Deviation Request Form (DRF)

Directions: The Initiator will complete Sections A through C. Additional continuation pages can be included if necessary.

Initiator	FSII Kathleen A. Clardy	**Date**	5/3/2019

A. Requested deviation applies to (Technical Procedure – include specific section):

1. Technical Procedure for Firearm Examination, sections 5.3 and 5.4.4
2. Technical Procedure for Firearm Examination, sections 5.1.3.7.5.5, 5.1.3.7.5.5.1-5, and 5.10
3. Technical Procedure for Firearm Examination, sections 5.4.3.1 through 5.4.3.4
4. Technical Procedure for Firearm Examination, section 5.2.13
5. Technical Procedure for Firearm Examination, Attachment B

B. Requested deviation:

1. The requested deviation is to remove this section and related sections from the technical procedure.
2. Add "(see 5.10 for uncertainty of measurement values)" to end of 5.1.3.7.5.5
   Removal of section 5.1.3.7.5.5.1-5; See attached document for additional deviations
3. Add coverage probability information to the suggested report wording examples (see attached document).
4. Change bullet points (see attached document).
5. Replace Attachment B with updated version (see attached document).

C. Necessity for the deviation:

1. The Firearms Section stopped performing these examinations as reflected in the laboratory's Policy and Procedure for Evidence Submissions (3.16.1), but the technical procedure was not updated.
2. These uncertainties of measurement are being provided to comply with ANAB accreditation requirements.
3. These changes are being provided to comply with ANAB accreditation requirements.
4. This change reflects decisions made in Technical Meeting on 03/13/2019. 5. See attached document

D. Technical review and Authorization (to be completed by the Quality Manager and/or Technical Leader)
Comments(to include merits and impacts):

1-4: n/a
5: An amended report will be issued in any affected case(s).

Approved	☑	Yes	☐	No	Duration	Until next procedure revision
Signature	Jessica L.R. Pappas — Digitally signed by Jessica Pappas DN: cn=Jessica Pappas, o=North Carolina State Crime Laboratory, ou=Physical Evidence Section - Firearms Unit, email=jpappas@ncdoj.gov, c=US Date: 2019.05.03 10:25:17 -04'00'				Date	5/3/2019

E. Quality Assurance Authorization (to be completed by the Quality Manager, Forensic Scientist Manager or designee)

Acceptable within general QA guidelines and good laboratory practice?	☑	Yes	☐	No
Significant negative impact to Crime Laboratory Quality System?	☐	Yes	☑	No

Restrictions/limitations:

☑	Authorized	☐	Rejected	Signature	Jennifer M. Slish — Digitally signed by Jennifer M. Slish Date: 2019.05.05 10:56:21 -04'00'	Date	8/30/2019

Form approved for use by: Timothy G. Suggs — Digitally signed by Timothy G. Suggs DN: cn=Timothy G. Suggs, o=North Carolina State Crime Laboratory, ou=Quality Manager, email=tsuggs@ncdoj.gov, c=US Date: 2014.12.19 09:01:52 -05'00'

DRF for Technical Procedure Firearm Examination
(dated 5/3/2019)

2.

5.10 Uncertainty of Measurement – The uncertainty of measurement was calculated for barrel and overall length measurements (see 5.1.3.6.5.5) 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 coverage factor k=3, 99.73% coverage probability.

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 coverage factor k=3, 99.73% coverage probability.

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 measurement, the uncertainty of measurement is provided for the dead weight method, with coverage factor k=2, 95.45% coverage probability.

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 evaluation 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.

3.

5.4.3 Barrel and Overall Length Measurements

5.4.3.1 Barrel Length measured using the DMD-48

- As received, the barrel of the K-1 rifle has been altered. The barrel length of K-1 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™

- As received, the barrel of the K-1 rifle has been altered. The barrel length of K-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

- As received, the stock of the K-1 shotgun has been altered. The overall length of K-1 is 28.75 inches, +/- 0.12 inches with a coverage probability of 99.73%.

5.4.3.4 Overall Length measured using a ruler

- As received, the stock of the K-1 shotgun has been altered. The overall length of K-1 is 28 ¾ inches, +/- 9/32 inch with a coverage probability of 99.73%.

4.

