Technical Procedure for Firearm Examination

1.0 Purpose – To outline the procedures for examination of firearm evidence.

2.0 Scope – This procedure applies to cases submitted to the Firearm and Tool Mark Section that contain firearms.

3.0 Definitions

- **Action** – The working mechanism of a firearm. Examples include automatic, semiautomatic, lever, bolt, etc.
- **Active safety** – A safety system that requires manual manipulation by the user.
- **Ammunition** – One or more loaded cartridges consisting of a primed case, propellant, and with one or more projectiles.
- **Autoloading firearm** – A firearm that uses the energy of discharge to perform the loading portion of the operating cycle.
- **Automatic firearm** – A firearm design that feeds cartridges, fires, extracts and ejects cartridge cases as long as the trigger is fully depressed and there are cartridges in the feed system.
- **Barrel length** – The distance between the end of the barrel and the face of the closed breechblock or bolt. On revolvers, it is the length of the barrel including the threaded portion within the frame.
- **Breechblock** – The locking and cartridge head support mechanism of a firearm that does not operate in line with the axis of the bore.
- **Caliber (Firearm)** – The approximate diameter of the circle formed by the tops of the lands of a rifled barrel.
- **Cartridge** – A single unit of ammunition consisting of the case, primer, and propellant with one or more projectile(s). Also applies to a shotshell.
- **Cartridge case** – The container for all other components which comprise a cartridge.
- **Chamber** – The rear part of the barrel bore that has been formed to accept a specific cartridge.
- **Cock** – To place a firing mechanism under spring tension.
- **Compensator** – A device attached to or integral with the muzzle end of the barrel to utilize propelling gases for counter-recoil.
- **Cylinder** – The rotatable part of a revolver that contains the chambers.
- **Double action** – A handgun mechanism in which a single pull of the trigger cocks and releases the hammer.
- **Ejection pattern** – The charting of locations where a particular firearm ejects fired cartridge cases.
- **Ejection port** – An opening in the receiver and/or slide to allow ejection.
- **Ejector** – A portion of a firearm's mechanism which ejects or expels cartridges or cartridge cases from a firearm.
- **Extractor** – A mechanism for withdrawing the cartridge or cartridge case from the chamber.
- **Firearm** – An assembly of a barrel and action from which a projectile(s) is propelled by products of combustion.
- **Flare** – The circular gray-black deposits around the face of the chambers of a revolver produced by gunpowder residues upon discharge.
- **Flash suppressor** – A muzzle attachment designed to reduce muzzle flash.
- **Gauge** – The number of round lead balls of bore diameter that equal one pound. Thus 12 gauge is the diameter of a round lead ball weighing 1/12 pound.
- **Groove** – The lowered portion between the lands in a rifled bore.
- **Hammer** – A component of the firing mechanism which gives impulse to the firing pin or primer.

- **Hammer notch** – A groove in a hammer which engages a firing or safety component.
- **Hand** – The lever that rotates a revolver cylinder.
- **Land** – The raised portion between the grooves in a rifled bore.
- **Lock** – The action, either manual or automatic, of locking or supporting the bolt of a firearm immediately prior to firing.
- **Magazine** – A container for cartridges which has a spring and follower to feed cartridges into the chamber of a firearm.
- **Muzzle** – The end of a firearm barrel from which the bullet or shot emerges.
- **Muzzle velocity** – The velocity of a projectile as it exits the muzzle of a firearm.
- **Ogive** – The curved forward part of a bullet.
- **Overall length** – The dimension measured parallel to the axis of the bore of a firearm from the muzzle to a line perpendicular to the axis and tangent to the rearmost point of the butt plate or grip.
- **Passive safety** – A safety system designed to return automatically to the "on" (safe) position when the firearm is opened.
- **Pistol** – A handgun in which the chamber is part of the barrel.
- **Ratchet** – A notched wheel on the rear of a revolver cylinder which causes the cylinder to rotate when force is applied by a lever (hand).
- **Receiver** – The basic unit of a firearm which houses the firing and breech mechanism and to which the barrel and stock are assembled.
- **Revolver** – A firearm, usually a handgun, with a cylinder having several chambers so arranged as to rotate around an axis and be discharged successively by the same firing mechanism.
- **Sear** – A component which retains the hammer or striker in the cocked position until the trigger is pulled.
- **Semiautomatic firearm** – A repeating firearm requiring a separate pull of the trigger for each shot fired, and which uses the energy of discharge to perform a portion of the operating or firing cycle (usually the loading portion).
- **Single action** – An action requiring the manual cocking of the hammer before sufficient pressure on the trigger releases the firing mechanism.
- **Slide** – A component attached to and reciprocating with the breechblock.
- **Striker** – A rod-like firing pin or a separate component which impinges on the firing pin.
- **Suppressor** – A type of silencer which reduces muzzle blast by decreasing the velocity of escaping gases, but maintains a bullet's high velocity.
- **Trigger pull** – The amount of force which must be applied to the trigger of a firearm to cause sear release.

