MNPD Crime Laboratory

Firearms & Toolmarks Quality Manual

Metropolitan Government of Nashville & Davidson County
Police Department

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1. INTRODUCTION AND SCOPE

The MNPD Firearm and Toolmark Identification Unit's (FTIU's) Quality System Requirements supplements the MNPD Crime Laboratory's Quality Manual (QM). These procedures, in combination with the QM, FTIU Technical Procedures Manual (TPM), and FTIU Technical Training Manual (TTM) provide the basis for the effective quality assurance of examinations performed in the Firearm and Toolmark Identification Unit.

The objectives of the FTIU Quality Manual are to:

- Ensure uniformity and accountability in records and analytical techniques.
- Ensure the accuracy of the analyses and reporting through administrative and technical reviews of case records.
- Ensure the use of documented and valid procedures and equipment.
- Ensure that the personnel performing analyses within the FTIU have the appropriate level of training and education.
- Ensure the Forensic Scientists' and Forensic Technicians' competency in performing the analyses and in interpreting results through annual proficiency testing.

2. Equipment

2.1 Introduction

Forensic Scientists or Technicians who utilize the equipment in the FTIU will be knowledgeable in their use. Training will occur during the initial FTIU Forensic Scientist/Technician Training Program, or as needed. This training will include the manufacturer's instructions, procedures to be used, and any calibration and maintenance requirements.

Operating manuals for all instruments are maintained within the FTIU Laboratory area, near the applicable instrument, if possible.

Supporting documentation for external calibrations and maintenance, service and repair logs, certificates of calibration, and performance checks will be documented and maintained in the Quality Management System.

The Equipment Inventory List of all equipment in the FTIU will be maintained in the Quality Management System.

All new instruments/equipment shall be performance checked when initially put in service. Any instruments/equipment that may have a significant effect on performed examinations will be performance checked routinely and recorded.

If errors or issues are found with the instruments/equipment, the FTIU Supervisor/TL will be notified, the issue documented in the Quality Management System, and the item removed from service until it has been repaired.

This section provides procedures on how to perform the performance and interval checks. Each Examiner/Forensic Technician assigned to the FTIU will be responsible for maintaining his/her individual equipment and all equipment assigned to the MNPD FTIU. The records of the performance checks and interval standard checks must be recorded in the appropriate Quality Management System Workflow.

It is necessary that the reference standard weights, reference standard gage blocks, overall length measuring device, and a tape measure designated for use in Distance Determination requests be properly calibrated by an external calibration provider. Reference standards will be traceable to the SI units of measurement, and will be calibrated every five years by an ISO 17025 calibration provider and include a Certificate of Calibration to document traceability and accuracy. External calibrations will meet the tolerance specifications for the equipment as described in this section.

During transport to the calibration provider, the equipment will be properly protected in bubble wrap (or other protective wrapping/cushion) and packaged for shipment.

If the equipment is outside the control of the FTIU, it will be performance checked before being returned to service.

A written record of all the aforementioned procedures shall be documented in a Quality Management System Workflow.

The reference weight standards and gage blocks will be stored in the proper manufacturer-provided container which ensures high protection against contamination, dust, rough handling and temperature change.

The steel rules will be stored level and flat in the provided sleeve or device, if applicable, within the FTIU.

The reference standards or their containers will be labeled with the current calibration expiration date/due date of next calibration.

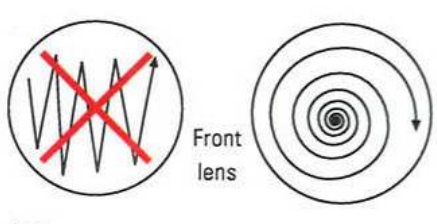
2.2 Comparison Microscopes

The Comparison Microscope shall be cleaned and serviced by a qualified technician annually.

2.2.1 General lens cleaning of the Leica FSC Comparison Microscope

Frequency: as needed

Using a soft lens cloth, lens cleaner paper or a Kim-Wipe, gently wipe the objectives in a circular motion until the lens is free of debris.



2.2.2 Performance check of the Leica FSC Comparison Microscope

Frequency: when initially put in service, quarterly, and as needed

Use the Performance Check Standard. This is not a calibration check.

The Performance Check Reference Standard is a tool which can determine whether the magnifications on both sides of the microscope are accurate. It is performed by using very precisely ruled slides, which will detect any differences in magnification from one side to the other. The slides are in .10", .05", .005", and .001" ruled increments. The slides are uniquely marked on the slide and the container they are stored in. Slide (A) is marked "FTIU A-1", Slide (B) is marked "FTIU A-2".

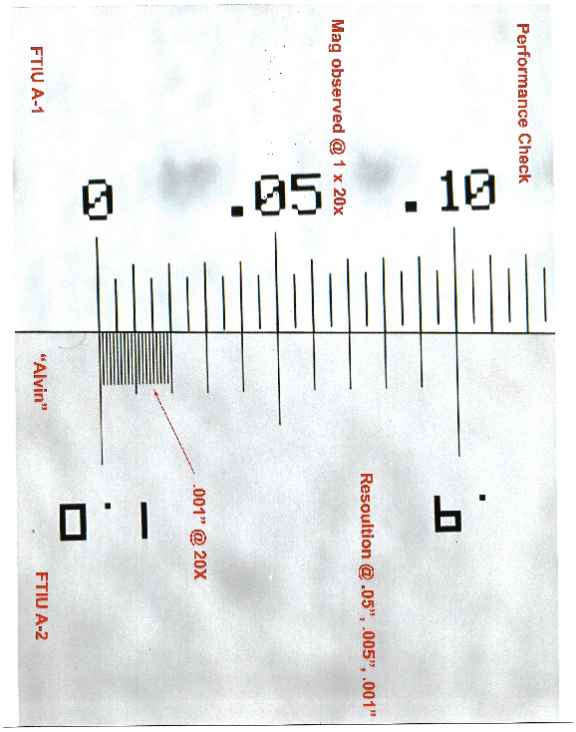


Figure 1: Example of initial performance check viewed through the Comparison Microscope

To perform the check, place one of the slides on each of the stage surfaces. Make sure that the slides are flat. Position an illuminator for the best illumination of the fine lines. Focus on each slide until the measurement lines are visible. Use the 1.0X, and 2.0X objectives during the check. These are ranges of magnification most typically utilized during casework. Align the finest lines you can see with the objectives being used. If the incremental lines do not line up across in the field of view, the microscope is in need of servicing. If the lines do line up at every magnification, the system is in proper working order.

Record the results in the appropriate Quality Management System Workflow.

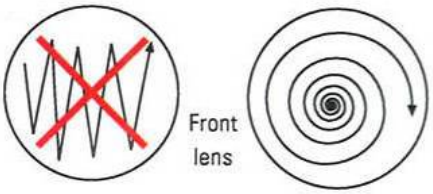
2.3 Stereo Microscopes

The Stereo Microscope should be cleaned and serviced by a qualified technician annually.

2.3.1 General lens cleaning of the Leica Stereomicroscopes

Frequency: as needed.

Using a soft lens cloth, lens cleaner paper, or a Kim-Wipe gently wipe the objectives in a circular motion until the lens is free of debris.



2.4 Balances/Scales

The Balances/Scales should be cleaned and serviced by a qualified technician annually.

2.4.1 Checking the calibration of the Mettler Toledo Series Weighing Balances

Frequency: quarterly and as needed.

- Use the Reference Standard Weight Set. The Reference Standard Weights are Mettler Toledo weights and have a Calibration of Certificate that applies to those specific weights. The weights that are used on a quarterly basis will have the calibration checked by an external calibration provider that is a signatory of ILAC once every five years.
- Be sure the balance is set to read in grains.
- Zero the balance.
- Place the appropriate weight onto the balance and check your results against the following conversion chart (1 gram = 15.43236 grains)

0.2 grams = 3.09 grains

20 grams = 308.65

200 grams = 3086.47 grains or .44 lbs.

2000 grams = 30864.72 grains or 4.4 lbs.

The tolerance set for this equipment is +/- 0.4 grains.

If the balance does not meet the set specifications, it will be taken out of service to be repaired by the manufacturer or permanently removed from service if not repairable.

2.5 Trigger Pull Weights

Frequency: yearly performance check; calibrated by external provider every five years

The standard Trigger Pull Weights shall be performance checked when initially put in service.

The standard Trigger Pull Weights shall be inspected before each use to ensure that the weights are not damaged.

If a significant change (corrosion, damage, etc.) is discovered, the weight(s) shall be taken out of service and replaced.

The FTIU routinely utilizes a Trigger Pull Weight Set in its examinations and firearm function tests. The Trigger Pull Weight Set measures the approximate amount of pressure needed to fire the firearm. This is not an exact measurement, but rather an approximation based on performing the trigger pull test to +/- ¼ lb. due to placement of the trigger weight bar onto the trigger of the firearm.

2.5.1 Description of the Trigger Pull Weight Set (B) and (C)

The Trigger Pull Weight Systems currently in use in the MNPD-CL FTIU consist of several weights that can be added to or removed from a weighted base. This base contains a rod, which is placed on the trigger of the firearm to measure the approximate amount of pressure required to engage the trigger mechanism. The MNPD-CL FTIU has two Trigger Pull Weight Sets (B & C).