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

- State Crime Laboratory Case number
- Examiner intials
- Item # - The K number assigned to this firearm and T number assigned to the test fire

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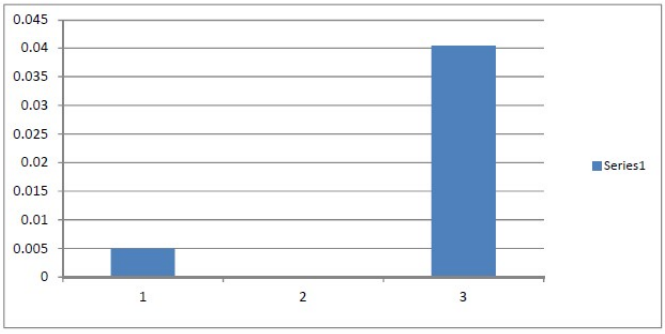
5. A transcription error was recently discovered in the Uncertainty Budget for Overall Length using the DMD-48. As a result, the reported uncertainty of measurement changed from 0.04” to 0.12”. The updated uncertainty budget is on the following page.

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

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 Unit 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 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 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.
- **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
- 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
- IBIS envelopes
- Cotton-tipped swabs
- Ethanol, acetone
- White evidence tags
- Dummy rounds
- Shotshell firing pin tester kit, primers
- Plastic/nylon tie
- Tape measures
- Protractor
- 9-volt batteries
- Alkaline 9-volt battery
- Rubber block backstop
- Snail® system bullet trap
- Parachute or drop cloth
- Plumb bob
- Personal protective equipment

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 Unit 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 potentially bio-hazardous material 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 white plastic numbered 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 entry shall be completed in FA for each evidence firearm.

5.1.3.2 IBIS only cases are not required to use the specific Firearms Worksheet as long as all information is entered into the case file.

5.1.3.3 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 (see Technical Procedure for Fired Projectile Examination)
  - Direction of twist
- Safeties and their conditions
- Extractor and/or ejector position

- Rust, wear, damage

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

5.1.3.3.4 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.

5.1.3.4 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™ and silicone rubber compounds.

5.1.3.5 Trigger Pull Determinations

5.1.3.5.1 Verify that the firearm is unloaded.

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

5.1.3.5.3 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 Reset the sear connection after each attempt.

5.1.3.5.5 Single Action Trigger Pull

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

5.1.3.5.5.2 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.

5.1.3.5.5.3 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.

5.1.3.5.5.4 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."

5.1.3.6.6 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").

5.1.3.7 Barrel and Overall Length Determinations

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

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

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

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

5.1.3.7.4 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.

5.1.3.7.5 DMD-48 Procedure

5.1.3.7.5.1 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.

5.1.3.7.5.1.1 Power on the DMD-48.

5.1.3.7.5.1.2 Using the attached handle, slide the rear movable plate until it is flush with the front plate.

5.1.3.7.5.1.3 Zero the DMD-48 by pressing the "X_0" button.

5.1.3.7.5.1.4 Remove the end caps from the 24″ calibration rod and place it in the center of the unit, with one end against the front plate.

5.1.3.7.5.1.5 Using the handle, slide the rear movable plate until it contacts the end of the calibration rod.

5.1.3.7.5.1.6 The tolerance for this length shall be +/- 0.03 inches. If the measured length falls within this tolerance range, the successful performance check shall be recorded in Forensic Advantage (FA).

5.1.3.7.5.1.7 The DMD-48 may now be used to measure barrel and overall length.

5.1.3.7.5.2 Barrel Length

5.1.3.7.5.2.1 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.

5.1.3.7.5.2.2 Measure the barrel length from the face of the closed breechblock or bolt to the farthest end of the barrel. For revolvers, measure the barrel including the threaded portion within the frame.

5.1.3.7.5.2.3 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.

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

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

5.1.3.7.5.2.6 Lock the collar into place using the thumb screw.

5.1.3.7.5.2.7 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.

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

5.1.3.7.5.2.9 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.

5.1.3.7.5.3 Overall Length

5.1.3.7.5.3.1 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.

5.1.3.7.5.3.2 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.

5.1.3.7.5.3.3 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.

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

5.1.3.7.5.4 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:

5.1.3.7.5.4.1 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″.

5.1.3.7.5.4.2 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″.

5.1.3.7.5.5 The uncertainty of measurement for barrel and overall length measurements shall be reported.

5.1.3.7.5.5.1 For barrel lengths measured using the DMD-48, the uncertainty of measurement is 0.11″.

5.1.3.7.5.5.2 For overall lengths measured using the DMD-48, the uncertainty of measurement is 0.04″.

5.1.3.7.5.5.3 For barrel lengths measured using a Hott-Rod™, the uncertainty of measurement is 5/32″.

5.1.3.7.5.5.4 For overall lengths measured using a ruler, the uncertainty of measurement is 9/32″.

5.1.3.7.5.5.5 The uncertainty of measurement shall be evaluated annually and updated or revised as needed. In the event of a 25% turnover of scientists approved to perform barrel and overall length measurements, the uncertainty shall be updated or revised.