4.0 Equipment, Materials and Reagents

- Stereomicroscope
- Sper Scientific Digital Sound Meter
- Sper Scientific Acoustical Calibrator
- Oehler Chronograph
- NRA approved weight set
- NIST-traceable rod and ruler
- Vertical water tank
- Horizontal water tank
- Cotton boxes (5' and 12')
- Kevlar bullet chamber
- Firearm Reference Collection

- Firearms Reference Table (Royal Canadian Mounted Police)
- ATF Serial Number Structure Guide
- NRA Fact Book
- Ultrasonic cleaner
- Engraver
- IBIS envelopes
- Cotton-tipped swabs
- Ethanol, acetone
- White evidence tags
- Dummy rounds
- Plastic/nylon tie
- Tape measures
- Protractor
- 9-volt batteries
- Alkaline 9-volt battery
- Personal protective equipment

5.0 Procedure

5.1 Firearm Examination

5.1.1 Item Preparation

5.1.1.1 Prior to examination, ensure that any additional service requests (e.g., Forensic Biology, Trace, Latent, etc.) that shall be completed before analysis by the Firearm and Tool Mark Section have been completed. This may be verified by examining one, or a combination, of the following:

5.1.1.1.1 The status of other case records in Forensic Advantage (FA).

5.1.1.1.2 The chain of custody.

5.1.1.1.3 Markings from other Forensic Scientists on the evidence packaging.

5.1.1.2 Wear personal protective equipment, such as gloves, lab coat, and/or safety glasses, if the firearm may be contaminated with a biohazardous material (blood or other potentially infectious material).

5.1.1.3 Thoroughly examine all firearms to ensure they are unloaded and safe.

5.1.1.3.1 If the firearm is received loaded, and if the position of fired and live rounds is germane to the case, those positions shall be noted. On revolvers, mark the position of the chamber under the hammer by marking the cylinder on each side of the top strap, then note the relationship of the other cartridges/cartridge cases in relationship to the chamber under the hammer.

5.1.1.4 Visually inspect the firearm for possible trace evidence such as hair, fibers, wood, etc. Note the location on the firearm where the trace material was found.

Carefully remove the material and place in a container suitable for return to the submitting agency or submission to the appropriate Laboratory Section for further examination.

5.1.1.4.1 If the trace material is not to be retained, indicate such in the case notes.

5.1.1.5 Firearms that are contaminated with blood, body matter or other biological material shall be cleaned with a soft bristle brush and a disinfectant such as Terg-A-Zyme, Hibiclens, and/or ethanol.

5.1.1.6 Firearms may generally be cleaned with a cotton-tipped swab saturated with ethanol or acetone. Firearms may also be cleaned in an ultrasonic cleaner.

5.1.1.7 Mark all evidence firearms for identification.

5.1.1.7.1 Mark with the item designation number (K number), the Laboratory case number, and the Forensic Scientist's initials away from surfaces that may contact ammunition components.

5.1.1.7.2 Do not engrave police officers' service firearms. Use a white plastic numbered evidence tag for police officers' firearms.

5.1.1.7.3 Other exceptions shall be approved by the Forensic Scientist Manager.

5.1.2 Safe Firearm Handling

5.1.2.1 Treat all firearms as if they were loaded.

5.1.2.2 Always point firearms in safe direction.

5.1.2.3 Never load live rounds in a firearm in an office or examination room.

5.1.3 Physical Characteristics Examination

5.1.3.1 A separate Firearms Worksheet shall be completed in FA for each evidence firearm. Each worksheet shall contain the item designation number (K number) assigned to the firearm by the Forensic Scientist.

5.1.3.2 Features of firearms that shall be noted, if applicable, include:

- Make/manufacturer
- Importer
- Model
- Serial number
- Firearm type
- Action type
- Caliber/gauge (can measure bore diameter)
- Finish and grip description

- Magazine/cylinder capacity
- Magazine type
- Cylinder direction
- Firing pin shape
- Bore condition
- General Rifling Characteristics (GRCs):
  Number of lands and grooves
  Width of lands and grooves
  Direction of twist
- Safeties and their conditions
- Extractor and/or ejector position
- Rust, wear, damage

5.1.3.2.1 The Forensic Scientist may use the Firearm Reference Collection, the Royal Canadian Mounted Police Firearms Reference Table, and/or the ATF Serial Number Structure Guide in an attempt to determine information such as make/manufacturer, importer, model, serial number location and structure, caliber, etc., that cannot be located on the evidence firearm.

5.1.3.2.2 If the serial number has been obliterated, this shall be noted and the Forensic Scientist shall attempt to restore the serial number according to the Firearm and Tool Mark Section Technical Procedure for Serial Number Restoration.

5.1.3.2.3 Use dummy rounds whenever possible for determining capacity.

5.1.3.2.4 The Forensic Scientist may assign a "K" number to submitted magazines. If a "K" number is assigned, it shall be recorded in the case notes.

5.1.3.2.5 The Forensic Scientist shall note if a magazine submitted with the firearm does not fit the firearm. If the Forensic Scientist determines the type/manufacturer of the firearm that the magazine does fit, it shall be noted in the case notes.

5.1.3.3 Bore/Chamber Casting

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

5.1.3.3.2 If a firearm cannot be test fired or the land and groove impressions of the test fired bullets cannot be accurately measured, it may be necessary to make a bore cast. The cast may then be measured to determine land and groove widths.

