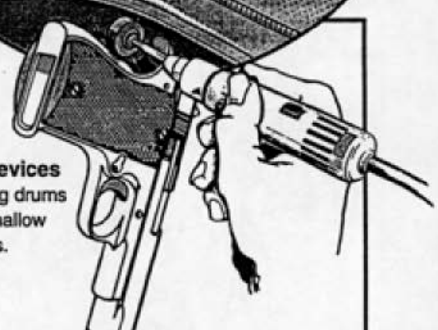


Serial Number Removed With a Fine Grit Grinding Wheel Resulting in a Smooth Relieved Area Exhibiting an "In-line" Grinding Signature



Shank Mounted Grinding Devices

Fine abrasive wheels and sanding drums generally produce a smooth shallow relief with feathered edges.



Bench Grinder and Hand Drill with Grinding Wheel

Large diameter fine grit abrasive wheels are generally used to alter larger areas with flat surfaces.

Hand-held Motorized Sanding Drum

Small diameter sanding devices may be used to address contoured surfaces.

Abrasive Grinding Devices used in Serial Number Removal that produce the GRS characteristics

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Serial Number Removal Definitions and Codes

Ground/Abrasive Grinding Device/Concave - GRV

The area containing the serial number is ground concave. This type of obliteration mark is consistent in alterations produced with a bench grinder or hand-held motorized grinding tool. The characteristic concave relief is achieved using an abrasive wheel or rotary file cutting in the same plane of the wheel's rotation which produces an "In-line" grinding signature.

Abrasive Grinding Devices used in Serial Number Removal that produce the GRV characteristics

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Serial Number Removal Definitions and Codes

Peened/Compression Device/Hammer - PND

A series of manually applied impact depressions (peening marks) administered repetitively with a hammer or similar tool over and around the serial number causing a flatening of the surrounding metal to render the number unreadable.

Compression Devices used in Serial Number Removal that produce the PND characteristics

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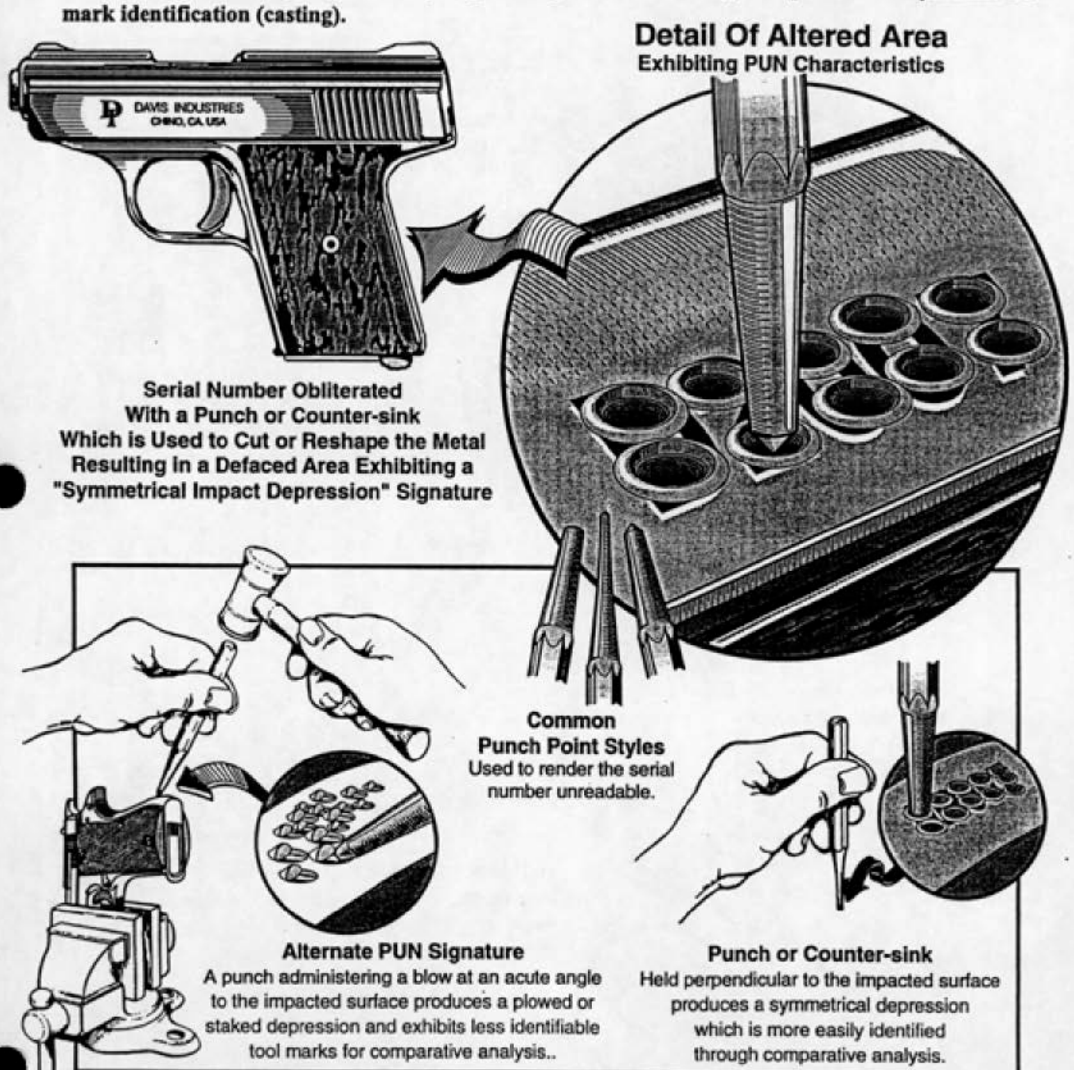
Serial Number Removal Definitions and Codes

