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 Firearms Section that contain firearms.

3.0 Definitions

- **Action** – The working mechanism of a firearm. Examples include automatic, semiautomatic, lever, and bolt.
- **Active safety** – A safety system that requires direct 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 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.
- **National Integrated Ballistic Information Network (NIBIN) –** a database that correlates images of fired cartridge cases from crime scenes and from firearms seized during criminal investigations for the purpose of discovering associations between crimes.
- **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 that does not require direct manual manipulation by the user.
- **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.
- **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
- Comparison microscope
- Comparison microscope reference bullet
- Approved weight set
- Hott-Rods™
- Calibrated rulers
- DMD-48
- DMD-48 calibration rod
- 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
- NIBIN envelopes
- Cotton-tipped swabs
- Ethanol, acetone
- White evidence tags
- Dummy rounds
- Shotshell firing pin tester kit, primers
- Plastic/nylon tie
- Tape measures
- Rubber block backstop
- Snail® system bullet trap
- Personal protective equipment
- Casting material (e.g. Mikrosil™, AccuTrans®)

5.0 Procedure

5.1 Firearm Examination

5.1.1 Item Preparation

5.1.1.1 Prior to analysis, ensure that any additional examinations (e.g., Forensic Biology, Trace, Latent) that must be completed before analysis by the Firearms Section have been completed.

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

5.1.1.2.1 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.

5.1.1.3 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.

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

5.1.1.4 Firearms that are contaminated with blood, bloody matter, or other biological material shall be evaluated for the need to preserve biological material. Upon evaluation and preservation, if required, the firearm may be cleaned with a soft bristle brush and a disinfectant such as Terg-A-Zyme, Hibiclens, and/or ethanol.

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

5.1.1.6 Mark all evidence firearms for identification.

5.1.1.6.1 Do not engrave police officers' service firearms. Use a plastic evidence tag for police officers' firearms.

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 worksheet shall be completed for each evidence firearm.

5.1.3.2 NIBIN-only cases are not required to use the specific Firearms Worksheet.

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

- Make/Manufacturer
- Model
- Serial number
- Firearm type
- Action type
- Caliber/gauge (can measure bore diameter)
- Safeties and their condition
- Rust, wear, damage
- Number of land and groove impressions
- Direction of twist

5.1.3.4 Feature of firearms that may be noted, if applicable, include:

- Importer
- Bore Condition
- Finish and grip description
- Cylinder rotation direction
- Magazine/cylinder capacity
- Magazine type
- Firing pin shape
- Width of lands and grooves (see Technical Procedure for Fired Projectile Examination)
- Extractor and/or ejector position

5.1.3.3.1 The Forensic Scientist may use the Firearm Reference Collection, the Royal Canadian Mounted Police Firearms Reference Table, firearm industry contacts, 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.

5.1.3.3.2 Use dummy rounds whenever possible for determining capacity.

5.1.3.3.3 The Forensic Scientist shall note if a magazine submitted with the firearm does not fit the firearm.

5.1.3.4 Bore/Chamber Casting

5.1.3.4.1 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.

5.1.3.4.2 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.

5.1.3.4.3 Casts can be made using various casting materials such as Mikrosil™, AccuTrans®, and silicone rubber compounds.

5.1.3.5 Trigger Pull Determinations

5.1.3.5.1 Trigger Pull Determinations shall be completed only upon request of the submitting agency, the prosecuting agency, or with approval from the Firearms Forensic Scientist Manager or designee.

5.1.3.5.2 Verify that the firearm is unloaded.

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

5.1.3.5.4 Using an approved weight set, trigger pulls shall be measured using the dead weight method such that the force applied during measurement is approximately parallel to the bore axis.

5.1.3.5.4.1 In the case of a firearm exhibiting an unusual design of the trigger, a second trigger pull test may be performed to accommodate these differences. Both sets of trigger pull measurement results shall be reported.

5.1.3.5.5 Reset the sear connection after each attempt.

5.1.3.5.6 Single Action Trigger Pull

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

5.1.3.6.5.2 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.

5.1.3.6.5.3 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.

5.1.3.6.5.4 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."

5.1.3.6.5.4.1 In the event a firearm's trigger pull consistently performs at a narrower range, a half-pound range may be reported.

5.1.3.6.6 Double Action Trigger Pull

5.1.3.6.6.1 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.

5.1.3.6.6.2 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.

5.1.3.6.6.3 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.

5.1.3.6.6.4 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").