5.1.3.3.3 Casts can be made using various casting materials such as Mikrosil™ and silicone rubber compounds.

5.1.3.4 Trigger Pull Determinations

5.1.3.4.1 Verify that the firearm is unloaded.

5.1.3.4.2 Measuring the trigger pull of a rimfire firearm shall not be performed on an empty chamber. Dummy rounds shall be used for this examination.

5.1.3.4.3 Using the NRA approved weight set provided to each Forensic Scientist, trigger pulls shall be measured using the dead weight method with the barrel of the firearm perpendicular to the floor.

5.1.3.4.4 Reset the sear connection after each attempt.

5.1.3.4.5 Single Action Trigger Pull

5.1.3.4.5.1 The firearm shall be cocked in the single action mode. For revolvers, measure the trigger pull on every chamber.

5.1.3.4.5.2 Record in pounds the greatest amount of weight the trigger can carry without releasing the hammer/striker from sear engagement. Record this number in the "greater than" (>) block in the case notes. This shall be recorded in no less than ¼ pound increments.

5.1.3.4.5.3 Record in pounds the least amount of weight the trigger can carry that releases the hammer/striker from sear engagement. Record this number in the "less than or equal to" (≤) block in the case notes. This shall be recorded in no less than ¼ pound increments.

5.1.3.4.5.4 The difference between the "greater than" weight and the "less than or equal to" weight shall be no less than one (1) pound. E.g., "greater than five (5.0) pounds but less than or equal to six (6.0) pounds" or "greater than seven and a half (7.5) pounds but less than or equal to eight and a half (8.5) pounds".

5.1.3.4.6 Double Action Trigger Pull

5.1.3.4.6.1 The firearm shall be in the double action mode with the hammer at rest and the safeties disengaged. For revolvers, measure trigger pull on every chamber.

5.1.3.4.6.2 Record in pounds the greatest amount of weight the trigger can carry without releasing the hammer/striker

from sear engagement. Record this number in the "greater than" (>) block in the case notes. This shall be recorded in no less than ¼ pound increments.

5.1.3.4.6.3 Record in pounds the least amount of weight the trigger can carry that actuates the internal mechanisms of the firearm and releases the hammer/striker from sear engagement. Record this number in the "less than or equal to" (≤) block in the case notes. This shall be recorded in no less than ¼ pound increments.

5.1.3.4.6.4 The difference between the "greater than" weight and the "less than or equal to" weight shall be no less than one (1) pound (e.g., "greater than five (5.0) pounds, but less than or equal to six (6.0) pounds" or "greater than seven and a half (7.5) pounds, but less than or equal to eight and a half (8.5) pounds").

5.1.3.5 Barrel and Overall Length Determinations

5.1.3.5.1 The barrel and overall lengths of any long gun that has had its barrel or stock shortened shall be measured.

5.1.3.5.2 These lengths shall include compensators, flash suppressors, or any other permanently affixed attachments to the muzzle of a firearm.

5.1.3.5.2.1 If the compensator or flash suppressor is removable, it shall be detached before measuring barrel length.

5.1.3.5.3 Barrel Length

5.1.3.5.3.1 Barrel length shall be measured using a NIST-traceable rod or ruler. If the NIST-traceable rod is to be used, the barrel length shall be measured after test firing and the subsequent microscopic comparison are completed. Care shall be taken when placing the rod down the barrel.

5.1.3.5.3.2 Measure the barrel length from the face of the closed breechblock or bolt to the farthest end of the barrel.

5.1.3.5.3.3 For revolvers, measure the barrel including the threaded portion within the frame.

5.1.3.5.4 Overall Length

5.1.3.5.4.1 Overall length shall be measured using a NIST-traceable ruler.

5.1.3.5.4.2 Measure the overall length of the firearm parallel to the axis of the bore from the muzzle to a line perpendicular to the axis of the bore and tangent to the rearmost point of the firearm.

5.1.3.5.5 Pursuant to N.C. G.S. 14-288.8(c)(3), "any shotgun with a barrel or barrels of less than 18 inches in length or an overall length of less than 26 inches, and rifle with a barrel or barrels of less than 16 inches in length or an overall length of less than 26 inches" is a "weapon of mass death and destruction".

5.1.4 Function Testing

5.1.4.1 No one procedure can sufficiently outline the steps necessary to examine all firearms for any malfunction. However, the following list of examinations shall serve as a guideline for the Forensic Scientist.

5.1.4.1.1 Visual Abnormalities

- Loose or bulged barrel
- Cracked receiver or slide
- Broken or missing parts
- Loose or missing screws
- Frozen or protruding firing pin
- Alterations or adaptations

5.1.4.1.2 Action (External)

- Correct assembly
- Proper locking of the action on closing
- Cylinder rotation (securely locks)
- Hand relationship to the ratchet
- Trigger pull and return
- Hammer push off

5.1.4.1.3 Safeties

- Active and passive
- The Forensic Scientist shall engage and disengage all safeties and, by dry firing or other methods, determine if the safeties are functioning properly. Dummy rounds shall be used when dry firing a rimfire firearm.