Punched/Compression Device/Punch - PUN

A series of manually applied impact depressions (punch marks or holes) administered at random or in a pattern over and around the serial number to render it unreadable. Individual punch marks may be classified by style of tip. Additionally, similar marks on other firearms or comparative test samples conducted with the suspect punch may be positively identified through comparative analysis and tool mark identification (casting).



Serial Number Obliterated With a Punch or Counter-sink Which is Used to Cut or Reshape the Metal Resulting in a Defaced Area Exhibiting a "Symmetrical Impact Depression" Signature

Common Punch Point Styles
Used to render the serial number unreadable.

Alternate PUN Signature
A punch administering a blow at an acute angle to the impacted surface produces a plowed or staked depression and exhibits less identifiable tool marks for comparative analysis..

Punch or Counter-sink
Held perpendicular to the impacted surface produces a symmetrical depression which is more easily identified through comparative analysis.

Compression Devices used in Serial Number Removal that produce the PUN characteristics

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Serial Number Removal Definitions and Codes

Scratched/Broad Tipped Hand Tool - SCB

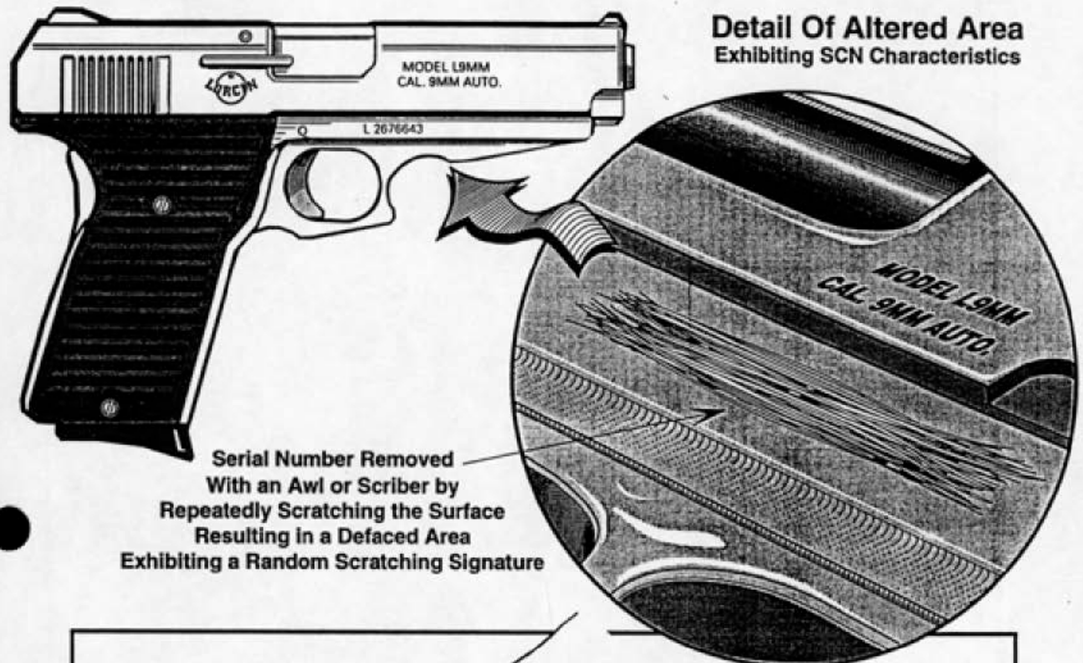
A broad tipped hand tool such as a chisel, scraper or screwdriver is used to repeatedly scratch the stamped or engraved depression of the serial number and the surrounding area until the number is unreadable.