The Trigger Pull Weight Sets consist of the following weights:

(1) – 2 lb. base with long rod (labeled B1)

(2) – 2 ¼ lb. base with short rods (B1 & C1)

(3) – ¼ lb. weights (B2-1, B2-2, C2)

(3) – ½ lb. weights (B3-1, B3-2, C3)

(7) – 1 lb. weights (B4-1 through B4-3, C4-1 through C4-4)

(3) – 3 lb. weights (B5, C5-1, C5-2)

(4) – 5 lb. weights (B6-1, B6-2, C6-1, C6-2)

2.5.2 Checking the Trigger Pull System Weights

Frequency: yearly performance check

Each individual trigger pull weight is uniquely identified and is recorded as to its weight on an identified precision balance. It is not necessary to designate a particular balance to perform all weights all of the time. However at the time of the performance check one precision balance should be used to record the weights on the entire set.

- The tolerance set for the individual trigger pull weights is +/- .02 lbs. of target value.

If the weights do not meet the set specifications, they will be taken out of service and a new Trigger Pull Weight Set will be purchased.

2.6 Micrometers/Calipers

Frequency: quarterly performance check and maintenance

The performance of the micrometer/calipers shall be checked prior to being put into service, utilizing the appropriate gage blocks.

2.6.1 Performance checking the Mitutoyo Digital Calipers & Micrometers

Frequency: quarterly and as needed

The gage blocks that are used on a quarterly basis will have the calibration checked by an external calibration provider that is a signatory of ILAC.

First, zero the caliper according to the instructions below:

1. Set the jaws of the calipers in the closed position
2. Press the on/off button located on the front face of the LCD. The calipers should be in the "ON" mode and reading on the LCD.
3. Press Zero/ABS button in order to zero the caliper.

- Using certified gage blocks, place the block into the jaws of the Mitutoyo Digital Caliper/Micrometer and measure the block as shown below. Repeat this procedure a minimum of three times using four (4) different size gage blocks of the following measurements: **0.025", 0.050", 0.200", and 0.500".**
- The tolerance for this calibration check is +/- 0.002".
- If the Mitutoyo Digital Caliper/Micrometer is out of specifications, perform the following procedures:
  - Perform the Zero-Set Function as outlined above.
  - Repeat the Performance Check outlined above.

2.6.2 Zero-Set Function of the Mitutoyo Digital Calipers/Micrometers

Frequency: as needed

- Set the jaws to a given extent (closed preferably) where the caliper is to be zero set, then press the ZERO/ABS switch for less than one second. The caliper should be zero set at this point and ready for measuring. If the LCD does not show "INC" mode then change the battery using SR44 battery.
- If the caliper is functional after battery replacement than ensure accuracy of the caliper by a performance check. Document in calibration/maintenance manual.
  - If after replacing the battery, the caliper is still unable to zero, document "taken out of service" and return caliper to the manufacturer for repair.

2.6.3 References

Mitutoyo Digital Caliper Instruction Sheet

2.7 Rulers and Linear Measuring Devices

Any and all linear measuring devices (steel rulers, barrel depth gauge rods, etc.) that could have a significant effect as the results of an examination used shall be verified upon purchase by comparing to NIST traceable rulers. This procedure does not replace the Uncertainty of Measurement calculations on any one measuring device.

The measuring device shall be inspected before each use to ensure that it is not damaged.

Depending on the severity of any damage noted, the measuring device shall be taken out of use and replaced.

One tape measure designated for use on Distance Determination requests will be calibrated by an external provider every five years.

2.8 Leeds Spectral Vision (LSV)

Frequency: annual performance and maintenance checks

The LSV shall be performance checked when initially put in service.

The LSV shall be inspected before each use to ensure that it is not damaged.

The LSV is a multi-wavelength imaging tool that may be used at the examiner's discretion for documentation purposes. The LSV is designed for evidence imaging and use as an alternate light source tool.

If damage is noted, the LSV shall be taken out of use, the manufacturer shall be contacted to arrange for service, and the appropriate Workflow shall be filled out in the Quality Management System.

2.8.1 Procedure for performance and maintenance check of the LSV

Frequency: yearly basis and as needed

- Full operation instructions for the LSV are located within the Leeds Forensic Systems LSV Instruction Manual.
- Ensure the green power button on the LSV base and the computer are both turned on.
- Double click the LSV icon to open the software and begin the live camera view.
- The LSV has seven LED light settings, ranging from 365nm to 850nm wavelengths, and a five position filter cassette, with filters ranging from 400nm to 830nm. Check to ensure that each LED light is operational and that the filter cassette turns to all five positions by clicking through all light and filter options (located in the lower right corner of the screen).
- The LSV system can be cleaned with a bleach and water solution.
- Cleaning solution is sprayed/applied to a lint free cloth and not directly onto the LSV.
- Wipe down the LSV head cover, touch screen, keyboard cover, LSV arm and base.
- DO NOT use cleaning solution inside the LSV head or inside vent holes.

2.8.2 References:

LSV Imaging Guide

LSV Instruction Manual

2.9 NIBIN Equipment

- IBIS BrassTrax System (two systems)
- IBIS MatchPoint + System (three systems)

2.9.1 Procedure for checking the performance of the NIBIN equipment

Frequency: yearly basis and as needed.

- The FTIU Technical Leader will provide a fired cartridge case to be used as a performance check standard.
- The performance check cartridge case will be entered into each IBIS BrassTrax System by the FTIU Technical Leader and/or his or her designee.
- The FTIU Technical Leader and/or his or her designee will correlate the images against the database.
- In order to pass the performance check, one performance check cartridge case from previous or off-site entries, at a minimum, should be found in the top 25 candidates resulting from the correlation. The top 25 candidates may be sorted by breech face or firing pin images.
- If the NIBIN equipment fails to show a previous performance check cartridge case entry in the top 25 candidates, complete the Quality Management System Workflow, remove the NIBIN equipment from service, notify the FTIU Technical Leader, and notify Forensic Technology.

2.10 Cybernational Bullet Recovery Tank

Frequency: yearly basis and as needed.

The bullet recovery tank should be serviced annually by CyberNational, Inc. A record of the annual maintenance will be retained in the Quality Management System.

Prior to use, the firearm examiner/technician should check the level of water to ensure that it is high enough to slow and stop a bullet. No documentation is required for this check.

In between the annual service and maintenance the water may be tested to determine its pH/Alkalinity as needed. The water condition and tank operability should also be checked prior to use. No documentation is required for this check. .

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2.11 Weight Standards

The FTIU will use calibrated weight standards in the quarterly calibration checks of the FTIU balances.

The individual weights will be handled with tweezers (if practical) to prevent deleterious change, and protected during transport to prevent damage.

The weight standards will be inspected for damage prior to each use, and removed from service, and replaced if damage is found.

The weight standards will be calibrated by an external provider every five years.

2.12 Gage Blocks

The FTIU will use calibrated gage blocks in the quarterly calibration checks of the micrometers and calipers utilized by the FTIU.

The gage blocks will be handled with gloves or Kim-wipes to prevent deleterious change, and protected during transport to prevent damage.

The gage blocks will be inspected for damage prior to each use, and removed from service and replaced if damage is found.

The gage blocks will be calibrated by an external provider every five years.

2.13 Steel Rules

The steel rules will be used for scale purposes only. No critical measurements will be taken using the steel rules.

2.14 Hott Rods

The Hott Rods may be used when taking barrel lengths for descriptive notetaking purposes only. No critical measurements will be taken using the Hott Rods.

3. Reference Materials

3.1 Firearms Reference Collection

3.1.1 Introduction

The MNPD-CL FTIU will maintain a Firearms Reference Collection (FRC). All firearms and firearm components (silencers, etc.) turned over to the MNPD-CL Firearm and Toolmark Identification Unit (FTIU) by court order will be maintained in a secured, limited access, Firearms Reference Vault located in the FTIU, or destroyed. This reference collection may be utilized for the following:

- Training purposes (breakdowns and proficiency testing).
- Identification – identifying parts of firearms that may be encountered in casework, or identifying make, model and source of evidence firearms.
- Familiarization – to review the particular firearm and its action and safeties before court or educational events.
- Testing purposes – to provide exemplar firearms for various testing purposes which might otherwise compromise evidence firearms. This testing may include test firing to determine ejection patterns, trigger pull, or at what distance residues are deposited with that particular firearm.
- As a serial number aid to identify location of serial numbers for comparison to evidence firearms received with obliterated or missing serial numbers. They may also be used to research the shapes/styles of the characters within the serial numbers.
- To provide a source of firearms parts for the repair of evidence firearms for test firing purposes.

3.1.1.1 Procedure for Acquisition of Firearms

A signed court order, if applicable, must accompany the receipt of the firearm(s) to show that authority has been given to the MNPD-CL FTIU to take possession of the indicated firearm(s) for forensic use, law enforcement use, or destruction. A document signed by the District Attorney General indicating that the identified firearm may be released to the MNPD-CL FTIU will also suffice.