5.1.4.1.4 Action (Internal)

- Worn hammer notch or sear
- Weak or broken springs

5.1.4.2 Attempt to render an inoperable firearm operable by performing simple repairs, such as substituting parts from the Firearm Reference Collection. After test firing, remove any reference parts that may have been used. List in the case notes any parts that were substituted.

5.1.4.2.1 A firearm submitted as an "IBIS only" case that does not function and cannot be quickly repaired shall not be test fired for IBIS entry. An exception to this policy must be requested in writing by the appropriate District Attorney, US Attorney, Judicial Official, or Federal/State Official and approved by the Section Forensic Scientist Manager, Deputy Assistant Director or Laboratory Director.

5.1.4.3 Determine, when necessary, if the firearm will fire without applying force to the trigger. Drop-tests, push off tests or other tests are performed using dummy rounds or an unloaded firearm in an exam office. When it is necessary to use a primed cartridge case or ammunition, testing can be performed on the range. Tests for accidental discharge shall be conducted when requested or when appropriate (e.g., a firearm is found to have a faulty safety mechanism or the potential to slam-fire). A drop-test or jar-off test may be performed using the SAAMI Standard ANSI/SAAMI Z299.5-1996 as a guideline. **These tests shall be performed after the firearm has been test fired.**

5.1.5 Pre-Test Firing Safety Examination

5.1.5.1 A visual examination of the firearm prior to test firing is needed to determine:

- The presence of an obstruction in the bore.
- Any signs of cracks or weaknesses in the frame, slide, cylinder, or barrel.
- The overall mechanism functioning.
- The type of ammunition appropriate for use with the firearm.
- The need to test fire the firearm remotely.

5.1.5.2 Before test-firing, the Forensic Scientist shall test all autoloading firearms to ensure that they have not been altered to fire as automatic firearms either intentionally or through wear or damage.

5.1.5.2.1 Pursuant to N.C. G.S. 14-288.8(c)(3), "any firearm capable of fully automatic fire" is a "weapon of mass death and destruction".

5.2 Test Firing Protocol

5.2.1 Test firing recovery methods for comparison specimens include the vertical water tank, the horizontal water tank, the cotton boxes (5' and 12'), and the Kevlar bullet chamber. The type of firearm and ammunition tested will usually dictate the type of recovery method used.

5.2.1.1 If the test fired bullets/projectiles do not need to be recovered, the firearm may be fired downrange.

5.2.2 Ensure that the firearm is SAFE to fire including that the bore is unobstructed. Always wear appropriate eye and ear protection. Always ensure that the in-use warning lights of the indoor shooting areas are activated during test firing.

5.2.3 Use ammunition designed for the firearm.

5.2.3.1 There are exceptions to the above when the perpetrator has fired ammunition components in a firearm that was not designed to fire them. e.g., 16 gauge shotshell in a 12 gauge shotgun or a 357 Magnum fired in a 30-30 rifle.

5.2.3.2 On those occasions where ammunition not designed for a firearm must be fired in that firearm, extreme caution shall be maintained. Firing the firearm remotely may be the best option.

5.2.4 Tests shall be marked with a "T" or test number in sequential order, preferably before firing (e.g., test bullets fired from the K-1 pistol are marked T-1 and T-2 and their respective test cartridge cases are also marked T-1 and T-2). If there is a second firearm in the case, test bullets would be marked T-3 and T-4 and the cartridge cases likewise.

5.2.5 Fire at least two (2) rounds. Forensic Scientists shall load only one round at a time in a magazine for semiautomatic/automatic firearms. However, if the firearm has been confirmed as semiautomatic only, the Forensic Scientist may load more than one round in the magazine.

5.2.6 In certain cases, it may be necessary to clean the bore after the first test shots before firing any additional test shots. The firearm shall first be fired as it was received except when the bore is rusted, corroded, or blocked by mud/dirt such that it could not have been fired in that condition. Any cleaning of the bore shall be documented in the case notes.

5.2.7 The Forensic Scientist may choose to pre-mark the test cartridge cases with marks to assist in phasing during microscopic examination or marks indicating sequence of fire. E.g., place a phase mark beginning on the ogive of the bullet and extending down onto the casing. Chamber the round with the phase mark at 12 o'clock.

5.2.8 Use proper safety equipment such as ear protectors and safety glasses.

5.2.9 Treat every barrel of multiple-barreled firearms separately.

5.2.10 Retrieve test bullets immediately after firing.

5.2.11 A small manila envelope shall be used to hold test shots for entry into the Integrated Ballistics Identification System (IBIS). One side of the IBIS envelope shall be marked with the following information:

- Caliber – The caliber of the firearm.
- State Crime Laboratory Case number
- Manufacturer – Manufacturer of firearm.
- Model – Model of firearm, if known.
- SN# – Serial number of firearm, if present.
- Item# – The "K" number assigned to this firearm.

- Test Fires – Include a description of the test ammo used and the "T" numbers assigned to the test fired cartridge cases.
- Date of offense
- County
- Type of case
- IBIS Entries – Which test fires are to be entered into IBIS.
- Initials of the Forensic Scientist assigned to the case
- Agency – the agency that submitted the firearm.
- File # – Agency OCA (case identifying number)

5.2.12 Test fires are considered only as reference items in the Laboratory.

5.2.12.1 Test fires created using Laboratory ammunition for comparison purposes shall be returned to the submitting agency with the firearm in/from which they were test fired.