5.1.3.6.6.4.1 In the event a firearm's trigger pull consistently performs at a narrower range, a half-pound range may be reported.

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
- Bore obstruction
- 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 "NIBIN only" case that does not function and cannot be quickly repaired shall not be test fired for NIBIN entry. An exception to this policy must be requested in writing by the appropriate prosecuting agency, and approved by the Section Forensic Scientist Manager, 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 as a guideline. **These tests shall be performed after the firearm has been test fired.**

5.1.4.4 Determine if the firearm is capable of firing using the test firing protocol below.

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 bullet comparison specimens include the vertical water tank, the horizontal water tank, the cotton boxes (5' and 12'), Snail® System bullet trap, 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 or into the rubber block backstop.

5.2.2 Ensure that the firearm is safe to fire including that the bore is unobstructed. Always wear appropriate eye and ear protection. If available, 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 ammunition components have been fired 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 Use proper safety equipment such as hearing protection and safety glasses.

5.2.5 Test fires created for comparison purposes shall be marked in sequential order, preferably before firing.

5.2.6 If no test fires are needed for comparison purposes, the firearm shall be test fired as follows:

5.2.6.1 For firearms that do not cycle automatically, such as revolvers, single shot rifles, and pump action shotguns, at least one (1) test fire shall be performed to illustrate functionality.

5.2.6.2 For semiautomatic and fully automatic firearms, at least two (2) test fires shall be performed to illustrate functionality fully by including the automatic cycling of the action.

5.2.6.3 Additionally, firearms that are capable of firing in single action and double action should be tested in each mode.

5.2.6.4 Firearms that are deemed unsafe to fire may be tested with a primed cartridge case only or by utilizing the remote fire device (if it can be performed safely).

5.2.7 If test fires will be created for comparison purposes, the firearm shall be test fired as follows:

5.2.7.1 When creating test fires for comparison purposes, choose the same reference ammunition as the evidence ammunition. If the same reference ammunition is not available, choose ammunition as similar as possible to the evidence ammunition in manufacturer, design, and/or weight.

5.2.7.2 Evidence ammunition used to create comparison specimens shall be examined for pre-existing cycling detail or manufacturing marks prior to test firing. Any such examination shall be documented in the case notes.

5.2.7.3 For comparison purposes, fire at least three (3) rounds.

5.2.7.4 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.

5.2.7.5 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.

5.2.7.6 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.

5.2.7.7 Treat every barrel of multiple-barreled firearms separately.

5.2.7.8 Retrieve test bullets immediately after firing.

5.2.7.9 Test fire packaging shall include, at a minimum, the following information:

- State Crime Laboratory Case number.
- Item #
- Examiner Initials

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

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

5.2.8.1.1 Test fires using Laboratory ammunition made for other purposes (e.g., gun function) may be disposed of on a regular basis.

5.2.8.2 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.

5.2.9 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 Barrel and Overall Length Determinations

5.3.1 The barrel and overall lengths of any long gun shall be measured, unless the condition of the firearm precludes accurate measurement, only upon request of the submitting agency, the prosecuting agency, or based on the training and experience of the Forensic Scientist.

5.3.2 The barrel and overall lengths shall be measured after any necessary test firing and/or comparisons are completed and verified.

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

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

5.3.4 The barrel and overall lengths shall be measured only by approved scientists (see the Work Authorization Record).

5.3.5 The barrel and overall lengths shall be measured using the DMD-48. Alternatively, with approval by the Forensic Scientist Manager or designee, the barrel length may also be measured using a Hott-Rod™ and the overall length may be measured using a calibrated ruler.

5.3.6 DMD-48 Procedure

5.3.6.1 The DMD-48 shall be zeroed and performance checked prior to being used in casework. The performance check shall be conducted prior to use each day it will be used in casework and for each separate case in which the DMD-48 will be used. If a performance check is conducted and the DMD-48 is subsequently powered off, the performance check shall be repeated before the DMD-48 is used in casework again. The performance check shall be completed according to the Technical Procedure for Instrument Calibration and Maintenance. The performance check shall be recorded in the Completed Tasks area of the worksheet.

5.3.6.2 Barrel Length

5.3.6.2.1 The barrel length shall be measured after test firing and the subsequent microscopic comparison are completed. Care shall be taken when placing a rod down the barrel.

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

5.3.6.2.3 Choose one of the three measuring rods supplied with the DMD-48 (3/16″ brass, ¼″ aluminum, or ½″ aluminum) as appropriate for the firearm to be measured.