A property release form or other type of inventory form must be completed and signed by the person releasing the firearm(s) and the MNPD-CL FTIU designee accepting the firearm(s). This property transfer form must also include the date of the transfer.

The court order and property release forms will be maintained in the MNPD-CL FTIU indefinitely.

3.1.1.2 Procedure for Maintaining the Firearms Reference Collection

These firearms and firearm components become the responsibility of the FTIU Supervisor or his/her designee, and shall be handled in the following manner:

Upon receipt, the firearm shall be checked to ensure it is unloaded and logged into the Firearms Reference Collection.

The reference firearm shall be logged for documentation and inventory purposes in a permanent electronic file on a network drive with the following information, at a minimum:

- Make
- Model
- Serial Number
- Inventory Number/Barcode Number
- Individual Storage Location (if assigned)
- Any other information deemed pertinent by a representative of the FTIU

The Firearms Reference Collection shall be housed in a secure area in the FTIU and shall have limited access.

Complete inventories of the reference collection shall be conducted as needed at the FTIU Supervisor's discretion, by members of the FTIU utilizing the inventory number and/or serial number. Visual spot checks of firearms placements may be conducted as needed to ensure firearms are in correct position and accounted for. Documentation including the results of the inventory and/or spot check inspection shall be recorded and maintained for a minimum of five years on the laboratory network drive.

If destruction of a reference firearm is deemed necessary, it shall be done in accordance with current state laws and the destruction order, if applicable. All records pertaining to destruction shall remain on file indefinitely in the FTIU. Any firearm destruction will be witnessed by at least a second FTIU representative and any other representatives the MNPD-CL Director designates.

The Firearms Unit Supervisor or his/her designee may authorize a firearm to be loaned to an authorized employee of the MNPD or any other member of a law enforcement agency. This request shall be in the form of a memo addressed to the Firearms Unit Supervisor and to the MNPD-CL Director preferably by the Agency's Top management. This policy shall not conflict with any directive of the MNPD General Orders.

The MNPD FTIU may transfer a reference firearm as well as receive reference firearms from other Law Enforcement Agencies and/or Forensic Laboratories. Proper documentation must accompany transfer with the firearm.

3.1.2 Ammunition Reference Collection

3.1.2.1 Introduction

The Ammunition Reference Collection (ARC) is a collection or catalog of both cartridges and cartridge components. This reference collection shall be maintained for identification, comparison, or interpretation purposes and shall be documented, uniquely

identified, and properly controlled. This reference collection shall be utilized by members of the MNPD-CL Firearm and Toolmark Identification Unit (FTIU) to:

- Identify the manufacturer's cartridge designation, source of evidence ammunition or component parts.
- To provide an exemplar resource for training.
- To provide a resource for the identification of ammunition components.
- To provide ammunition for test firing purposes.

3.1.2.2 Maintenance of Reference Ammunition

Pulled ammunition components from the ammunition storage room may be housed in the original packaging they were received, as well as plastic storage boxes or other types of storage containers.

For each type of ammunition, the following will be maintained in the reference collection:

- At least one intact cartridge, if possible; and
- One pulled cartridge, broken down into its component parts.

Each container shall be uniquely labeled and inventoried.

An electronic record on a network drive of items contained in the ammunition reference collection shall be maintained.

3.1.3 Test Fire Reference Collection

3.1.3.1 Introduction

The MNPD-CL FTIU will maintain a test fire reference collection. Test fired bullets and cartridge cases from all firearms submitted in conjunction with a criminal matter and test fired by the MNPD-CL FTIU will be maintained in a secured, limited access, designated area within the FTIU. This reference collection shall be utilized for the following:

- Training purposes (indexing and identifying bullets and cartridge cases).
- Individual Characteristics Database (ICD).
- Reference purposes (for comparing class characteristics of an unknown bullet or cartridge case to known firearm types).
- Future comparisons to additional evidence received in casework.
- Future comparisons for IBIS associations.

It should be noted that test fired ammunition is not routinely used for evidence comparisons.

3.1.3.2 Procedure for Maintaining Test Fires

A small cardboard box (or equivalent container) should be used to hold test fired bullets and/or cartridge cases. One side of the container shall be marked with the following information, if applicable:

- The MNPD-CL laboratory number and exhibit number assigned to the firearm.
- The manufacturer of the firearm, if known.
- The model of the firearm, if known.
- The serial number of the firearm.
    - If the firearm is manufactured without a serial number, note "N/A" on the test box.
    - If the serial number had been obliterated and restored, the recovered serial number shall be listed.
    - If the serial number had been obliterated, and restoration was not possible, a notation of "obliterated" shall documented.

After completion of examinations, the test fire box shall be sealed with tape. The corresponding LIMS barcode shall be attached to the box and electronically scanned to the Test Fire Storage.

The barcode will contain the unique identifier assigned to the test fires.

An electronic inventory of the Test Fire Reference Collection will be maintained in the Laboratory Information System (LIMS).

3.2 Chemicals & Reagents

Chemicals will be logged into the Quality Management System when they are received into the Unit. The date received, supplier, lot number, and storage location/requirements will be recorded at this time. If the chemical poses a hazard, a warning sticker must be applied to the container if not already appropriately labeled. In addition, the container will be labeled with the date received, storage location/requirements and the initials of the examiner. When a chemical is initially opened, the examiner will record the date and their initials on the container. Only one container of a chemical should be opened at a time.

Chemicals will be stored in the appropriate cabinets and under the conditions specified by the manufacturer.

Safety Data Sheets will be maintained on all chemicals in the Quality Management System.

Reagents shall be prepared in accordance with the procedures outlined in this section. Any deviation from the described methods will occur only if the deviation has been documented through the Workflow Module in the Quality Management System, technically justified, and authorized by the Unit Supervisor.

The Reagent Log Workflows located in the Quality Management System will be filled out for each reagent made. The Reagent Log Workflows will include the reagent name, preparation date, expiration date (if applicable), appropriate lot numbers, name of the examiner that prepared the reagent, and results of testing to ensure the reagent is performing correctly. A reagent sticker

will be placed on the container with the reagent name, date prepared, expiration date (if applicable), and examiner's initials.All reagents will be tested when prepared to ensure proper functioning. If testing indicates that the reagent is not functioning properly, the reagent will be discarded and made again. Results of initial testing shall be recorded in the Quality Management System Workflow.

Reagents will be tested prior to use on evidence. Reagents that require a positive and negative control test prior to testing on evidence will have those results recorded in the case notes.

3.2.1 Griess Solution

Solution A

- 38.5 grains sulfanilic acid
- 500 ml deionized water
- Dissolve sulfanilic acid in deionized water.

Solution B

- 21.5 grains alpha-naphthol
- 500 ml methanol

Dissolve alpha-naphthol in methanol.

For the working Griess Solution, combine equal volumes of Solution A and Solution B. The Griess Solution is applied to desensitized photographic paper or gloss printing photographic paper and allowed to air dry. The treated photographic paper is stored away from direct light.

3.2.1.1 Controls

Griess paper must be tested after treatment and prior to use in casework. With a nitrite swab saturated with 15% acetic acid, dab the corners of the treated Griess paper.

A positive reaction will be indicated by the appearance of an orange color at each corner, confirming sensitivity to nitrite compounds.

A negative control will consist of applying cheesecloth soaked in 15% acetic acid to the treated photographic paper, with the addition of heat, and no reaction should be observed.

Griess paper must also undergo a positive and negative control test concurrent with its use in casework, following the same testing procedure..

Storage: Store Solution A and Solution B in separate sealed containers until ready for use.

Expiration: one year after preparation

3.2.2 Nitrite Test Swabs

- 9.3 grains sodium nitrite (0.6 grams)
- 100 ml deionized water

Dissolve sodium nitrite in deionized water.

Soak the cotton-tipped ends of a package of six-inch swabs in the solution. Set the swabs aside to dry.

Makes approximately 100 swabs.

3.2.2.1 Controls:

Nitrite swabs must be tested prior to use in casework. With a nitrite swab saturated with 15% acetic acid, dab the corners of treated Griess Paper.

A positive reaction will be indicated by the appearance of an orange color at each corner.

No negative control is necessary.

Storage: in a sealed container

Expiration: none

3.2.3 15% Acetic Acid Solution

- 150 ml glacial acetic acid
- 850 ml deionized water

Add acetic acid to deionized water. Gently pour acid into the water to preclude potential spattering of undiluted acid.

NOTE: NEVER add water to a concentrated acid.

3.2.3.1 Controls:

Acetic acid solution must be tested prior to use in casework. With a nitrite swab saturated with the acetic acid solution, dab the corners of the treated Griess paper.

A positive reaction will be indicated by the appearance of an orange color at each corner, confirming sensitivity to nitrite compounds.

A negative control will consist of applying cheesecloth soaked in the acetic acid solution to the Griess paper, with the addition of heat, and no reaction should be observed.