5.2.12.1.1 Test fires using Laboratory ammunition that are made solely for entry into the NIBIN/IBIS database and test fires made for other purposes (e.g., distance determination, gun function, muzzle velocity, etc.) may be disposed of on a regular basis. Disposal may be accomplished by placing the items in the appropriate containers that are transferred to State Surplus or other acceptable means approved by the Forensic Scientist Manager.

5.2.12.2 Test fires that are made from evidence ammunition submitted by the agency shall be returned in the same container in which the evidence cartridges were received. A statement shall be included in the Laboratory Report to reflect the fired condition of the evidence cartridges.

5.2.12.2.1 Bullets/projectiles from test fires using evidence ammunition that are used for distance determinations, muzzle velocity examinations, and suppressor examinations are not typically returned to the submitting agency because these tests preclude recovery of the projectiles.

5.2.13 After completion of examination and all necessary test firing, firearms shall be made safe by blocking the action with a plastic or nylon band/tie before packaging.

5.3 Ejection Pattern Examination

5.3.1 Standard ejection pattern test

5.3.1.1 Ejection pattern testing is firearm and ammunition specific. Use the suspect firearm and the same manufacturer and type of ammunition used in the incident. This determination may be made by the Forensic Scientist based on the ammunition and ammunition components received from the requesting agency.

5.3.1.2 Fire all ejection pattern tests at the indoor or outdoor range.

5.3.1.3 Shoot the tests at shoulder height. With pistols, use the strong hand and a strong grip and have the shooting arm extended. A measurement shall be made from the ejection port to a point on the ground directly below the ejection port (this point can be found using a plumb bob).

5.3.1.4 A minimum of five (5) rounds shall be fired.

5.3.1.5 A technician or second Forensic Scientist may be needed to locate and mark the points on the ground where the fired cartridge cases initially land or the Forensic Scientist may elect to use a parachute or other large drop cloth to determine where the fired cartridge cases initially land.

5.3.1.6 Measurements

5.3.1.6.1 General – Measurements shall be taken from the point on the ground directly below the ejection port to the ejected cartridge cases and the general direction (right/left of shooter, front/rear of shooter) of the ejected cartridge cases shall be noted.

5.3.1.6.2 Grid or Coordinate – A grid may be created from the point on the ground directly below the ejection port and may consist of two tape measures extending perpendicular and parallel to the axis of the bore (X and Y axes, respectively). The measurements would then be taken from the location of the cartridge case initial hit at right angles to the X and Y axes.

5.3.1.6.3 Protractor **–** A protractor may be placed on the ground directly below the ejection port with the muzzle pointing to the zero degree position. The distance to the location of the cartridge case initial hit may be measured and the approximate angle may be read from the protractor.

5.3.1.7 The Forensic Scientist may draw a sketch to illustrate the results.

5.3.2 A non-standard ejection pattern test

5.3.2.1 When information is provided to the Forensic Scientist about the conditions/situations of a shooting incident and the requesting agency asks that an ejection pattern test be conducted simulating those conditions/situations, the following protocol shall be followed:

5.3.2.1.1 First, conduct a standard ejection pattern test.

5.3.2.1.2 Next, using information provided by the submitting agency about the reported conditions of the shooting incident (e.g., shooter was 6' 6" tall, using a two-handed grip with the gun canted to the right, or the shooter was aiming the gun down at a 45 degree angle), the Forensic Scientist shall devise a method that best simulates the reported conditions. Because the variables are infinite, no set procedures shall be established for simulating these variables. It

shall be up to the Forensic Scientist to determine the best methodology to be used.

5.3.2.1.3 A minimum of five (5) rounds shall be fired.

5.3.2.1.4 A technician or second Forensic Scientist may be needed to locate and mark the points on the ground where the fired cartridge cases initially land or the Forensic Scientist may elect to use a parachute or other large drop cloth to determine where the fired cartridge cases initially land.

5.3.2.1.5 The same measurement method used for the standard ejection pattern test shall be used for the non-standard test.

5.3.2.1.6 The Forensic Scientist may draw a sketch to illustrate the results.

5.4 Suppressor Examination

5.4.1 Suppressor testing shall be performed at the indoor range using the Sper Scientific Digital Sound Meter and the Sper Scientific Acoustical Calibrator.

5.4.2 If, as received, the suppressor device ("device") is damaged to such a degree that it cannot be used again or may be unsafe to use, it shall be in the Forensic Scientist's discretion as to whether sound level testing will be performed.

5.4.3 The sound meter shall be calibrated prior to testing. Calibrate the sound meter using the acoustical calibrator as follows (the manual found inside the calibrator's case contains these instructions).

5.4.3.1 Insert two (2) 9-volt batteries into the acoustical calibrator and one (1) 9-volt battery into the sound meter.

5.4.3.2 Insert the microphone of the Digital Sound Level Meter into the Acoustical Calibrator Probe. Be sure the microphone fits snugly and is inserted completely.