5.3.6.2.4 Loosen the collar on the measuring rod and gently slide the rod into the barrel until it rests against the breechface.

5.3.6.2.5 Let the collar slide down until it encounters the furthest point on the muzzle.

5.3.6.2.6 Lock the collar into place using the thumb screw.

5.3.6.2.7 Using the black thumb screw, attach the retaining plate to the movable plate. The retaining plate can be rotated and centered for the appropriate sized rod.

5.3.6.2.8 Place the measuring rod through the cutout in the movable plate, ensuring that the front of the collar is flush with the retaining plate.

5.3.6.2.9 Center the other end of the rod with the recessed point in the front plate to ensure the rod is parallel when reading the digital measurement.

5.3.6.3 Overall Length

5.3.6.3.1 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.

5.3.6.3.2 Using the attached handle, slide the movable plate away from the front plate far enough to allow the firearm to rest in the DMD-48.

5.3.6.3.3 Place the firearm in the unit with the butt against the front plate and the barrel parallel to the side plate. For most firearms, this is best accomplished with the firearm resting on its right side.

5.3.6.3.4 Using the handle, gently slide the movable plate until it contacts the furthest point on the muzzle.

5.3.6.4 The digital readout of the DMD-48 shows four digits after the decimal point. Barrel and overall lengths shall be reported to two decimal places. Rounding for the DMD-48 shall be as follows:

5.3.6.4.1 If the third decimal place (thousandth place) is a "0", the second decimal place (hundredth place) shall not change. For example, 19.2604″ would round to 19.26″.

5.3.6.4.2 If the third decimal place is any other digit, the second decimal place shall round up. For example, 19.2614″ would round to 19.27″.

5.3.6.5 The uncertainty of measurement for barrel and overall length measurements shall be reported (see 5.10 for uncertainty of measurement values).

5.3.7 In the event that a firearm has been altered but the barrel or overall length remains too long to be measured by the DMD-48, Hott-Rod™, or ruler, as appropriate, the measurement shall be reported as "greater than X inches", where "X" represents the maximum length measureable by the measuring device.

5.3.8 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".

5.4 Range of Conclusions

5.4.1 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 by the technical reviewer.

5.4.2 Firearm Function and Trigger Pull Examinations

5.4.2.1 Proper function

- "Item 1 functions properly."

5.4.2.2 Malfunctioning Safety

- "The Item 2 pistol will fire by pulling the trigger when the hammer is cocked and the safety lever is either engaged or disengaged."

5.4.2.3 Broken or Missing Parts

- "As received, Item 3 does not function. Item 3 is missing a hammer and recoil spring. Parts from a reference firearm were used to replace the missing parts, Item 3 then functioned properly."

5.4.2.4 Firearm received disassembled

- "As received, the Item 10 pistol was disassembled by removal of the slide. Upon reassembly, Item 10 was found to function properly."

5.4.2.5 Trigger Pull

- "Item 2 has a single action trigger pull of greater than five (5.0) pounds but less than or equal to six (6.0) pounds and a double action trigger pull of greater than ten (10.0) pounds but less than or equal to eleven (11.0) pounds."

5.4.3 Barrel and Overall Length Measurements

5.4.3.1 Barrel Length measured using the DMD-48

- "The barrel length of Item 3 is 14.25 inches, +/- 0.11 inches with a coverage probability of 99.73%."

5.4.3.2 Barrel Length measured using a Hott-Rod™

- "The barrel length of Item 1 is 14 ¼ inches, +/- 5/32 inch with a coverage probability of 99.73%."

5.4.3.3 Overall Length measured using the DMD-48

- "The overall length of Item 4 is 28.75 inches, +/- 0.12 inches with a coverage probability of 99.73%."

5.4.3.4 Overall Length measured using a ruler

- "The overall length of Item 7 is 28 ¾ inches, +/- 9/32 inch with a coverage probability of 99.73%."

5.4.3.5 Overall Length too long to be measured using the DMD-48

- "The overall length of Item 5 is greater than 39 inches."

5.5 Standards and Controls – N/A

5.6 Calibration – For comparison microscope, Hott-Rod™ and ruler calibration information, see the Firearms Section Technical Procedure for Instrument Calibration and Maintenance.

5.7 Maintenance – For comparison microscope, Hott-Rod™, and ruler maintenance, see the Firearms Section Technical Procedure for Instrument Calibration and Maintenance.