Storage: in an appropriately labeled, sealed container

Expiration: None

3.2.4 Sodium Rhodizonate Solution

Place a small amount of Sodium Rhodizonate in a small aerosol or spray bottle and add a sufficient amount of deionized water to make a saturated solution approximately the color of strong tea. Swirl to mix.

Make only enough solution for immediate use.

3.2.4.1 Controls:

Sodium rhodizonate solution must be tested in conjunction with buffer solution prior to use in casework.

For a positive control, a lead standard (lead bullet) should be used to mark a piece of clean filter paper. After the addition of buffer solution and sodium rhodizonate solution, a pink reaction should be seen in the area wiped with the lead.

For a negative control, an untreated piece of clean filter paper should be used and no color change should occur after treatment with each of the chemicals.

Storage: None

Expiration: after completion of the test or when color of solution fades

3.2.5 Buffer Solution

- 29.3 grains sodium bitartrate (1.9 grams)
- 23.1 grains tartaric acid (1.5 grams)
- 100 ml deionized water

In an aerosol or spray bottle, dissolve sodium bitartrate and tartaric acid in deionized water. This might require both heat and agitation to complete in a reasonable period of time.

3.2.5.1 Controls:

Buffer solution must be tested in conjunction with sodium rhodizonate solution after preparation and prior to use in casework.

For a positive control, a lead standard (lead bullet) should be used to mark a piece of clean filter paper. After the addition of buffer solution and sodium rhodizonate solution, a pink reaction should be seen in the area wiped with the lead.

For a negative control, an untreated piece of clean filter paper should be used and no color change should occur after treatment with each of the chemicals.

Buffer solution must also undergo a positive and negative control test concurrent with its use in casework, following the same testing procedure.

Storage: kept refrigerated in order to control mold

Expiration: one year after preparation.

3.2.6 Dilute Hydrochloric Acid Solution

- 5 ml concentrated hydrochloric acid
- 95 ml deionized water

Add concentrated hydrochloric acid to deionized water. Gently pour acid into the water to preclude potential spattering of undiluted acid.

NOTE: NEVER add water to concentrated acid.

3.2.6.1 Controls:

Hydrochloric acid solution must be tested in conjunction with buffer solution and sodium rhodizonate solution prior to use in casework.

For a positive control, a lead standard should be used to mark a piece of clean filter paper. After the addition of buffer solution and sodium rhodizonate solution, a pink reaction should be seen in the area wiped with the lead. After the addition of dilute hydrochloric acid, this pink area should change to a blue-violet color.

For a negative control, an untreated piece of clean filter paper should be used and no color change should occur after treatment with each of the chemicals.

Dilute hydrochloric acid solution must also undergo a positive and negative control test concurrent with its use in casework, following the same testing procedure.

Storage: in an appropriately labeled sealed container

Expiration: none

[1]Rawls, Donald D. and John P. Ryan, Jr., "Modified Feigl Test for Lead", AFTE Journal, Summer 2006, Vol. 38, No.3, pgs. 213-222.

3.2.7 Turner's Reagent

(Cast Steel Etching Solution)

- 40ml hydrochloric acid
- 30 ml deionized water
- 25 ml ethyl alcohol
- 2.5 grams cupric chloride

Add the ethyl alcohol and hydrochloric acid to the deionized water. Then dissolve cupric chloride in water, ethyl alcohol, and hydrochloric acid solution.

NOTE: NEVER add water to concentrated acid.

3.2.7.1 Controls:

Etching solution must be tested prior to use in casework. To test, apply Etching Solution #1 to a reference sample of cast steel (a cast steel reference firearm may be used to test reagent). A positive reaction is indicated by either a color distortion of the metal surface, or bubbling reaction. No negative control is required. Results of testing shall be recorded on the Reagent Log Sheet. Etching solution must also undergo a positive control test immediately prior to its use in casework, following the same testing procedure. For this

test, the evidence firearm should be used, and the chemical applied to an area away from the serial number.

Storage: appropriately labeled and sealed container

Expiration: ten years after preparation

3.2.8 Frye's Reagent

(Cold Rolled Steel Etching Solution)

- 120 ml hydrochloric acid
- 100 ml deionized water
- 90 grams cupric chloride

Add hydrochloric acid to deionized water. Then, dissolve cupric chloride in water and hydrochloric acid solution.

NOTE: NEVER add water to concentrated acid.

3.2.8.1 Controls:

Etching solution must be tested prior to use in casework. To test, apply Etching Solution #2 to a reference sample of cold rolled steel (a reference firearm may be used to test reagent).

A positive reaction is indicated by either a color distortion of the metal surface, or bubbling reaction.

No negative control is required.

Etching solution must also undergo a positive control test immediately prior to its use in casework, following the same testing procedure. For this test, the evidence firearm should be used, and the chemical applied to an area away from the serial number.

Storage: in an appropriately labeled and sealed container

Expiration: ten years after preparation

3.2.9 25% Nitric Acid

(Aluminum or Pot Metal Etching Solution)

- 150 ml deionized water
- 50 ml concentrated nitric acid

Add nitric acid to deionized water.

NOTE: NEVER add water to a concentrated acid.

3.2.9.1 Controls:

Etching solution must be tested prior to use in casework. To test, apply Nitric Acid Solution to a reference sample of pot metal (a reference firearm may be used to test reagent).

A positive reaction is indicated by either a color distortion of the metal surface, or a bubbling reaction.

No negative control is necessary.

Etching solution must also undergo a positive control test immediately prior to its use in casework, following the same testing procedure. For this test, the evidence firearm should be used, and the chemical applied to an area away from the serial number.

Storage: in an appropriately labeled and sealed container

Expiration: ten years after preparation

3.2.10 50% Nitric Acid

(Aluminum Etching Solution)

- 100 ml deionized water
- 100 ml concentrated nitric acid

Add nitric acid to deionized water.

NOTE: NEVER add water to a concentrated acid.

3.2.10.1 Controls:

Etching solution must be tested prior to use in casework. To test, apply Nitric Acid Solution to a reference sample of aluminum (a reference firearm may be used to test reagent).

A positive reaction is indicated by either a color distortion of the metal surface, or a bubbling reaction.

No negative control is necessary.

Etching solution must also undergo a positive control test immediately prior to its use in casework, following the same testing procedure. For this test, the evidence firearm should be used, and the chemical applied to an area away from the serial number.

Storage: in an appropriately labeled and sealed container

Expiration: ten years after preparation

3.2.11 Acidic Ferric Chloride

(Aluminum Etching Solution)

- 100 ml deionized water
- 25 ml concentrated hydrochloric acid
- 25 g ferric chloride

Dissolve ferric chloride in hydrochloric acid. Then, add hydrochloric acid mixture to deionized water.

NOTE: NEVER add water to a concentrated acid.

3.2.11.1 Controls:

Etching solution must be tested prior to use in casework. To test, apply Acidic Ferric Chloride Solution to a reference sample of aluminum (a reference firearm may be used to test reagent).

A positive reaction is indicated by either a color distortion of the metal surface, or a bubbling reaction.

No negative control is necessary.

Etching solution must also undergo a positive control test immediately prior to its use in casework, following the same testing procedure. For this test, the evidence firearm should be used, and the chemical applied to an area away from the serial number.

Storage: in an appropriately labeled and sealed container

Expiration: ten years after preparation

3.2.12 10% Sodium Hydroxide

(Aluminum Etching Solution)

- 90 ml deionized water
- 10 ml concentrated sodium hydroxide

Add sodium hydroxide to deionized water.

3.2.12.1 Controls:

Etching solution must be tested prior to use in casework. To test, apply one of the previously described Etching Solutions to a reference sample of aluminum (a reference firearm may be used to test reagent) and then follow with application of Sodium Hydroxide Solution.

A positive reaction is indicated by a bubbling reaction accompanied with a color distortion of the metal surface.

No negative control is necessary.

Sodium Hydroxide Solution must also undergo a positive control test immediately prior to its use in casework, following the same testing procedure. For this test, the evidence firearm should be used, and the chemical applied to an area away from the serial number.

Storage: in an appropriately labeled and sealed container

Expiration: ten years after preparation

3.2.13 10% Bleach Solution

(Disinfecting Solution)

- 90 ml deionized water
- 10 ml bleach

Add bleach to deionized water.

3.2.13.1 Controls:

No controls necessary. Not necessary to record on a Reagent Log Sheet.

Make fresh daily, or as needed. Any commercially available dispenser may be used for preparing this solution.

Storage: in an appropriately labeled and sealed container

4. Handling of Test Items

This section outlines the evidence handling procedures utilized by the MNPD-CL Firearm and Toolmark Identification Unit (FTIU). Adherence to these procedures will ensure the integrity of the evidence is maintained.

It is the responsibility of the firearm examiner/forensic technician to employ appropriate safety and health practices. Safe firearm handling procedures shall be strictly followed at all times when dealing with firearms and ammunition as outlined in the Safety section of this manual.

The official chain of custody for evidence handling will be the electronic chain of custody housed in the Laboratory Information Management System (LIMS). Evidence transfers will be electronically recorded.