5.4.3.3 Set the sound meter on a stable flat surface using the tripod stand built into the back of the meter. Turn on the Sound Level Meter and select the 50 - 100 dB range. Turn the sound level "speed" selector switch to "slow." Turn the calibration switch to the "C" position.

5.4.3.4 Move the switch on the Acoustical Calibrator to the "Battery Test" position. Be sure the LED lights up indicating a good battery.

5.4.3.5 Move the switch to the "ON" position on both the acoustical calibrator and the sound meter.

5.4.3.6 Using the small screwdriver provided with the sound meter, turn the calibration adjustment screw on the sound meter until the display reads 94 dB in the C

scale. (Reading may vary slightly from A to C weighting scales, but should be within the accuracy specifications.)

5.4.3.7 The meter is now calibrated and ready to use. The Forensic Scientist shall document in the case notes in the Suppressor section of the Firearms Worksheet that the meter was calibrated immediately prior to use.

5.4.4 Set up the Digital Sound Level Meter.

5.4.4.1 Place the sound meter on a flat surface using the built-in tripod approximately 10 feet from where the firearm will be fired. Point the microphone toward the muzzle of the firearm.

5.4.4.2 Move the power switch to the "ON (DC)" position.

5.4.4.3 Place the A/C weighting selector switch into the "C" position for C scale weighting.

5.4.4.4 Set the range selector the 80 - 100 dB range.

5.4.4.5 Set the speed selector to "PEAK."

5.4.5 Test fire the firearm without the device.

5.4.5.1 After each test fire:

5.4.5.1.1 Read the LCD reading of the sound level and record. Accuracy is +/- 1.5 dB.

5.4.5.1.2 Reset the "PEAK" reading by moving the speed selector to "FAST" and then back to "PEAK." A minimum of five (5) tests shall be fired. Adjust the range selector if necessary.

5.4.6 Test fire the firearm with the device attached to the muzzle.

5.4.6.1 After each test fire:

5.4.6.1.1 Read the LCD reading of the sound level and record. Accuracy is +/- 1.5 dB.

5.4.6.1.2 Reset the "PEAK" reading by moving the speed selector to "FAST" and then back to "PEAK." A minimum of five (5) tests shall be fired if allowed by the design or materials of the device. Adjust the range selector if necessary.

5.4.7 These readings shall be included in the case notes in the Suppressor section of the Firearms Worksheet.

5.4.8 Upon the conclusion of suppressor testing, remove the batteries from the acoustical calibrator and the sound meter and place them in their respective cases.

5.4.9 The order of testing (device/no-device) may be reversed if the device, due to materials or method of attachment to the firearm, may be damaged by removal and re-attachment to the firearm.

5.4.10 If the sound level is reduced when the firearm is equipped with the device by an amount greater than the sound meter's accuracy limitations as defined below, the device functions to reduce the sound.

5.4.10.1 Calculate the average measurement of the five (5) test shots performed without the device attached to the firearm (firearm-only) and the average measurement of the five (5) test shots performed with the device attached to the firearm (firearm-with-device).

5.4.10.2 The accuracy of the Sper Scientific Digital Sound Level Meter is 1.5 dB and this shall be considered when determining the significance of the reduction. If the firearm-only average is more than 3dB greater than the firearm-with-device average, the device functions to reduce sound. The 3dB tolerance is the result of conservative application of the sound meter's accuracy limitations.

5.4.10.3 Due to design or materials of the device, a series of five (5) test shots may not be possible. In this case, the maximum value reading for the firearm-with-device testing shall be subtracted from the minimum value reading for the firearm-only testing. If this difference is more than 3dB, the device functions to reduce sound.

5.4.10.4 Any and all calculations related to sound testing shall be included in the Suppressor section of the Firearms Worksheet.

5.5 Muzzle Velocity Examination

5.5.1 Muzzle velocity testing may be performed at the indoor or outdoor firing range using the Oehler Chronograph.

5.5.2 For CO_2-operated firearms, a new CO_2 cartridge shall be used for muzzle velocity testing.

5.5.3 For pneumatic firearms, the maximum number of pumps as defined by the manufacturer shall be used for muzzle velocity testing.

5.5.4 The calibration of the chronograph shall be checked prior to testing. Check the calibration of the chronograph as follows.

5.5.4.1 The calibration check shall be performed using the following rifle and ammunition:

5.5.4.1.1 U.S. Springfield Armory, caliber 22 Long Rifle, bolt action rifle, serial number 666A, Model M2, Firearm Reference Collection #FA3280. This firearm shall be maintained in the Firearm Reference Collection.

5.5.4.1.2 Federal Gold Medal Target, caliber 22 Long Rifle, 40 grain solid lead, Lot #3AV141. This ammunition shall be maintained with the other reference standards in a designated area of the Firearm Section. Once this lot of ammunition is depleted, the chronograph shall be returned to the manufacturer for calibration and a new lot of ammunition shall be utilized upon return.

5.5.4.2 The Oehler chronograph shall be set up according to the manufacturer's instructions.

5.5.4.3 The spacing of the start/stop sensors (skyscreens) shall be placed at a four (4) foot interval. The lens surface of each skyscreen may need to be cleaned. Cleaning shall be performed with a swab and distilled water.