5.8 Sampling – N/A

5.9 Calculations – N/A

5.10 Uncertainty of Measurement – The uncertainty of measurement was calculated for barrel and overall length measurements and trigger pull measurements.

5.10.1 For barrel length, the uncertainty of measurement is provided for the DMD-48 method and the Hott-Rod™ method, with a coverage factor of k=3 and a coverage probability of 99.73%.

5.10.1.1 The uncertainty of measurement for the DMD-48 method is 0.11 inches.

5.10.1.2 The uncertainty of measurement for the Hott-Rod™ method is 5/32 inches.

5.10.2 For overall length, the uncertainty of measurement is provided for the DMD-48 method and the ruler method, with a coverage factor of k=3 and a coverage probability of 99.73%.

5.10.2.1 The uncertainty of measurement for the DMD-48 method is 0.12 inches.

5.10.2.2 The uncertainty of measurement for the ruler method is 9/32 inches.

5.10.3 For trigger pull measurements, the uncertainty of measurement is provided for the dead weight method, with a coverage factor of k=2 and a coverage probability of 95.45%.

5.10.3.1 The uncertainty of measurement for the dead weight method is 1.03 pounds.

5.10.4 The above uncertainties of measurement shall be evaluated annually and updated or revised as needed. In the event of a 25% turnover of scientists approved to perform these measurements, the uncertainty shall be updated or revised.

6.0 Limitations – N/A

7.0 Safety – Examinations performed in the Firearms Section are inherently dangerous.

7.1 Assume that all body fluids contain bloodborne pathogens and handle accordingly.

7.2 If the examination involves a biohazard, wear proper personal protective equipment such as eye protection, lab coat, and/or gloves.

7.3 Treat all firearms as if loaded.

7.4 Always point firearms in a safe direction.

7.5 When firearms are test fired, wear ballistic eye protection and hearing protection. Activate all ventilation systems.

7.6 Lead is toxic.

7.7 Refer to Attachment 1 for chemical hygiene and safety precautions for extremely hazardous and particularly hazardous substances.

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.

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9.0 Records

- FA Worksheets

10.0 Attachments

- Attachment A - Chemical Hygiene and Safety Precautions for Extremely Hazardous and Particularly Hazardous Substances
- Attachment B - Uncertainty Budget, Barrel Length using the DMD-48
- Attachment C - Uncertainty Budget, Overall Length using the DMD-48
- Attachment D - Uncertainty Budget, Barrel Length using a Hott-Rod™
- Attachment E - Uncertainty Budget, Overall Length using a Ruler
- Attachment F - Uncertainty Budget, Trigger Pull Weight using Dead Weights

Revision History		
Effective Date	Version Number	Reason
06/25/2021	12	**Header** and throughout– corrected to reflect organizational change. Throughout – changed IBIS to NIBIN. **3.0** – added definition for National Integrated Ballistic Information Network and removed definitions for ejection pattern, muzzle velocity, and suppressor. **4.0** – removed the following items: protractor, 9 volt batteries, alkaline 9 volt battery, parachute or drop cloth, and plumb bob – added "Casting material (e.g. Mikrosil™, AccuTrans®)" **5.1.1.6.1** – removed "white" and "numbered" **5.1.3.1** – changed "entry" to "worksheet" and removed "in FA" **5.1.3.3.** and **5.1.3.4 –** updated list of features that shall be noted, included list of features that may be noted Removed old **5.1.3.3.3** Removed second sentence of new **5.1.3.3.3** **5.1.3.4.3** – added "AccuTrans®". Added new **5.1.3.5.1** Added new **5.1.3.5.4.1** Added new **5.1.3.6.5.4.1** and **5.1.3.6.6.4.1** Removed **old 5.1.3.7.5.5.1 through 5.1.3.7.5.5.5** Removed **old 5.3**. Moved Barrel and Overall Length Determinations section to **new 5.3**. and added "unless the condition of the firearm precludes accurate measurement" to **5.3.1** **5.1.4.2.1** – removed "Deputy" **5.1.4.3** – removed "-1996" from SAAMI standard, removed reference to shoot tank annex at WRL Added new **5.1.4.4**. Reorganize test firing protocol by moving **old 5.2.10** to **5.2.4** and **old 5.2.6** to **5.2.5**. **5.2.4** – changed "ear protectors" to "hearing protection" **5.2.6.4** – added "or by utilizing the remote fire device (if it can be performed safely)" Added new **5.2.6** and subsections. Created new **5.2.7** and moved appropriate subsections here. **5.2.7.**3 – changed number of required test fires for comparison purposes from two to three. **5.2.7.9** – removed bullet points to reflect new minimum test fire packaging, added "Examiner Initials" **5.2.8.1** – added "or for entry into NIBIN". **5.2.8.1.1** – removed reference to IBIS and distance determination. Removed **5.2.8.2.1** and **5.2.8.2.2** **5.3.6.1 –** updated, added reference to Instrument Calibration and Maintenance procedure **5.3.6.2.2** – removed second sentence **5.3.6.5** – added "(see 5.10 for uncertainty of measurement values)"