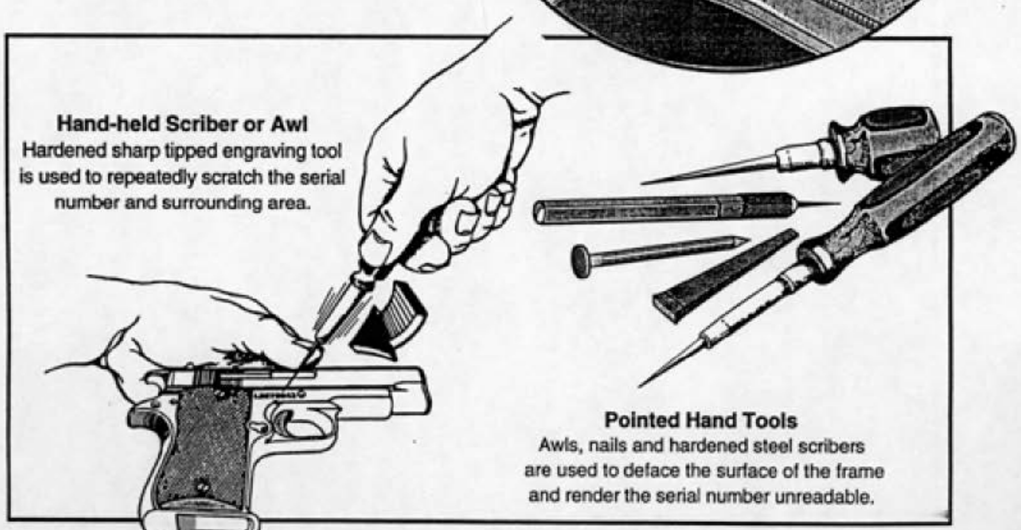
Engraving Devices used in Serial Number Removal that produce the SCB characteristics

Serial Number Removal Definitions and Codes

Scratched/Pointed Hand Tool - SCN

A pointed hand tool such as an awl or a hardened scriber is used to repeatedly scratch the stamped or engraved depression of the serial number and the surrounding area until the number is unreadable.





Engraving Devices used in Serial Number Removal that produce the SCN characteristics

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APPENDIX 2: PHYSICAL MATCHING

1.0 INTRODUCTION

Physical matching is the total or partial reconstruction of a broken, fragmented, or separated object. This section outlines the procedures used in the realignment of two or more evidence fragments to determine if they were at one time joined to form a single object. When an object has been torn, broken, or separated, one piece of it has the potential to match another piece of it when they are placed next to one another. In forensic investigations, this is called physical or fracture matching. Because both the composition of an object and the stress applied to break it are always unique, when something is broken, torn, or separated, the edges of the pieces will always have characteristics that identify them with each other. When the pieces fit together, an examiner can conclude they were originally part of the same object. Physical (or fracture) match is such an important concept in evidence presentation that it is considered to be scientific evidence in courts of law.