5.5.4.4 The muzzle of the test firearm shall be placed ten (10) feet from the start sensor. The triangular light diffusers shall form a triangle-within-a-triangle sight picture looking down the barrel at the target from a normal shooting position.

5.5.4.5 Connect the cables from the skyscreens to the input jacks of the Oehler model 35P as described in the operating manual. Make sure the chronograph has an alkaline 9-volt battery installed and the plugs are pushed all the way into the jacks.

5.5.4.6 Place the chronograph at a convenient location well behind the muzzle to protect it from muzzle blast.

5.5.4.7 A string of five (5) verification shots shall be made using the designated rifle and ammunition. The string of shots shall be considered sufficient if no error readings are obtained (indicated by "*" on the printout). If error readings are obtained, a second string of five (5) shots shall be made. No more than five (5) attempts shall be made to obtain an error-free string of verification shots. If five (5) attempts are made and no error-free string is obtained, the chronograph shall be pulled from service and returned to the manufacturer for calibration inspection.

5.5.4.8 Once an error-free string of verification shots is obtained, the Forensic Scientist shall view the summary of the test shots.

5.5.4.8.1 If the given standard deviation (indicated by an "S" on the printout) is 25 or greater, the chronograph shall be considered to be "out of calibration" and shall be pulled from service and returned to the manufacturer for calibration inspection.

5.5.4.8.2 If the given standard deviation is less than 25, then the Forensic Scientist may proceed with test firing of the questioned/evidence firearm.

5.5.4.9 A printout shall be made of each string of verification shots. The printout shall be dated and initialed by the Forensic Scientist. The printouts shall then be

electronically scanned and imported into the Case Record Object Repository and into the designated Firearm and Tool Mark Section shared folder.

5.5.5 After the calibration check, the display will read "- - - 0" to show that it is ready to begin a new group. If it does not, push the RESET button.

5.5.6 The firearm shall be test fired a minimum of five (5) times consecutively without an erroneous reading. Allow the chronograph to print the result of each test fire before firing the next. If an erroneous reading occurs (indicated by "*") press the OMIT button one (1) time to erase this reading from the memory. A minimum of five (5) valid readings shall be taken.

5.5.7 Upon completion of test firing, press the SUMMARY button to print a summary of the test velocities. These figures shall be included in the Chronograph section of the Firearms Worksheet in the Forensic Scientist's notes. The print summary will show:

- The high velocity denoted by +
- The low velocity denoted by -
- The extreme velocity spread denoted by E
- The average velocity denoted by M
- The standard deviation denoted by S

5.5.7.1 The printed summary shall be dated and initialed by the Forensic Scientist. The printout shall then be electronically scanned and imported into the Case Record Object Repository.

5.6 Range of Conclusions

5.6.1 The suggested report wording listed below may be modified at the Forensic Scientist's discretion to reflect more accurately his/her conclusions. Any such modifications to report wording shall be reviewed and approved with the technical review.

5.6.2 Firearm Function and Trigger Pull Examinations

5.6.2.1 Proper function

- "The K-1 pistol functions properly."

5.6.2.2 Malfunctioning Safety

- "The K-1 pistol will fire by pulling the trigger when the hammer is cocked and the safety lever is either engaged or disengaged."

5.6.2.3 Broken or Missing Parts

- "As received, the K-1 pistol does not function. K-1 is missing a hammer and recoil spring. Parts from a reference firearm were used to replace the missing parts in the K-1 pistol and K-1 then functioned properly."

5.6.2.4 Trigger Pull

- "The K-1 pistol has a single action trigger pull of greater than five (5) pounds but less than or equal to six (6) pounds and a double action trigger pull of greater than ten (10) pounds but less than or equal to eleven (11) pounds."

5.6.3 Ejection Pattern Examination

5.6.3.1 Standard ejection pattern test

5.6.3.1.1 Results shall be reported in general terms unless asked by the requesting Agency for more specific information.

- "Using the K-1 pistol and ammunition like the K-1A cartridges, an ejection pattern test was conducted. The K-1 pistol was held at shoulder height (approximately 58 inches) [always include the approximate height in inches] with a firm grip in the Forensic Scientist's strong hand. Fired cartridge cases landed or tended to land to the right and rear of the shooter."

5.6.3.1.2 The Forensic Scientist may include distances in the results.

- "Using the K-1 SKS rifle and the K-2 ammunition, an ejection pattern test was conducted. The rifle was held at shoulder height (approximately 58 inches) [always include the approximate height in inches] and fired cartridge cases were ejected to the right front of the shooter from 16 feet to 32 feet."

5.6.3.2 Non-standard ejection pattern test

5.6.3.2.1 First, report the results of a standard ejection pattern test.

5.6.3.2.2 Next, report the results of the non-standard ejection pattern test including an explanation of all the variables used to conduct the examination.

- "With the K-1 pistol held at a height of approximately 60 inches in a two handed grasp and with the pistol canted to the right at an approximate 45 degree angle, fired cartridge cases were ejected or tended to be ejected to the right of the shooter at distances from 2 feet to 4 feet."

5.6.4 Suppressor Examination

5.6.4.1 Device reduces the sound level

- "The barrel attachment supplied with the K-1 pistol acts as a sound suppression device."