		5.4 – added quotation marks around suggested report wording examples throughout this section. **5.4** – Removed all references to item designations Added new **5.4.2.4** and bullet point. New **5.4.2.5** – added decimal places to trigger pull results. New **5.4.3** – added "with a coverage probability of 99.73%" to each bullet point under subsections and removed first sentence Corrected uncertainty value listed in **5.4.3.3**. Removed **old 5.4.4**. **5.10** – removed "(see 5.1.3.6.5.5)", added "and trigger pull measurements". Added new **5.10.1** through **5.10.4** and related subsections. **6.0** – changed to "N/A". **7.0-** reworded 7.0 and added additional safety statements in 7.1-7.7 **10.0** – added uncertainty budget for trigger pull measurement. New Attachment A **Attachment B (now Attachment C)** – added updated budget Added new **Attachment F**.

Attachment A: Chemical Hygiene and Safety Precautions for Extremely Hazardous and Particularly Hazardous Substances

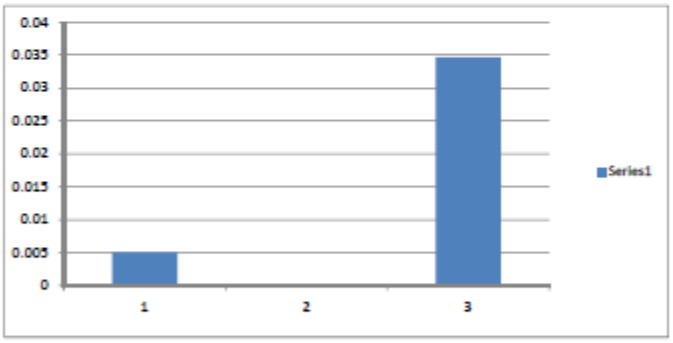
Lead **DANGER: PARTICULARLY HAZARDOUS SUBSTANCE**	
	**HEALTH 2** **FLAMMABILITY 0** **REACTIVITY 0**
Detection of Release	Assume release during firing of firearms.
Signs/Symptoms of Exposure	1) Short term (acute) overexposure. Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise which develops quickly to seizures, coma, and death from cardiorespiratory arrest. A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects which take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years. (2) Long-term (chronic) overexposure. Chronic overexposure to lead may result in severe damage to your blood-forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic there may be severe abdominal pain.
PEL	ACGIH TWA 0.05mg/m^3 of air
Associated Hazards	Carcinogenic. Reproductive toxin. Specific organ toxicity. Respiratory hazard.
Controls	Provide adequate general and local exhaust ventilation. Ensure good ventilation of the work station. Wear protective goggles, gloves. If appropriate, wear respiratory protection.
Safe handling, storage, disposal	Do not discharge waste into the drain. Observe strict hygiene. Carry out operations in the open/under local exhaust/ventilation or with respiratory protection. Do not breathe dust, fume. Take all necessary technical measures to avoid or minimize the release of the product on the workplace. Limit number of exposed workers. Wear PPE. Floors, walls, and other surfaces in the hazard area must be cleaned regularly. Launder clothing separately. Do not eat, drink, or smoke. Always wash hands after exposure.
Emergency Procedures	**Eye Contact:** N/A. Rinse eyes with water as a precaution. **Inhalation Exposure:** remove to fresh air and keep comfortable for breathing. Call poison control/doctor if you feel unwell. **Ingestion:** N/A. Rinse mouth. **Skin Contact:** N/A. Wash with plenty of water. **Spills:** N/A

Attachment B: Uncertainty Budget, Barrel Length using the DMD-48

North Carolina State Crime Laboratory
Physical Evidence Section
Firearms Unit
Uncertainty of Measurement Budget
Barrel Length, DMD-48