2.0 PREPARATION

2.1 Anything that can be torn, broken, or separated can be physically matched. Items commonly used for physical matching analysis include:

- Plastics
- Glass
- Metal
- Wood
- Car parts
- Paper
- Currency
- Tape
- Cloth

2.2 There are four different physical match criteria:

- The pieces have been broken apart.
- The pieces can be realigned.
- The pieces fit together along the fracture and the fit is verified by markings on the surface or within the three-dimensional structure of the fracture.
- The pieces contain unique shapes.

3.0 INSTRUMENTATION

3.1 Stereomicroscope

3.2 Comparison microscope with camera

3.3 Alternate light source

4.0 PROCEDURE

4.1 Before making any attempt at physical matching, known and unknown pieces are kept separate.

4.2 Inspect the shape of the break, any irregularities in the surface of the two pieces, and any striations that might have occurred during the break.

4.3 Examine the composition of the pieces for similarities in age, texture, and deformation.

4.4 When working with glass, preliminary observations regarding color, thickness, curvature, fluorescence, and surface features are made to eliminate pieces or to assure that all pieces could be from a single object. A mechanical fit is then attempted to determine if broken edges of unknown pieces lock together with pieces of known origin. Accidental characteristics such as scratches, striations, stains, etc. may aid in this reconstruction.

4.5 View paper fragments utilizing alternate light sources.

4.6 With paint samples, physical matching is the most conclusive type of identification. **Class Characteristics** such as topcoat color, layer sequence, and texture need to be distinguished from **Accidental Characteristics** which arise from use, abuse, and wear, such as fractured edges and surface striations.

4.7 In order for an examiner to identify two fragments as parts of one item, a microscopic comparison utilizing a stereomicroscope should be performed. The stereomicroscope allows the examiner to place the evidence within the same field.

4.8 A fragment can be positively identified if it can either be fitted into another fragment ("jig saw puzzle" fit) and/or the continuity of the item's surface markings can be established across the break or tear between the two fragments.

5.0 DOCUMENTATION

5.1 Photography is the recommended method of documentation for physical matches.

6.0 LIMITATIONS

6.1 This laboratory does not have the capability of performing chemical analysis for the purpose of fragment comparison.

APPENDIX 3: PACKAGING OF EVIDENCE FOR SUBMITTAL TO THE LABORATORY

1.0 INTRODUCTION

Submittal of firearm and toolmark evidence to the laboratory is addressed in the discipline manual for the Evidence section:

"Guns, knives, tools, etc. should be wired to the bottom of a box so the item does not puncture the packaging."

Firearm personnel should be consulted on issues involving specific packaging questions.

2.0 SAFETY

2.1 Firearm personnel should be consulted on issues involving specific safety questions.

3.0 PREPARATION

3.1 None

4.0 INSTRUMENTATION

4.1 None

5.0 PROCEDURE

5.1 Loaded Firearms

Is there ever a time or protocol when an agency can or will submit a loaded firearm and if so, how do you wish it to be boxed and delivered?

- There are situations where the lab would receive loaded firearms.
- Loaded guns should be hand-carried (not mailed) and any outside packaging boldly and clearly labeled to indicate the loaded condition.
- Once the gun is at the lab an experienced lab person familiar with firearms should unpackage the gun and unload it as soon as possible. It should not be put into storage at the lab in a loaded condition unless that is the only option.
- Common sense should rule the day. Keep fingers away from triggers and safeties. Any handling of the firearm must be with the muzzle pointed in a safe direction.

- However, I encourage everyone to treat every gun as if it is loaded with the safety in the "off" position. Keeping a heightened state of alert while handling guns will be valuable in the event of an unanticipated discharge.

5.2 Fired Bullets

5.3 Discharged Cartridge Cases

Follow protocol above, eliminating the rinse step (1).

6.0 DOCUMENTATION

6.1 None

APPENDIX 4: Shooting Reconstruction or Bullet Trajectory

SCOPE AND BASIC PRINCIPLES: The examination of defects and holes caused by projectiles fr om
firearms can provide information useful in the reconstruction of a shooting incident. Observations of impact sights can provide information about the projectile, the firearm,
intermediate objects in the
path of the projectile, direction of travel (entrance or exit), order of shots and other information. In some circumstances, the trajectory of the projectile may be determined and this can assist in determining possible positions from where a shot originated.