- All evidence transactions by the Forensic Scientist or Forensic Technician will be conducted in LIMS, scanned electronically, and recorded and secured with a personal identification number (PIN).
- Once the evidence is scanned electronically to the Forensic Scientist or Forensic Technician in the FTIU, it is in their possession. The evidence can then be stored in the Personal Storage Location (PSL) assigned to that individual or a Temporary Storage Location such as the GSR room. The PSL encompasses both the work station storage and unit vault personal storage locations. The PSLs are locked storage locations accessible by only the Forensic Scientist or Forensic Technician assigned to them.
- Evidence in the process of being examined may be left out at work units for short periods of time (lunch, breaks, etc.), and must be stored in the PSL or in limited circumstances (i.e., clothing being examined for gunshot residues, serial number restoration, or heavily rusted firearms) in the GSR room overnight. The GSR Room is card keyed limited access to authorized personnel. In this exception, the door will be locked and only accessible by the FTIU.
- Evidence being verified by another Forensic Scientist does not have to be scanned electronically. If the verification takes more than one day, the evidence must be stored overnight in a secured storage location.
- While examination is in progress, the case is considered active. Active casework evidence can be in the possession of a Forensic Scientist or Forensic Technician for up to 180 days without a proper seal. After 180 days, the evidence must be returned to the ERU, or documented approval shall be acquired from the Unit Supervisor/Technical Leader through a deviation request.

All evidence packaging should be marked by the Forensic Scientist or Forensic Technician with the laboratory number, exhibit number, and initials.

- All evidence should be marked, at a minimum, with examiner's initials for identification purposes, unless too small to mark. If an item (bullet/bullet fragment) is too small to mark, the proximal container may be marked.
- Exceptions to the above are law enforcement firearms and other firearms under special circumstances (stolen, wildlife, etc.). The Forensic Scientist or Forensic Technician will

have discretion as to how documentation will be conducted for identification of the evidence.

When handling evidence with possible biological hazardous materials, proper PPE shall be worn.

After completion of testing, and before returning the firearm(s) to the ERU, the firearm shall be visually safe. This can be accomplished by placing a cable tie through the action of the firearm, or by some other suitable means.

When examination is completed, all evidence packaging will be sealed with MNPD-CL evidence tape and initialed.

Evidence will be returned to the ERU, or another Forensic Scientist or Forensic Technician, with that transfer recorded electronically and secured with a PIN in LIMS.

5. Individual Characteristic Database – NIBIN

The National Integrated Ballistics Information Network (NIBIN) is a ballistic imaging network designed for the acquisition and comparison of known and unknown cartridge cases (test fires and crime scene evidence). Images of cartridge cases are entered into an Integrated Ballistic Identification System (IBIS) using optical and electronic technology. The FTIU utilizes two separate IBIS systems: IBIS BrassTrax and IBIS MatchPoint. The IBIS BrassTrax system images the primer (breech face) area, the firing pin impressions, and the ejector markings of fired cartridge cases. These images are then stored in databases and algorithms are used to correlate the images against each other using filters such as caliber, shape of firing pin impression, and date of crime. These correlations produce lists of possible associations, ranked in order of correlation score (best match). A trained firearm examiner/firearms technician can then recall images from the correlation list and compare them side by side on the IBIS MatchPoint systems. If a possible association is found during this screening process, upon request, the actual evidence and/or test fired items can be microscopically examined by a trained firearm examiner to determine if the associated items had been fired in the same firearm. If this determination is made, the associated items are confirmed as a Hit.

Currently, the images entered into the NIBIN system are automatically searched against a regional database. A manual correlation can be created to include specific states, regions, or be searched against the nation-wide database at the discretion of the firearm examiner/forensic technician or if requested by the submitting agency.

The firearm examiners and forensic technicians in the FTIU will be certified by the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) in order to, and prior to, making independent entries into the NIBIN system.

Once authorized by the ATF to gain access to the system, access is controlled by a user name and password for each examiner/technician. Only those authorized to use the system may gain access to the system.

Performance checks will be conducted yearly by the FTIU Supervisor and/or his or her designee.

Individual characteristic database samples (test fires) are treated as reference materials.

6. Technical Records

The FTIU must maintain technical records on all significant aspects of the firearm and toolmark identification procedures as well as any related documents or laboratory records that are pertinent to the analysis or interpretation of results. These records will serve as a traceable audit trail as well as an archive for retrospective scientific inspection, re-evaluation of the data, and reconstruction of the firearm and toolmark procedure. Technical records will exist for the following topic areas:

6.1 Test Methods and Procedures for Firearm and Toolmark Identification

This documentation describes, in detail, the procedure currently used for the analytical testing of firearm and toolmark evidence in the FTIU. It includes the date the procedure was adopted and approved for use. Revisions are clearly documented and appropriately approved. This information can be found in the FTIU Technical Procedures Manual housed in the MNPD-CL's document control software (Quality Management System).

6.2 Case Files/Case Notes/Case Records

There are policies and quality assurance procedures in place to ensure the reliability and completeness of the documentation, data analysis, reports, and review processes of all cases examined by the FTIU.

6.3 Casework Documentation

Casework Documentation provides a foundation for the results and conclusions contained in the Official Firearms Report.

- Documentation must be in such a form that a competent examiner or supervisor/technical leader, in the absence of the primary examiner, would be able to evaluate the data and evaluate the conclusions rendered.

- Documentation must include, but is not limited to, data obtained through the analytical process. It should also include information regarding the packaging of evidence upon receipt and the condition of the evidence itself.

- All documentation of procedures, observations made, results of tests performed, photographs, etc., which are used to support the examiner's conclusions, must be preserved as a record according to laboratory policy. Results will be preserved by notes, photography, computer drives, or other suitable means. This can be accomplished by either electronic (paperless) or hardcopy.

- The start date of examination should be documented in the additional data information located in LIMS under:

6.4 Interpretation of Data

The FTIU has general guidelines for interpretation of data for each method utilized in the examination of firearm and toolmark evidence. These guidelines are found in the FTIU Technical Procedures Manual.

6.5 Review of Casework

Casework Review includes verification of evidence, technical review of the case record, and administrative review of the case record. Specific information regarding these reviews is found in the Verifications and Casework Reviews section of this manual.

6.6 Technical Review

Data, documentation, and conclusions must be reviewed independently by a second qualified examiner in accordance with MNPD-CL Quality Manual. Technical Reviews may be performed by all authorized scientists/technicians performing casework. Prior to issuing a report, the interpretation of the data and the conclusions derived from that data must be agreed upon by the scientist/technician and reviewer. Refer to the Technical Review section of this manual.

If a discrepancy, or difference of opinion, occurs during the technical review resulting in an examiner changing his or her original report, this discrepancy and outcome will be recorded in the case record. If the discrepancy is clerical in nature, that may also be noted.

It is the responsibility of the FTIU Supervisor/Technical Leader or his or her designee to ensure that all deficiencies are acknowledged and that any corrective action is successfully completed.

6.7 Administrative Review

The report and case notes must be reviewed for grammatical and spelling errors, proper page numbering, a complete Chain of Custody, and that all administrative information is correct. Administrative Reviews can be performed in conjunction with or separate from the Technical Review. All FTIU members authorized to perform Technical Reviews may perform Administrative Reviews.

6.8 Method Validation Records

Method Validation Records will be maintained in the Quality Management System.

7. Estimation of Uncertainty of Measurement

The NIST - 8 Step Process for Estimating and Reporting Measurement Uncertainty will be followed for obtaining the data and performing the calculations. These steps include:

1. Specify the measurement process.
2. Identify uncertainty components.
3. Quantify uncertainty components.
4. Convert quantities to standard uncertainties.
5. Calculate combined standard uncertainty.
6. Expand the combined standard uncertainty by coverage factor (k).
7. Evaluate the expanded uncertainty.
8. Report the uncertainty.

All equipment that is used for measurements is calibrated by an external calibration laboratory.

7.1 Definitions

Measurement Uncertainty: A parameter associated with the result of measurement that characterizes the dispersion of values that could reasonably be attributed to the particular quantity subject to measurement.

From *ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty – Annex C*:

No measurement is exactly known.

If a measurement is repeated several times using the same measurement process, a different measured quantity value is obtained each time, assuming that the measuring system has sufficient resolution (sensitivity). Therefore, anytime a measurement is taken, the measured quantity value depends on many different variables including the measuring system, the measurement procedure, the person performing the measurement, as well as other aspects of the measurement process.

Measurements that matter: A measurement that is used, or may reasonably be expected to be used, by an immediate or extended customer (anyone in the judicial process) to determine, prosecute, or defend the type or level of criminal charge(s).

7.2 References

ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty – Annex C, Firearms/Toolmarks Discipline, Firearms Category of Testing, Example – Overall Length of a Firearm, ASCLD/LAB-*International*, AL-PD-3064 Version 1.0, Effective date: May 22, 2013.