Measurement:	Barrel Length using DMD-48
Range of measurement values:	Up to ~39.5 inches
Procedure name:	Technical Procedure for Firearm Examination
Budget prepared by:	Jessica L. R. Pappas
Date Prepared:	July 31, 2017

Line Item	Uncertainty Component		Value	Units	Distribution	Type	Divisor	Degrees Freedom (n-1)	Standard Uncertainty	Component Contribution %
1	DMD-48 Calibration Uncertainty		0.01000000	inches	normal	B	2.00	∞	0.005	13
2	DMD-48 Resolution		0.00010000	inches	rectangular	B	1.73	∞	5.7735E-05	0
3	Reproducibility Study		0.0347	inches	normal	A	1.00	223	0.0347	87
	Combined Standard Unc	u							0.035058427	100
	Expanded Unc	U (k=2)							0.070116855	
	Expanded Unc	U (k=3)							0.105175282	
	Reported Uncertainty:		**0.070**		**k=2**	95.45% confidence level				
	Reported Uncertainty:		**0.105**	(0.11")	**k=3**	99.73% confidence level				



Notes - document the basis for the data above:

1 Uncertainty of the calibration by Cal Tec Labs of Ohio Certificate = 0.01 inches at 95.45% level of confidence (k=2)
2 DMD-48 scale resolution
3 Reproducibility data - highest standard deviation of the six guns measured

The estimation of uncertainty of measurement shall be evaluated annually and updated or revised as needed.

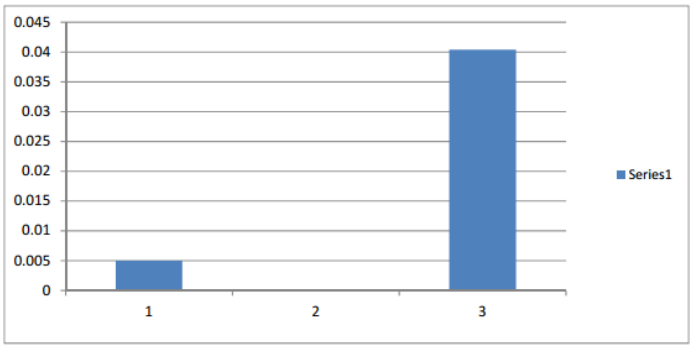
Revision History		
Version Number	**Date**	**Reason**
1	5/2/2013	Original Document
2	7/20/2015	Updated Reproducibility Study
3	7/31/2017	Updated Reproducibility Study

Attachment C: Uncertainty Budget, Overall Length using the DMD-48

North Carolina State Crime Laboratory
Physical Evidence Section
Firearms Unit
Uncertainty of Measurement Budget
Overall Length, DMD-48

Measurement:	Overall Length using DMD-48
Range of measurement values:	Up to ~39.5 inches
Procedure name:	Technical Procedure for Firearm Examination
Budget prepared by:	Jessica L. R. Pappas
Date Prepared:	March 21, 2019

Line Item	Uncertainty Component		Value	Units	Distribution	Type	Divisor	Degrees Freedom (n-1)	Standard Uncertainty	Component Contribution %
1	DMD-48 Calibration Uncertainty		0.01000000	inches	normal	B	2.00	∞	0.005	11
2	DMD-48 Resolution		0.00010000	inches	rectangular	B	1.73	∞	5.7735E-05	0
3	Reproducibility Study		0.0404	inches	normal	A	1.00	150	0.0404	89
	Combined Standard Unc	u							0.040708271	100
	Expanded Unc	U (k=2)							0.081416542	
	Expanded Unc	U (k=3)							0.122124813	
	Reported Uncertainty:		**0.08**	inches	**k=2**	95.45% confidence level				
	Reported Uncertainty:		**0.12**	inches	**k=3**	99.73% confidence level				



Notes - document the basis for the data above:

1 Uncertainty of the calibration by Cal Tec Labs of Ohio Certificate = 0.01 inches at 95.45% level of confidence (k=2)
2 DMD-48 scale resolution
3 Reproducibility data - highest standard deviation of the four guns measured

The estimation of uncertainty of measurement shall be evaluated annually and updated or revised as needed.