Shooting incidents are dynamic and varied, as is the evidence produced during such an event. No method can cover all types of evidence encountered at shooting scenes. This method is a starting point covering some of the basic equipment and techniques often used to process such scenes. Additional techniques and equipment may be necessary to meet the needs of a specific situation.

APPARATUS / REAGENTS:
Trajectory Kit

Multiple diameter trajectory rods
Zero edge protractors (90° and 180°, with laser mount)
Laser (threaded to fit trajectory rods) and extra batteries
String (colored and/or reflective)
Vernier/angle finder
Spacer trajectory cones (for centering rods in oversized holes)
Caliper or other measuring device
Calculator or sine table

Tripod with mount threaded to accept trajectory rods and laser
Photographic fog and or fine particulate material (like talcum powder)
Sodium Rhodizonate Kit

SAFETY PRECAUTIONS:
Laser - The lasers used in shooting reconstruction are typically class IIia. Direct, intrabeam exposure to the retina can cause damage. Never look directly into the beam and use caution when projecting the beam near others.

<u>Lead</u> - Lead is typically present on or in projectiles associated with shooting incidents and can be found in association with holes and impacts produced by these projectiles. Hands should be was hed as soon as practical after possible exposure, and prior to eating, drinking, smoking or other activities that could facilitate ingestion. Gloves may be used to avoid absorption through the skin or eyes by contact with a contaminated surface (hands, bullet hole, etc.).

PROCEDURES:

<u>1) General Observations:</u> After identification of an apparent impact sight or hole has been made, general visual observations should be noted. Characteristics of impacts and holes vary greatly and are affected by numerous factors including intermediate objects and the type of surface impacted. Such observations might include the dimensions of the impact or hole, any trace material that may have been transferred by the projectile (may indicate the type of projectile or an intervening object), indications of directionality (including exit vs. entrance) and any other significant observations. Such observations should be documented in written notes an d
photographically if possible. The location of impacts should also be documented (see additional information on documentation). Some materials have properties that produce characteristic defects upon impact which merit special consideration.

Metal:
<u>Pinch Point:</u> Angled impacts of a projectile with a surface, especially a painted metal surface, can produce a compression of paint or other material between the projectile and impacted surface. This compression, or pinch point, indicates where the projectile first made contact and its locatio n in relation to the hole or defect can assist in determining direction of travel of the projectile.

<u>Wake Effect on Ricochets:</u> Low angle impacts on painted metal surfaces (such as vehicles) can produce ricochets. In some cases the projectile can produce patterns in the paint or primer in a wake-like effect indicating the direction of travel of the projectile. The impact may result in arcs in the paint or primer, with the center arching in the direction of travel. The impact may also result in cracking of the paint which angles away from the direction of travel. It has been observed that thi s wake effect holds true for the impact side of the metal surface, in that the "wake" points in the direction of impact. It should be noted that the side opposite the impact may show similar effects. However, these effects on the opposite side from impact point in the opposite direction, with the "wake" pointing to where the projectile originated.

Glass:

Entrance vs. Exit: Penetrating shots produce cratering on the exit side. Non-penetrating shots pro duce cratering on the impact side. It should be noted that non-penetrating shots may produce holes in glass.

On non-tempered glass, if the area of impact is broken out so this cratering effect cannot be observed, pieces of glass remaining in the frame can be examined by the Trace Section to determine the direction of the force by the fracture patterns on the edge of the pieces. It is necessary to record which side of the collected pieces was on the interior and exterior of the pane of glass for the analysis to be meaningful.

Ricochets: Projectiles striking glass at low angles of impact (<15") may ricochet. Such impacts ma y produce defects in the glass that provide information regarding the direction of travel of the project ile.

Skid Marks are produced by the projectile skidding across the glass leaving a linear defect that reflects the path of the projectile. The skid mark shows the path of the projectile, but not the direction of travel. The skid mark gives two possible directions of origin 180 apart. Also, a ricoche t provides a maximum angle of 15° (or less) in either direction.