5.1.3.7.6 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.

5.1.3.7.7 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
- 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 "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 or shoot tank annex (Western Laboratory). 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 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 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.

5.2.5 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.

5.2.6 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.

5.2.7 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.

5.2.8 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.

5.2.9 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.

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

5.2.11 Treat every barrel of multiple-barreled firearms separately.

5.2.12 Retrieve test bullets immediately after firing.

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

- State Crime Laboratory Case number.
- Agency – the agency that submitted the firearm.
- Agency Case # – Agency OCA (case identifying number).
- Date of offense.
- Type of case.
- Item # – The "K" number assigned to this firearm.
- Make – Manufacturer of firearm.
- Model – Model of firearm, if known.
- Caliber – The caliber of the firearm.
- SN # – Serial number of firearm, if present.
- IBIS Entry/Brand – Include a description of the test ammo used and which test fires are to be entered into IBIS.

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

5.2.14.1 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.

5.2.14.1.1 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) may be disposed of on a regular basis.

5.2.14.2 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.

5.2.14.2.1 Bullets/projectiles from test fires using evidence ammunition that are used for distance determinations are not typically returned to the submitting agency because these tests preclude recovery of the projectiles. A statement shall be included in the Laboratory Report to identify when such bullets/projectiles are consumed during testing.

5.2.14.2.2 Cartridge cases/shotshells from test fires using evidence ammunition that are used for distance determinations shall be returned in the original packaging. A statement shall be included in the Laboratory Report to identify when such cartridge cases/shotshells are returned in a fired condition.

5.2.15 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 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

- The K-1 pistol functions properly.

5.4.2.2 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.

5.4.2.3 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.

5.4.2.4 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.

5.4.3 Barrel and Overall Length Measurements

5.4.3.1 Barrel Length measured using the DMD-48

- As received, the barrel of the K-1 rifle has been altered. The barrel length of K-1 is 14.25 inches, +/- 0.11 inches.

5.4.3.2 Barrel Length measured using a Hott-Rod™

- As received, the barrel of the K-1 rifle has been altered. The barrel length of K-1 is 14 ¼ inches, +/- 5/32 inch.

5.4.3.3 Overall Length measured using the DMD-48

- As received, the stock of the K-1 shotgun has been altered. The overall length of K-1 is 28.75 inches, +/- 0.04 inches.

5.4.3.4 Overall Length measured using a ruler

- As received, the stock of the K-1 shotgun has been altered. The overall length of K-1 is 28 ¾ inches, +/- 9/32 inch.

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

- As received, the stock of the K-1 shotgun has been altered. The overall length of K-1 is greater than 39 inches.

5.4.4 Ejection Pattern Examination

5.4.4.1 Standard ejection pattern test

5.4.4.1.1 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.

5.4.4.1.2 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.

5.4.4.2 Non-standard ejection pattern test

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

5.4.4.2.2 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.

5.5 Standards and Controls – N/A

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

5.7 Maintenance – For comparison microscope, Hott-Rod™, and ruler maintenance, see the Firearms Unit 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 (see 5.1.3.6.5.5). For barrel length, the uncertainty of measurement is

provided for the DMD-48 method and the Hott-Rod™ method. For overall length, the uncertainty of measurement is provided for the DMD-48 method and the ruler method.

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

7.0 Safety – Examinations performed in the Firearms Unit 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.

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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

10.0 Attachments

- Uncertainty Budget, Barrel Length using the DMD-48
- Uncertainty Budget, Overall Length using the DMD-48
- Uncertainty Budget, Barrel Length using a Hott-Rod™
- Uncertainty Budget, Overall Length using a Ruler