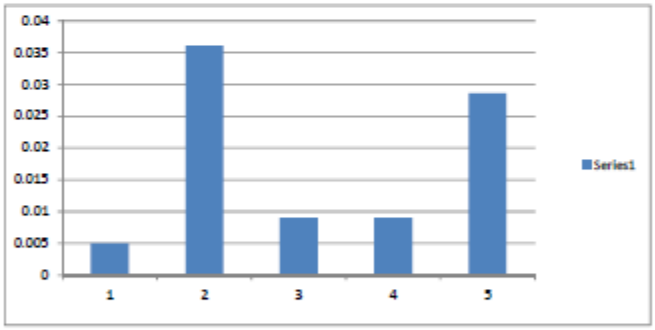
Revision History		
Version Number	**Date**	**Reason**
1	5/2/2013	Original Document
2	7/20/2015	Updated Reproducibility Study
3	7/31/2017	Updated Reproducibility Study
4	3/21/2019	Corrected reproducibility study data value and recalculated k=3

Attachment D: Uncertainty Budget, Barrel Length using a Hott-Rod™

North Carolina State Crime Laboratory
Physical Evidence Section
Firearms Unit
Uncertainty of Measurement Budget
Barrel Length, Hott-Rod™

Measurement:	Barrel Length using Hott Rod™
Range of measurement values:	Up to 24 inches
Procedure name:	Technical Procedure for Firearm Examination
Budget prepared by:	Jessica L. R. Pappas
Date Prepared:	July 31, 2017

Line Item	Uncertainty Component		Value	Units	Distribution	Type	Divisor	Degrees Freedom (n-1)	Standard Uncertainty	Component Contribution %
1	HottRod Calibration Uncertainty		0.01000000	inches	normal	B	2.00	∞	0.005	6
2	HottRod Resolution		0.06250000	inches	rectangular	B	1.73	∞	0.036084392	41
3	Calibrated scale error		0.01562500	inches	rectangular	B	1.73	∞	0.009021098	10
4	Calibrated butted error		0.01562500	inches	rectangular	B	1.73	∞	0.009021098	10
5	Reproducibility Data		0.02867	inches	normal	A	1.00	208	0.02867	33
	Combined Standard Unc	u							0.048081313	100
	Expanded Unc	U (k=2)							0.096162626	
	Expanded Unc	U (k=3)							0.144243939	
	Reported Uncertainty:		**0.096**		**k=2**	95.45% confidence level				
	Reported Uncertainty:		**0.144**	(5/32")	**k=3**	99.73% confidence level				



Notes - document the basis for the data above:

1. Uncertainty of the calibration by Heusser Neweigh Certificate = 0.01 inches at 95.45% level of confidence (k=2)
2. HottRod scale resolution
3. Calibrated scale error of 1/64" as stated by Heusser Neweigh Certificate
4. Calibrated butted error of 1/64" as stated by Heusser Neweigh Certificate
5. Reproducibility data - highest standard deviation of the five guns measured

***Hott-Rods™ measure in fractions of an inch. These fractions have been converted to decimals for ease of calculations.

The estimation of uncertainty of measurement shall be evaluated annually and updated or revised as needed.

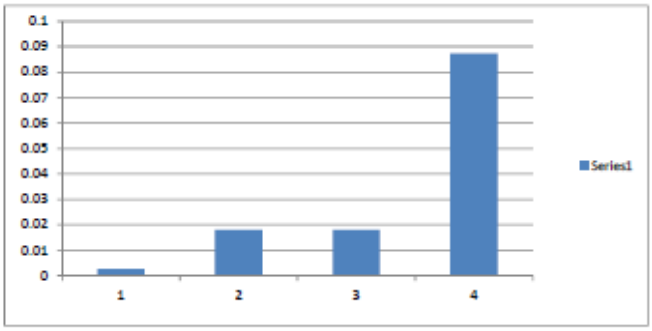
Revision History		
Version Number	**Date**	**Reason**
1	5/2/2013	Original Document
2	7/20/2015	Added uncertainty components of calibrated scale and butted errors, updated Reproducibility Study
3	7/31/2017	Updated Reproducibility Study

Attachment E: Uncertainty Budget, Overall Length using a Ruler

North Carolina State Crime Laboratory
Physical Evidence Section
Firearms Unit
Uncertainty of Measurement Budget
Overall Length, Ruler

Measurement:	Overall Length using Ruler
Range of measurement values:	Up to 36 inches
Procedure name:	Technical Procedure for Firearm Examination
Budget prepared by:	Jessica L. R. Pappas
Date Prepared:	July 31, 2017