5.6.4.2 Device does not reduce the sound level

- "The barrel attachment supplied with the K-1 firearm does not act as a sound suppression device."

5.6.5 Muzzle Velocity Examination

- "The K-1 pistol has an average muzzle velocity of 805 feet per second."

5.7 Standards and Controls – N/A

5.8 Calibration

5.8.1 For sound meter calibration information, see 5.4.3.

5.8.2 For chronograph calibration information, see 5.5.4.

5.8.3 For NIST-traceable rod and ruler calibration information, see the Firearm and Tool Mark Section Technical Procedure for Instrument Calibration and Maintenance.

5.9 Maintenance – For sound meter, chronograph, and NIST-traceable rod and ruler maintenance, see the Firearm and Tool Mark Section Technical Procedure for Instrument Calibration and Maintenance.

5.10 Sampling – N/A

5.11 Calculations – N/A

5.12 Uncertainty of Measurement – See the Plan for Estimating the Uncertainty of Measurement.

6.0 Limitations – The ejection pattern examination is firearm and ammunition specific.

7.0 Safety – Examinations performed in the Firearm and Tool Mark Section are inherently dangerous. These procedures involve hazardous chemicals, firearms, ammunition, and potential biohazards. All hazardous procedures shall be performed in compliance with the State Crime Laboratory Safety Manual. If the examination involves a biohazard, the Forensic Scientist shall use proper personal protective equipment such as eye protection, lab coat, and/or gloves.

8.0 References

American National Standards Institute. "Criteria for Evaluation of New Firearms Designs Under Conditions of Abusive Mishandling for the Use of Commercial Manufacturers". *Voluntary Industry Performance Standards ANSI/SAAMI Z299.5-1996* Newtown, CT: Sporting Arms and Ammunition Manufacturers' Institute Inc., 1996.

Association of Firearm and Tool Mark Examiners. *Glossary*. 4th ed. 2001.

Association of Firearm and Tool Mark Examiners. *Procedures Manual*. 2001.

Biasotti, A. A. "Vise/Rest for Remote Firing." *AFTE Journal* Fall 1979: 16.

"Bullet and Cartridge Case Recovery." *AFTE Journal* Spring 1984: 75.

Crum, Richard A., and Edward M. Owen. "Silencer Testing." *AFTE Journal* Spring 1989: 433.

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

Denio, Dominic. "Making a Rusted Gun Functional." *AFTE Journal* Summer 1981: 29.

"Forensic Examination Guidelines for Silencers." *swggun.org*. SWGGUN, n.d. Web. 14 Dec. 2011.

Gamboe, Tom. "MAFS Firearms Workshop: Trigger Pull Methods." *AFTE Journal* Summer 1986: 77.

"Guidelines for Trigger Pull Analysis." *swggun.org*. SWGGUN, n.d. Web. 14 Dec. 2011.

Haag, Michael, Jay Stuart, and Kim Haag. "Ejection Patterning – Standard Testing and Effects of Non-Standard Angles, Orientations and Maneuvers." *AFTE Journal* Spring 2009: 111-129.

Howe, Walter, J. "Laboratory Work Sheets." *AFTE Newsletter, No 2* August 1969: 13.

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

McBrayer, William S. "What? Another Water Tank and Bullet Stop!" *AFTE Journal* Spring 1978: 90.

National Rifle Association of America. *A Guide to Firearms Safety*. May 1994.

National Rifle Association of America. *NRA Firearms Fact Book*. 3rd ed. Fairfax, VA: National Rifle Association of America, 1989.

"New Ballistics Tank from Detroit-Armor Corporation Allows Fast Recovery Without Projectile Distortion." *AFTE Journal* Summer 1984: 106.

Poole, Robert A. "Mikrosil Casting Material Information." *AFTE Journal* Spring 1983: 80.

"The Proper Method for Measuring Weapons." *AFTE Journal* Summer 1982: 10.

Rios, Ferdinand and Thornton, John. "Static vs. Dynamic Determination of Trigger Pull." *AFTE Journal* Summer 1984: 84.

"Silencers - A Review and A Look At The State Of The Art." *AFTE Journal* Spring 1991: 668.

Thompson, Roger C. "Firearms Malfunction Worksheets." *AFTE Journal* Winter 1983: 100.

United States. Title 18, United States Code, Chapter 44. Section 921, paragraph 24 (Gun Control Act of 1968).

United States. Title 18, United States Code, Chapter 44. Section 923, paragraph I (Gun Control Act of 1968).

9.0 Records

- FA Worksheets: Main, Firearms, Serial Number, and Disposition/Result
- Chronograph Result Printout

10.0 Attachments – N/A

Revision History		
Effective Date	Version Number	Reason
09/17/2012	1	Original Document
10/17/2012	2	Removed an item from the list in 5.1.3.2; changed pounds to pound in 5.1.3.4.5.3; added parentheses in 5.1.3.4.6.4; added a phrase to 5.2.1 to specify that that section is referring to test firing for comparison specimens; added the last sentence to 5.2.5; removed items from the list in 5.2.11.
12/07/2012	3	5.1.3.2 – changed "Maximum capacity, including chamber" to "Magazine/cylinder capacity"