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"
02/15/2013	4	Removed Raleigh from the header; **3.0** – added direct to the definition of active safety and changed the definition of passive safety; **4.0** – added seven items and specified items located in the Raleigh Laboratory; **5.1.3.2** – added text in parentheses for widths of lands and grooves; **5.1.3.2.1** – added firearm industry contacts; **5.1.4.1.1** – added bore obstruction; **5.1.4.3** – added shoot tank annex language; **5.2.1** – added bullet in beginning of first sentence and snail trap language; **5.2.1.1** – added rubber backstop language; **5.2.2** – added If available; **5.2.3.1** – removed perpetrator language; created new **5.2.4**; **5.2.13.2.1** – added last sentence; added new **5.2.13.2.2**; **5.4.1** – added shoot tank annex language; **5.4.3.7** – added first sentence; created new **5.4.3.8** from former last sentence of **5.4.3.7**; **5.5.4.1.1** – added Raleigh Laboratory; **5.5.4.1.2** – added Raleigh Laboratory; created new **5.6.3**, **5.6.3.1**, and **5.6.3.2**; created new **5.8.1**; **5.9** – added comparison microscope
05/10/2013	5	**4.0** – added Hott-Rods™, DMD-48, and DMD-48 calibration rod, changed "NIST-traceable rods and rulers" to "NIST-traceable rulers;" created new **5.1.3.5.3**, **5.1.3.5.4**, and **5.1.3.5.5**; changed **5.6.3.1** from "Legal Length" to "Barrel Length measured using the DMD-48" and changed the corresponding suggested report wording to reflect barrel length and uncertainty of measurement; changed **5.6.3.4** (formerly **5.6.3.2**) from "Illegal Length" to "Overall Length measured using a NIST-traceable ruler" and changed the corresponding suggested report wording to reflect overall length and uncertainty of measurement; added new **5.6.3.2**, **5.6.3.3**, and **5.6.3.5**; **5.8.4** – changed "NIST-traceable rod and ruler" to "Hott-Rod™ and NIST-traceable ruler;" **5.9** – changed "and NIST-traceable rod and ruler" to "Hott-Rod™, and NIST-traceable ruler;" **5.12** – removed "See the Plan for Estimating the Uncertainty of Measurement" and added paragraph; **8.0** – added instruction manual for the DMD-48; **10.0** – added four attachments
09/06/2013	6	Created new **5.2.4**

11/15/2013	7	Added issuing authority to header
09/05/2014	8	**Header and various subsections** – corrected to reflect organizational change; grammar
02/27/2015	9	**5.2.5** – Added second sentence; **5.2.13** – removed references to IBIS
12/11/2015	10	**4.0** - removed located in Raleigh Laboratory **5.1.1.1** - reworded Removed **old 5.1.1.1.1, 5.1.1.1.2, 5.1.1.1.3, 5.1.1.2, 5.1.1.7.1, 5.1.1.7.3** **5.1.1.5** – changed shall to may **5.1.3.1** – replaced firearms worksheet with entry; removed 2nd statement Added **5.1.3.2** Removed old **5.1.3.2.2** **5.1.3.4.3** - removed provided to each forensic scientist **5.1.3.5.4.5** – updated UCM **5.2.2** – changed SAFE to safe **5.2.13** – reworded to remove manila envelope **5.2.14.1.1** – removed disposal **5.4.3.1- 5.4.3.8, 5.5.4.9** – transferred to calibration procedure **5.4.7, 5.4.10.4** – removed worksheet section **5.4.10.4** – removed any **5.5.4.1, 5.5.4.1.1, 5.5.4.1.2, 5.5.4.2, 5.5.4.3, 5.5.4.4, 5.5.4.5, 5.5.4.6** **5.5.4.7** – transferred to calibration procedure **5.5.7** – removed specific worksheet section **5.5.7.1** – removed 1st sentence, CROR to case file **5.6.1** – changed with to by Removed **5.8.1. 5.8.2, 5.8.3, 5.8.4 –** combined into **5.8** Removed quotation marks from all conclusions **8.0** – added NC GS 14-288.8(c)(3) **9.0** – removed specific worksheets Updated Attachments A-D
09/22/2017	11	Update header information Overall, remove etc. from e.g., statements; removed individual who will perform calibration. Removed "NIST-traceable" in regard to rulers throughout. **4.0** – Remove sound meter, acoustical calibrator, and chronograph. Remove NRA from **4.0** and **5.1.3.5.3**. **5.1.3.5.3** – change perpendicular to parallel to the bore axis. Delete old **5.1.3.5.4.5.5**, **5.4** (in entirety), **5.5** (in entirety), **5.6.5** (in entirety), **5.6.6**. Added new **5.1.3.6.3**. **5.1.3.6.5.5.1** through **5.1.3.6.5.5.4** – updated uncertainty values. **5.1.3.6.5.5.5** – added second sentence. **5.2.13** – Added "at a minimum", removed several bullet points and reordered. Remove muzzle velocity from **5.2.14.1.1**. **5.2.14.2.1** and **5.2.14.2.2** – removed references to muzzle velocity and suppressor examinations 5.4.3 – updated uncertainty of measurements