Crescent Shaped Cracks may also be produced by ricochets, and are normally observed at the terminal end of a skid mark. These crescent shaped cracks are similar to the "wake" effect in metal mentioned above, in that they indicate the direction of travel. The observation of these crescent shaped cracks, in conjunction with a skid mark, provides a maximum angle in a specific direction.

Radial Fracture Patterns: Non-tempered glass, either single pane or laminated (windshields) will often show a fracture pattern radiating from an impact sight. Once an impact creates radial fractures, fractures produced by subsequent impacts will be blocked by the fractures from the preceding impact(s). Observation of this blocking of fracture patterns indicates the order of impacts. Windshi elds, and some other safety glass, are actually two panes of glass with a plastic laminate between the panes. When examining fracture patterns it is important to verify that fractures being examined are on the same pane of glass. Interpretation of the order of shots should be done at the scene. Transportation of damaged glass for this purpose is not recommended due to the fragile nature of this type of evidence. If transportation is necessary, stabilize the glass with tape and/or superglue and mark the center of the holes by forming an X with two pieces of string.

In cases where the impact sight in glass has broken out, radial fracture patterns can be used to approximate the original location of a hole. By running strings along the fracture lines a central poi nt of
convergence can be obtained which will generally be close to the location of the original hole. The location of the hole may be useful in trajectory determination.

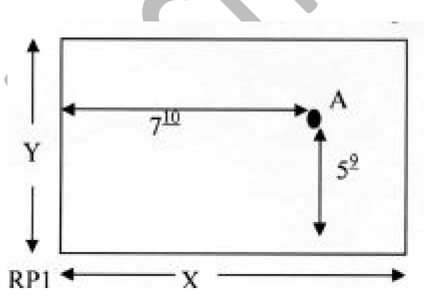
Particles of glass (2^0 projectiles) are often associated with impacts in glass. On penetrating shots, the greatest deposit is normally found on the exit side of the impact. However,

Glass fragments will normally be found on both the entrance and exit sides. Particles of glass may adhere to individuals in proximity of the impact. Known samples of the glass may be useful in linking a person to the incident (Trace SOP)

2) Documentation: There are several methods that will work to place bullet holes and defects, including baseline measurements, NEWS-type (North, East, West, South) measurements using reference points and azimuth measurements. In general, this laboratory will use two different methods. One method applies to flat surfaces, usually walls, and another method applies to vehicles or other irregular surfaces. Certain circumstances may require other documentation methods at the discretion of the case analyst. The critical aspect of documentation is to clearly define the method used, be consistent and take complete and clear notes.

Flat Surfaces will normally be documented in relation to a reference point. Once the reference point is established, measurements are taken documenting the distance of the point of interest from the reference point along two perpendicular axes. On *horizontal surfaces* the measurements will usually be given in NEWS format, as distances in two specified directions in relation to the fixed reference point. On *vertical surfaces*, the measurements from the reference point will be along a horizontal X-axis and a vertical Y-axis. These measurements should be recorded utilizing photography, sketch(s) showing the surface, reference points and points of interest, as well as table(s) indicating the reference point used and the distances from that point.

Example Sketch and Table



South wall of kitchen			
RP	Hole	X	Y
1	A	7^{10}	5^{9}

Vehicles and Other Irregular Surfaces require special consideration for documentation, and will generally involve *baseline measurements*. For vehicles, two baselines are established perpendicular to each other, with one down a side and the other across the front or back. These become the X- and Y-axis. A third, Z-axis, represents the height. Baselines must be placed out at least as far as the furthest protrusion on the vehicle or object (often the side mirrors and center of bumpers).

3) Determining Trajectories:

Trajectory Rods are used to produce a linear relationship between holes to produce a visual representation of the path the projectile traveled to produce those holes. Their use is relatively uncomplicated, they are highly visible and easy to photograph and can incorporate the use of lasers and/or string. After making general observations (step 1 above), carefully guide the rod along the observed path, taking care to do as little damage to the hole as possible. When connecting with a second hole, be sure the angles seem consistent with each other, especially if multiple shots are involved.