ASCLD/LAB Policy on Measurement Uncertainty, AL-PD-3060 Ver 1.1, Effective Date: May 22, 2013

ASCLD/LAB Guidance on the Estimation of Measurement Uncertainty-ANNEX A: Details on the NIST 8 Step Process; AL-PD-3062 Ver 1.0, Effective date: May 22, 2013

Joint Committee for Guides in Metrology (JCGM), Evaluation of measurement data-*Guide to the expression of uncertainty in measurement (GUM)*; BIPM-JCGM, September 2008, http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf

Evaluation of measurement data – Guide to the expression of uncertainty in measurement, GUM 1995 with minor corrections, JCGM 100:2008, 2010.

International vocabulary of metrology – Basic and general concepts and associated terms (VIM), JCGM 200:2012, 2012.

7.3 UoM for Barrel and Overall Length

Based on Tennessee State Statute and Federal Laws, the FTIU identifies reported measurements that matter as barrel length and overall length of rifles and shotguns that have been shortened, and fall on or between the legal length and one-half inch below the legal length. Specifically:

- Shotguns and rifles with an overall length at or between 25 ½ and 26 inches.
- Rifle barrels with lengths at or between 15 ½ and 16 inches.
- Shotgun barrels at or between 17 ½ and 18 inches.

7.3.1 Introduction

The FTIU has and applies a procedure to estimate the measurement uncertainty for the measurements of barrel length of a firearm and/or overall length of a firearm.

The estimation of uncertainty is a representation of the confidence, or certainty, associated with a measurement.

7.3.2 Approach for Estimation of Measurement Uncertainty

As a conservative approach to the estimation of uncertainty for reported measurements that matter, measurements will be recorded to the precision of 1/16 of an inch. Measurements that do not fall directly on a 1/16 of an inch demarcation will be rounded up to the next 1/16 of an inch.

The measurement uncertainty for measurements performed in the FTIU shall be considered to be plus or minus two standard deviations.

7.3.3 Reporting Results

When the measurement that matters falls within ½ inch of the mandated length, the measurement uncertainty will be reported.

7.3.4 Documentation

The Measurement Uncertainty Estimation Form is used to calculate the measurement uncertainty.

Raw data of each individual measurement, number of analysts involved, parameters of Type

A and B evaluations and calculations of the estimated measurement uncertainty of each procedure are within the FTIU-Measurement Uncertainty Folder in the Quality Management System.

Records for the estimation of the Measurement Uncertainty will be maintained in the Quality Management System. These records will include data collected, any resulting calculations, and uncertainty components.

7.3.5 Measurement Uncertainty Procedure

The Firearms and Toolmark Identification Unit (FTIU) used the following method in order to calculate a measurement of uncertainty for the overall length and barrel length of firearms that may come within a critical range. The MNPD (Metro Nashville Police Department) FTIU utilized shortened rifles and shotguns in order to perform measurements for calculating the measurement of uncertainty. These firearms are realistic in nature of what would be encountered in actual casework, and include both barrels and stocks having non-symmetrical ends.

7.3.6 Instruments

Instruments utilized in this procedure are calibrated every five years by an external calibration laboratory accredited to ISO/IEC 17025.

- Precision Forensic Testing Ruler (SN: 1012, calibrated 09/12/2019)

7.3.7 Experiment

The experiment is designed to obtain overall lengths and barrel lengths of the above listed firearm types. The barrel length will be measured by two methods. All firearms examiners will take part in the measurement process. The following parameters are to be completed:

- At least 350 measurements for each method (A and B) will be made using five (5) firearms.
- Each set of examiner's measurements will be made on different days.
- Record the date of the measurement and name or initials of who performed the measurement on the worksheet as to the particular method.
- Record at least 10 worksheets (measurement sets) per analyst so that total number of measurements will equal approximately 350 data points (measurements).

7.3.8 Methods

7.3.8.1 Method A (Recording overall length)

- Place the firearm in the overall length and barrel measuring device with the barrel parallel to the edge of the device.
- Make sure the stock end is at the opposite end of the movable plate and is in contact with the edge of the device with axis of bore of the firearm parallel to the edge of the device.

- With the firearm firmly seated in the device adjust the moveable plate to contact the end of the barrel. Make sure that the plate is not in hard contact due to the fact that the plate may not be perpendicular to the ruler located on the device.
- Read the measurement directly over the moveable plate on the side where the barrel is in contact with the plate. Record the value.

7.3.8.2 Method B (Recording barrel length)

- Make sure the firearm is cocked so no firing pin could be protruding thru the breech.
- Using the Brass Dowel Rod that is part of the Overall Length and Barrel Measuring device, place the correct gauge of dowel rod gently down the bore of the firearm while holding the firearm vertical and perpendicularly as possible to the floor.
- Once the dowel rod is seated into the barrel, gently loosen the wing nut of the locking collar of the dowel rod and position it where it comes in contact with barrel, then tighten the collar with the wing nut. Note: In barrels where edges are non-symmetrical the collar should be positioned to the highest point on the barrel's muzzle.
- Once the collar is tightened, gently remove the rod from the barrel and place the dowel rod directly beside the ruler located on the Overall Length and Barrel Measuring Device with the end of the dowel that is seated into the breech face in contact with the zero (0) ruled edge of the plate. Read the left side of the collar on the ruler to obtain the barrel length. Record the value.

7.3.9 Calculations

All data was retrieved from each examiner and tabulated and calculated according to guidelines set forth by the NIST 8-Step Process for Estimating and Reporting Measurement Uncertainty.

Step 1. Specify the measurement process. Outlined above in Methods section.

Step 2. Identify uncertainty components. These include, but are not limited to: measurement process reproducibility, length scale readability, and ruler calibration uncertainty.

The uncertainty components considered and how they will be evaluated:

Uncertainty Component	**Method of Evaluation**
Measuring Equipment	
Length Scale readability	Type B Evaluation
Length Scale resolution	Type B Evaluation
Calibration Uncertainty	Type B Evaluation
Calibrated Scale Error	Type B Evaluation
Proper Use, Storage and handling	Covered in Type A Evaluation of process reproducibility data
Staff	

Multiple analysts	Covered in Type A Evaluation of process reproducibility data
Training	Covered in Type A Evaluation of process reproducibility data
Experience	Covered in Type A Evaluation of process reproducibility data
Visual acuity	Covered in Type A Evaluation of process reproducibility data
Time of day, day of week, interruptions, workload	Covered in Type A Evaluation of process reproducibility data
Test Method	
Differences in establishing parallel and perpendicular between analysts	Covered in Type A Evaluation of process reproducibility data
Analyst positioning of measuring equipment	Covered in Type A Evaluation of process reproducibility data
Facility	
Temperature coefficient of expansion for measuring equipment	Type B Evaluation
Lighting	Covered in Type A Evaluation of process reproducibility data
Space	Covered in Type A Evaluation of process reproducibility data

Step 3. Quantify uncertainty components. Two separate Measurement Uncertainty Estimation Forms were completed, one for each of the measurement methods. All measurements were reported and calculated in inches.

Step 4. Convert quantities to standard uncertainties. These calculations were completed using the Measurement Uncertainty Estimation Forms. The divisors were based on the distribution types, which are identified on the forms.

Step 5. Calculate combined standard uncertainty. These calculations will be completed using the Measurement Uncertainty Estimation Forms. The formula for calculating the combined standard uncertainty is commonly called the Root Sum of the Squares, or RSS.

Step 6. Expand the combined standard uncertainty by coverage factor (k). These calculations were completed using the Measurement Uncertainty Estimation Forms. k=2 and k=3 values were both evaluated for each measurement process (Methods A –B). Calculated values were converted from decimal places to sixteenths of an inch, rounding up to the next 1/16". The MNPD FTIU will utilize the calculated k=2 value with a 95.45% coverage factor (often referred to as 95%). This is a conservative approach to cover all measurement processes.

Step 7. Evaluate the expanded uncertainty. The expanded uncertainty will be re-evaluated every five years. Any personnel and/or equipment changes will be reflected in the next scheduled uncertainty evaluation and recorded.

Step 8. Report the uncertainty. Examples of report wording may be found in the Range of Conclusions & Reporting Results section of this manual.

7.4 UoM for Trigger Pull

7.4.1 Introduction

The FTIU has and applies a procedure to estimate the measurement uncertainty for the measurements of trigger pull of a firearm.

The estimation of uncertainty is a representation of the confidence, or certainty, associated with a measurement.

7.4.2 Approach for Estimation of Measurement Uncertainty

As a conservative approach to the estimation of uncertainty for reported measurements that matter, measurements will be recorded to the precision of 1/4 of a pound.

The measurement uncertainty for measurements performed in the FTIU shall be considered to be plus or minus two standard deviations.

7.4.3 Reporting Results

When the trigger pull result is reported the measurement uncertainty will be reported.

7.4.4 Documentation

The Measurement Uncertainty Estimation Form is used to calculate the measurement uncertainty.

Raw data of each individual measurement will be recorded in the firearm worksheet and maintained in the technical record(s) of that particular case.

Type A and B evaluations and calculations of the estimated measurement uncertainty of each procedure are maintained within the FTIU-Measurement Uncertainty Folder in the Quality Management System.

Records for the estimation of the Measurement Uncertainty will be maintained in the Quality Management System. These records will include data collected, any resulting calculations, and uncertainty components.