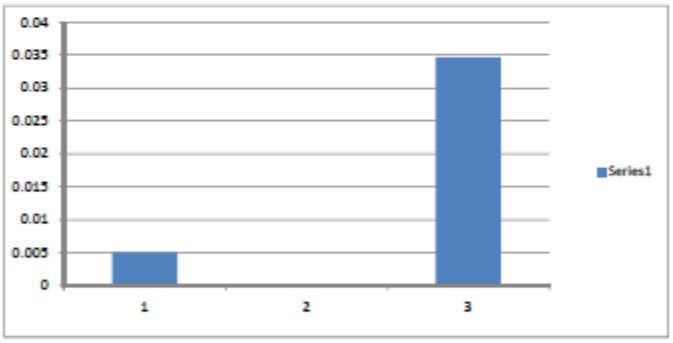
		5.6 & **5.7** – remove sound meter and chronograph. **5.10** – corrected hyperlink to uncertainty information. **8.0** – removed several references pertaining to suppressors. **9.0** – remove chronograph result printout. Updated UCM budgets (attachments). Reordered attachments and removed raw data

Attachment A: 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.

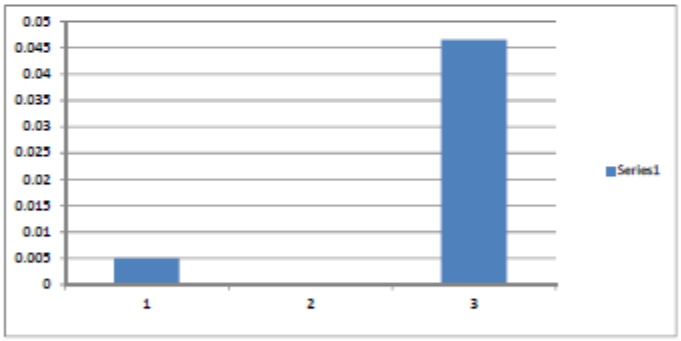
Revision History		
Version Number	**Date**	**Reason**
1	5/2/2013	Original Document
2	7/20/2015	Updated Reproducibility Study
3	7/31/2017	Updated Reproducibility Study

Attachment B: 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:	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	10
2	DMD-48 Resolution		0.00010000	inches	rectangular	B	1.73	∞	5.7735E-05	0
3	Reproducibility Study		0.0465	inches	normal	A	1.00	150	0.0465	90
	Combined Standard Unc	u							0.04676808	100
	Expanded Unc	U (k=2)							0.093536161	
	Expanded Unc	U (k=3)							0.140304241	
	Reported Uncertainty:		**0.094**		**k=2**	95.45% confidence level				
	Reported Uncertainty:		**0.040**	**(0.04")**	**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.

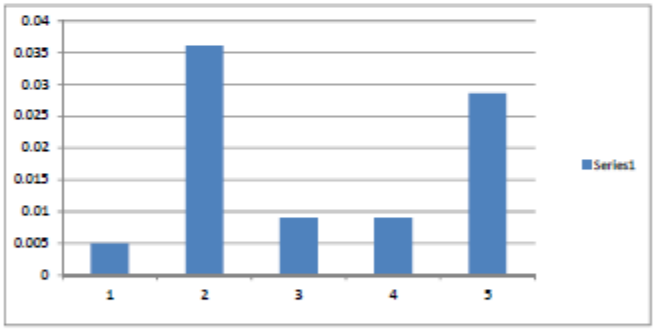
Revision History		
Version Number	**Date**	**Reason**
1	5/2/2013	Original Document
2	7/20/2015	Updated Reproducibility Study
3	7/31/2017	Updated Reproducibility Study

Attachment C: 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.

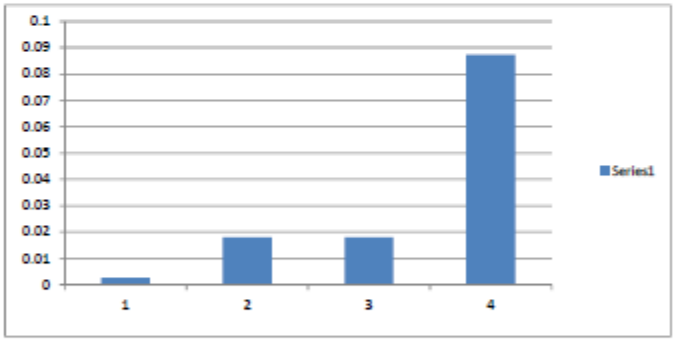
Revision History		
Version Number	**Date**	**Reason**
1	5/2/2013	Original Document
2	7/20/2015	Added uncertainty components of calibrated scale and butted errors, updated Reproducibility Study
3	7/31/2017	Updated Reproducibility Study

Attachment D: 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