Trajectory Cones center rods in oversized holes (due to large caliber projectiles, deformed or unstable projectiles, debris/2^0 projectiles, etc). Holes must be evaluated to determine if a central location for the rod accurately reflects the path of the projectile.

Lasers or Strings can be used to extend the trajectories represented by rods. The laser will project a beam that may be used to help determine the direction of travel of the projectile, which may be useful in determining position of shooter or additional holes or impacts associated with the projectile in question. The use of *photographic fog* or *fine powder*, such as talcum powder, will allow the length of the laser beam to be visualized and photographically documented. These laser-enhancing techniques often work best in relatively small, enclosed areas where the product can be more concentrated. String can be used in a similar fashion to extend the trajectory established by rods to another point. String is often useful when trying to provide visual representation of multiple trajectories at one time.

When establishing trajectories, observe physical barriers that could provide limiting angles. This can assist in determining where a shot could not have originated from, or indicate a door or window was open, etc.

4) Determining the Angle of Impact:

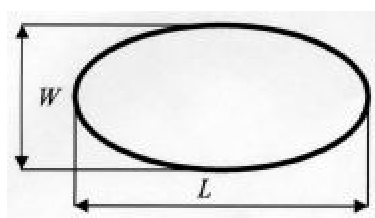
On some holes, the angle of impact of a projectile can be determined. This may be done as supplemental information after establishing a trajectory using rods.
Also, in instances where rods are not practical or possible, information regarding the trajectory may be gained that would not otherwise be available.

Directly Measuring the Angles of Trajectory Rods is the most straightforward and preferred method. On a vertical surface, such as a wall, a zero-edge protractor is used to measure the horizontal angle while holding the protractor flat against the wall with the 90" mark centered on the hole. This method can also be used to determine the vertical angle, however a vernier placed on the rod will allow for direct reading of the vertical angle. A similar method can be used to measure angles in two axes on a horizontal surface such as a floor.

Irregular or Curved Surfaces, such as vehicles, require care to ensure the angle measurements are taken in relation to fixed horizontal planes and a true vertical plane. If the base of the protractor is held at different planes on different holes to follow the curved contours of an object, the angles obtained will not be accurate or meaningful.

Trigonometric Method: In some instances, the use of rods to establish a trajectory my not be possible or practical. In such instances, the angle of impact may be determined by mathematical means based on the length and width measurements of a hole, as in determining the angle of impact on bloodspatter. This is based on the following formula:

$$\text{Angle of impact} = \sin^{-1} \frac{\text{width of hole } (W)}{\text{length of hole } (L)}$$



Once
the width and length of a hole have been measured, a calculator or sine table can be used to determine the inverse sine of W/L. Some holes may have one side with a poorly defined border. In such instances either an estimation of the length can be made, or an estimation of the midpoint of the hole is made and this half-length is doubled to produce an estimated length. If these types of estimations are made they should be noted and will detract from the weight of any conclusions based on the obtained angle of impact. Not all holes are suitable for accurate measurements.

This method may also be used on shot patterns. It is often difficult to clearly define the borders of a shot pattern. Holes produced by individual shot within a pattern may be measured to provide the angle and/or provide support for the estimated angle obtained by measuring the entire pattern.

Conclusions: The goal of this type of reconstruction is to describe where a shot originated from as accurately as possible in a manner that is understandable. Notes need to contain precise information on observations and measurements, and support any conclusions made. When the evidence at the scene is clear, conclusions may indicate a shot originated from a relatively small area such as the center of a room or an open doorway. If the evidence is less clear, general directions may be as precise as possible. Whenever possible, reported origins of projectiles should be given in context with the scene rather than just numbers or directions.

**It is important to note that not all holes are of sufficient quality to perform all the examinations mentioned above. Also, not all reconstructions will require all these examinations to be performed to reach a conclusion.

QUALITY ASSURANCE: Interpretation of trajectories and conclusions based on such interpretation is to be reported only by laboratory personnel who have completed documented training, including a competency examination, in this area of expertise. The peer review of this type of examination and related conclusions is to be conducted by laboratory personnel who have also competed such documented training.

APPENDIX 5

REVISION HISTORY

Changes from FTMWI2014 R0 to FTMWI2015 R0
No changes for this issue.