7.4.5 Measurement Uncertainty Procedure

The Firearms and Toolmark Identification Unit (FTIU) used the following method in order to calculate a measurement of uncertainty for the trigger pull weight of firearms when requested by the customer.

7.4.6 Instruments

Instruments utilized in this procedure are calibrated every five years by an external calibration laboratory accredited to ISO/IEC 17025.

- Trigger Pull Weight Set B

- Trigger Pull Weight Set C

7.4.7 Experiment

The experiment is designed to obtain the trigger pull of the submitted firearm(s) in question. The trigger pull will be obtained according to the method outlined in this procedure.

7.4.8 Method

- Record ten measurements on the specific firearm utilizing one of the two trigger pull weight sets available in the FTIU as outlined in section 3.3 of the FTIU TPM and record these in the firearm worksheet. Take the average of the ten measurements which is to be used for reporting.

7.4.9 Calculations

All data was retrieved from the examiner at the time of examination for that specific case and calculated according to guidelines set forth by the NIST 8-Step Process for Estimating and Reporting Measurement Uncertainty.

Step 1. Specify the measurement process. Outlined above in Methods section.

Step 2. Identify uncertainty components. These include, but are not limited to: measurement process reproducibility, equipment readability and equipment calibration uncertainty.

The uncertainty components considered and how they will be evaluated:

Uncertainty Component	**Method of Evaluation**
Measuring Equipment	
Weights (1/4lb increments)	Type B Evaluation
Calibration Uncertainty	Type B Evaluation
Calibrated Scale Error	Type B Evaluation
Proper Use, Storage and handling	Covered in Type A Evaluation of process reproducibility data
Staff	
Multiple analysts	Covered in Type A Evaluation of process reproducibility data
Training	Covered in Type A Evaluation of process reproducibility data
Experience	Covered in Type A Evaluation of process reproducibility data
Visual acuity	Covered in Type A Evaluation of process reproducibility data
Time of day, day of week, interruptions, workload	Covered in Type A Evaluation of process reproducibility data
Test Method	

Differences in establishing parallel and perpendicular between analysts	Covered in Type A Evaluation of process reproducibility data
Analyst positioning of measuring equipment	Covered in Type A Evaluation of process reproducibility data
Number of measurements made	Type A Evaluation
Facility	
Temperature coefficient of expansion for measuring equipment	Type B Evaluation
Lighting	Covered in Type A Evaluation of process reproducibility data
Space	Covered in Type A Evaluation of process reproducibility data

Step 3. Quantify uncertainty components. One Measurement Uncertainty Estimation Form will be completed. All measurements will be calculated and reported in pounds.

Step 4. Convert quantities to standard uncertainties. These calculations will be completed using the Measurement Uncertainty Estimation Forms. The divisors are based on the distribution types, which are identified on the form.

Step 5. Calculate combined standard uncertainty. These calculations will be completed using the Measurement Uncertainty Estimation Forms. The formula for calculating the combined standard uncertainty is commonly called the Root Sum of the Squares, or RSS.

Step 6. Expand the combined standard uncertainty by coverage factor (k). These calculations will be completed using the Measurement Uncertainty Estimation Forms. k=2 and k=3 values will both be evaluated. Calculated values will be converted from decimal places to ¼ of a pound. The MNPD FTIU will utilize the calculated k=2 value.

Step 7. Evaluate the expanded uncertainty. The expanded uncertainty will be calculated at the time of examination.

Step 8. Report the uncertainty. The uncertainty of measurement will be determined and reported based on the calculations at the time of examination. The uncertainty of measurement will be reported on a case by case basis when trigger pull has been requested via MNPD form 282.

7.5 UoM for Muzzle to Garment Distance Determination

7.5.1 Introduction

The FTIU has and applies a procedure to estimate the measurement uncertainty for the measurements of muzzle to garment distance determination.

The estimation of uncertainty is a representation of the confidence, or certainty, associated with a measurement.

7.5.2 Approach for Estimation of Measurement Uncertainty

As a conservative approach to the estimation of uncertainty for reported measurements that matter, measurements will be recorded to the precision of 1/16 of an inch. Measurements that do not fall directly on a 1/16 of an inch demarcation will be rounded up to the next 1/16 of an inch.

The measurement uncertainty for measurements performed in the FTIU shall be considered to be plus or minus two standard deviations.

Procedures for the measurement and calculation of the estimated measurement uncertainty of muzzle to garment distance determination are found in the Technical Procedures Manual - Firearms Folder within the Quality Management System System.

7.5.3 Reporting Results

Results will be reported when a muzzle to garment distance has been determined.

7.5.4 Documentation

The Measurement Uncertainty Estimation Form is used to calculate the measurement uncertainty. Uncertainty components and their types were considered and can be found in the Measurement of Uncertainty Folder in the Quality Management System.

Raw data of each measurement, number of analysts involved, parameters of Type A and B evaluations and calculations of the estimated measurement uncertainty of each procedure are within the FTIU-Measurement Uncertainty Folder in the Quality Management System.

Records for the estimation of the Measurement Uncertainty will be maintained in the Quality Management System. These records will include data collected, any resulting calculations, and uncertainty components.

7.5.5 Measurement Uncertainty Procedure

The Firearms and Toolmark Identification Unit (FTIU) used the following method in order to calculate a measurement of uncertainty for a muzzle to garment distance determination measurement. The MNPD (Metro Nashville Police Department) FTIU utilized a stainless steel ruler of a defined length in order to perform measurements for calculating the measurement of uncertainty.

7.5.6 Instruments

Instruments utilized in this procedure are calibrated every five years by an external calibration laboratory accredited to ISO/IEC 17025.

- Stanley 25' tape measure (SN: N/A (Identified by calibration sticker), calibrated 8/31/2018)

7.5.7 Experiment

The experiment is designed to obtain measurements of the designated object for determining the uncertainty of measurement. All firearms examiners will take part in the measurement process. The following parameters are to be completed:

- At least 180 measurements.
- Up to 10 measurements may be made on one day.
- Record the date of the measurement and name or initials of who performed the measurement on the worksheet.
- Record at least 3 worksheets (measurement sets) per analyst so that total number of measurements will equal 180 data points (measurements).

7.5.8 Method

- Place the designated ruler on a steady surface and measure the overall length of the ruler using the calibrated tape measure.
- Record the value.

7.5.9 Calculations

All data was retrieved from each examiner and tabulated and calculated according to guidelines set forth by the NIST 8-Step Process for Estimating and Reporting Measurement Uncertainty.

Step 1. Specify the measurement process. Outlined above in Methods section.

Step 2. Identify uncertainty components. Note: All Type A and Type B uncertainty components considered and evaluated can be found in the Measurement of Uncertainty Folder in the Quality Management System. These include, but are not limited to: measurement process reproducibility, length scale readability, and ruler calibration uncertainty.

The uncertainty components considered and how they will be evaluated:

Uncertainty Component	**Method of Evaluation**
Measuring Equipment	
Length Scale readability	Type B Evaluation
Length Scale resolution	Type B Evaluation

Calibration Uncertainty	Type B Evaluation
Calibrated Scale Error	Type B Evaluation
Proper Use, Storage and handling	Covered in Type A Evaluation of process reproducibility data
Staff	
Multiple analysts	Covered in Type A Evaluation of process reproducibility data
Training	Covered in Type A Evaluation of process reproducibility data
Experience	Covered in Type A Evaluation of process reproducibility data
Visual acuity	Covered in Type A Evaluation of process reproducibility data
Time of day, day of week, interruptions, workload	Covered in Type A Evaluation of process reproducibility data
Test Method	
Differences in establishing parallel and perpendicular between analysts	Covered in Type A Evaluation of process reproducibility data
Analyst positioning of measuring equipment	Covered in Type A Evaluation of process reproducibility data
Facility	
Temperature coefficient of expansion for measuring equipment	Type B Evaluation
Lighting	Covered in Type A Evaluation of process reproducibility data
Space	Covered in Type A Evaluation of process reproducibility data

Step 3. **Quantify uncertainty components.** Note: All Type A and Type B uncertainty components considered and evaluated can be found in the Measurement of Uncertainty Folder in the Quality Management System. Two separate Measurement Uncertainty Estimation Forms were completed, one for each of the measurement methods. All measurements were reported and calculated in inches.

Step 4. **Convert quantities to standard uncertainties.** These calculations were completed using the Measurement Uncertainty Estimation Forms. The divisors were based on the distribution types, which are identified on the forms.

Step 5. **Calculate combined standard uncertainty.** These calculations will be completed using the Measurement Uncertainty Estimation Forms. The formula for calculating the combined standard uncertainty is commonly called the Root Sum of the Squares, or RSS.

Step 6. **Expand the combined standard uncertainty by coverage factor (k).** These calculations were completed using the Measurement Uncertainty Estimation Forms. k=2 and k=3 values were both evaluated for each measurement process. Calculated values were converted from decimal places to sixteenths of an inch, rounding up to the next 1/16". The

MNPD FTIU will utilize the calculated k=2 value with a 95.45% coverage factor (often referred to as 95%). This is a conservative approach to cover all measurement processes.