Line Item	Uncertainty Component		Value	Units	Distribution	Type	Divisor	Degrees Freedom (n-1)	Standard Uncertainty	Component Contribution %
1	Ruler Calibration Uncertainty		0.00500000	inches	normal	B	2.00	∞	0.0025	2
2	Ruler Resolution		0.03125000	inches	rectangular	B	1.73	∞	0.018042196	14
3	Length scale readability at zero		0.03125000	inches	rectangular	B	1.73	∞	0.018042196	14
4	Reproducibility Data		0.08736	inches	normal	A	1.00	168	0.08736	69
	Combined Standard Unc	u							0.091044282	100
	Expanded Unc	U (k=2)							0.182088564	
	Expanded Unc	U (k=3)							0.273132846	
	Reported Uncertainty:		**0.182**		**k=2**	95.45% confidence level				
	Reported Uncertainty:		**0.273**	(9/32")	**k=3**	99.73% confidence level				



Notes - document the basis for the data above:

1 Uncertainty of the calibration by Heusser Neweigh Certificate = 0.005 inches at 95% level of confidence (k=2)
2 Ruler scale resolution
3 Length scale readability at zero (1/32")
4 Reproducibility data - highest standard deviation of the four guns measured

***Rulers measure in fractions of an inch. These fractions have been converted to decimals for ease of calculations.

The estimation of uncertainty of measurement shall be evaluated annually and updated or revised as needed.

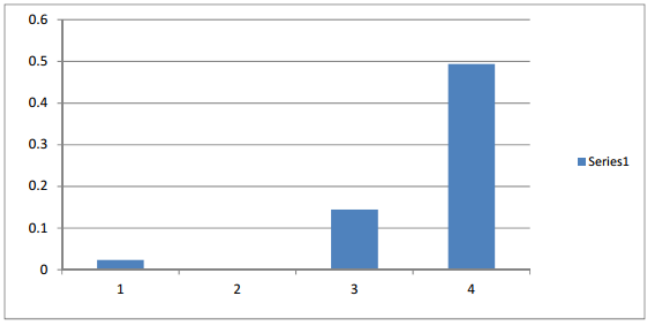
Revision History		
Version Number	**Date**	**Reason**
1	5/2/2013	Original Document
2	7/20/2015	Added uncertainty component of length scale readability at zero, updated Reproducibility Study
3	7/31/2017	Updated Reproducibility Study

Attachment F: Uncertainty Budget, Trigger Pull Weight using Dead Weights

North Carolina State Crime Laboratory
Physical Evidence Section
Firearms Unit
Uncertainty of Measurement Budget
Weight, Trigger Pull by Dead Weight Method

Measurement:	Weight, Trigger Pull by Dead Weight Method
Range of measurement values:	Up to 17.75 Pounds
Procedure name:	Technical Procedure for Firearm Examination
Budget prepared by:	Jessica L. R. Pappas
Date Prepared:	May 3, 2019

Line Item	Uncertainty Component		Value	Units	Distribution	Type	Divisor	Degrees Freedom (n-1)	Standard Uncertainty	Component Contribution %
1	Dead Weight Cal. Tolerance		0.04681600	pounds	normal	B	2.00	∞	0.023408	4
2	Bulk Balance Cal. Uncertainty		0.00035625	pounds	normal	B	2.00	∞	0.000178127	0
3	Dead Weight Resolution		0.25000000	pounds	rectangular	B	1.73	∞	0.144337567	22
4	Reproducibility Data		0.49398	pounds	normal	A	1.00	419	0.49398	75
	Combined Standard Unc	u							0.515167694	100
	Expanded Unc	U (k=2)							1.030335389	
	Reported Uncertainty:		**1.03**		**k=2**	95.45% confidence level				



Notes - document the basis for the data above:

1 Uncertainty of the calibration by J.A. King Certificate = As Left tolerance for each weight combined = 0.046816 lb

2 Uncertainty of the calibration by CLC Calibration LLC Certificate
$u = \sqrt{(u.eccentricity^2 + u.linearity^2 + u.repeatability^2 + u.span^2)}$
$u = \sqrt{(0.02418^2 + 0.0122^2 + 0.02418^2 + 0.07218^2)}$
u = 0.008079689 g
u.exp (k=2)= 0.16159378 g = 0.00035625316 lb

3 Dead weight resolution

4 Reproducibility data - average standard deviation of the four guns measured

The estimation of uncertainty of measurement shall be evaluated annually and updated or revised as needed.

Revision History		
Version Number	**Date**	**Reason**
1	4/4/2018	Original Document
2	5/3/2019	Updated with weight calibration information