Step 7. Evaluate the expanded uncertainty. The expanded uncertainty will be re-evaluated every five years. Any personnel and/or equipment changes will be reflected in the next scheduled uncertainty evaluation and recorded.

Step 8. Report the uncertainty. Examples of report wording may be found in the Range of Conclusions & Reporting Results & Reporting Results section of this manual.

8. Safety

8.1 General Safety

Refer to the MNPD-CL Safety Manual and QM for general safety requirements and hazard information.

Personal Protective Equipment shall be used when working with clothing and/or bloodstained items.

Hazardous chemicals should be used in a vented hood area; however, small amounts of chemicals are permitted at an examiner's workstation. These chemicals include serial number restoration agents and chemicals used for cleaning purposes (acetone, methanol, etc).

When diluting acids, always add acid to water.

When necessary, consult Safety Data Sheets (SDS) regarding any chemical used in the FTIU.

Any personnel handling a firearm to be examined and/or repaired shall follow Section 8 .2 procedures.

8.2 Firearm Safety

Each employee assigned to the FTIU will have their blood tested annually for Blood Lead Levels. Because lead contamination is an inherent risk associated with excessive use, handling discharge of firearms, the following safety measures are in place to reduce this exposure:

- Firing Range and Bullet Recovery Tank are ventilated to remove airborne lead resulting from firing of firearms.

Firearms Safety is absolutely vital in the Firearms Identification discipline. All members of the MNPD Firearm and Toolmark Identification Unit (FTIU) shall observe these practices and educate others whenever possible. The practices shall be adhered to at all times and shall not be deviated from for any reason.

A Safe Firearm is defined as one in which:

A. The source of ammunition has been removed from the firearm (magazine, cylinder chambers).
B. All ammunition has been removed from the chamber and action of firearm.
C. Visual and tactile verification is performed to ensure (A) and (B) have been completed.

8.2.1 General Safety Rules that Apply to All Firearms

- Treat all firearms as if they are loaded at all times.
  - Keep action open if at all possible when firearm is not being actively examined.
  - When handing or receiving a firearm from someone, have the action open and visually show a safe firearm.

- Never allow the muzzle of the firearm to cross any part of your body or that of anyone else even if visually shown to be safe. Build the mindset of knowing where muzzle direction is at all times.
- Never put your finger near or inside the trigger guard until you are ready to fire.
- Do not depend on any mechanical device for safety.
- Always be sure of your target and what is behind and in front of it.
- Always wear eye and ear protection when test firing firearms.
- Always be sure the barrel of the firearm is clear of any obstruction before test firing.
- When available, have someone present when test firing. This may also be monitored electronically.
- Never leave an unattended gun loaded or a loaded gun unattended.

These rules, if followed constantly and diligently will ensure and establish the best safety practices for firearms handling.

8.2.2 Firearms Range/Water Tank Safety Procedures

Absolutely no one outside the FTIU will be permitted to shoot on the range or in the water tank without authorization from the FTIU Supervisor or MNPD-CL Director.

Another person must be verbally notified, physically present, or electronically monitored when test firing in the bullet recovery water tank or firing range. Newly trained examiners/technicians in training must have a spotter physically present at all times until they are authorized to perform unsupervised casework after which the above procedure is followed.

Before firing, make sure the main door to the range is closed securely and the ventilation for the range is on.

When firing on the range or in the water tank, safety glasses and hearing protection is mandatory. Make sure that anyone observing is wearing proper eye and ear protection.

Before firing, make sure there is no obstruction in the barrel and do a safety check to ensure the firearm is safe to fire. If there is any doubt as to the safety of shooting a certain firearm, use the proper remote firing device.

Make sure to use the correct ammunition suited for the firearm you are shooting.

For firing on the range, only load the firearm at the firing line with the muzzle pointed downrange. The firing line may be at any safe location in the range. For firing into the water tank, load no more than two cartridges in a magazine and chamber the firearm while the muzzle is in the shooting port.

While chambering a semi-automatic rifle, pull the slide/bolt back and release the hand at a 90 degree angle away from the gun quickly to avoid being injured in case of a slam fire.

Keep your finger off the trigger until you are ready to fire the firearm.

If the trigger is pulled when the firearm is loaded and nothing happens, hold the firearm downrange or in the shooting port of the water tank in position for a minimum of 30 seconds. This will be done to avoid being injured from a hang fire. Clear the weapon, assess the problem and start the whole procedure over again.

If you have a malfunction (E.g. stovepipe, double feed, etc.), clear the firearm, assess the problem, and start the whole procedure over again.

8.2.3 Four Step Safety Check

Remove the magazine (pistol/rifle) or unlatch the cylinder/open the loading gate.

Lock or hold open the slide/bolt/cylinder.

Look to make sure no cartridges are in the chamber.

Feel to make sure no cartridges are in the chamber.

8.2.4 Safety Check Illustrated

8.2.4.1 Semi-automatic Handguns

Step 1: Remove the magazine

Step 2: Lock or hold open the slide

Step 3: Visually inspect the chamber

Step 4: Physically inspect the chamber

8.2.4.2 Revolvers

Step 3: Visually and physically check all chambers

9. Range of Conclusions & Reporting Results

9.1 Interpretation of Results

Range of conclusions contained in this section are recognized and used throughout the Forensic Firearms Identification Discipline. It is acknowledged that this is not an all-inclusive list of conclusions that a firearm examiner/forensic technician may reach in performance of his/her duties. This section shall serve as a guide for the firearm examiner/forensic technician and this range of conclusions may be modified by the firearm examiner/forensic technician as circumstances arise.

Firearms examiners must include in their notes all conclusions reached from the microscopic comparison of evidence bullets, cartridges, cartridge cases, shotshells, shotshell cases, toolmarks, etc. Examiners must also explain their reasons for reaching these conclusions. The reasons must be clear and concise and should be able to be understood by any other competent firearms examiner. The examiners may include the position and type of index marks used.

When analytical conclusions and/or opinions are made on evidence submitted for analysis, an"Official Firearms Report" or "NIBIN Notification" will be issued to the requesting customer. The results shall be reported accurately, clearly, unambiguously and objectively.

When comparative Firearm/Tool Mark examinations result in an identification, elimination or inconclusive result, the report shall clearly communicate the result.

The FTIU follows Section 7.8 Reporting Results in the MNPD-CL Quality Manual.

9.2 Range of Conclusions

Identification: There is an agreement of a combination of individual characteristics and all discernible class characteristics where the extent of agreement exceeds that which can occur in the comparison of toolmarks made by different tools and is consistent with the agreement demonstrated by toolmarks known to have been produced by the same tool.

Elimination: There is significant disagreement of discernible class characteristics and/or individual characteristics.

Inconclusive

A. There is some agreement of individual characteristics and all discernible class characteristics, but insufficient for an identification.
B. There is agreement of all discernible class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility.
C. There is an agreement of all discernible class characteristics and disagreement of individual characteristics, but insufficient for an elimination.

Unsuitable: Unsuitable for microscopic comparison due to lack of discernible class or individual characteristics.

9.3 Reporting Guidelines and Examples

9.3.1 Firearm Examinations and Function Tests

Examination of the firearm in Item ___ revealed it to be in operating condition with the safety feature(s) functioning.

Examination of the firearm in Item ___ revealed to be in a non-operating condition when received due to ___. Using parts from a reference firearm, Item ___ was restored to operating condition and test fired.

Examination of the firearm in Item ___ revealed to be in a non-operating condition when received due to ___. Item ___ could not be returned to an operating condition, and no test fires were obtained.

The firearm in Item ___ was examined and test fired using the submitted magazine and laboratory ammunition. Examination and test firing revealed the firearm to have an after-market slide cover plate that has physical and design characteristics consistent with an autosear. As submitted, Item ___ is capable of automatic fire.

9.3.2 Overall Length and Barrel Length

Examination of Item____revealed the overall length to be_____+/- 1/5", with a barrel length of____+/- 1/6" at a 95% confidence interval.

9.3.3 Uncertainty of Measurement

The uncertainty of measurement is based on a 95% confidence interval.

9.3.4 Comparative Examinations

9.3.4.1 Identification

When associations are made, the significance of the association shall be properly qualified and clearly communicated in the report by use of a qualitative statement. This statement can be found in the definitions section on the final page of the report.

Reporting Examples:

- The Item __ fired cartridge case(s) was/were examined and microscopically compared to cartridge cases test fired from the Item __pistol with the following results:
  -The Item __ fired cartridge case(s) was/were identified as having been fired in the Item __ pistol.
- The Item __ fired bullets were examined and microscopically compared to each other with the following results:
  -The Items __ and __bullets were identified as having been fired through the barrel of the same firearm.
- Test tool marks from the Item ___ tool were examined and microscopically compared with the tool mark on Item __ with the following results:
  -The Item __ tool mark was identified as having been produced by the Item __ tool.

9.3.4.2 Elimination

When comparative examinations result in the elimination of an individual or object, the report shall clearly communicate the elimination.

Reporting Examples:

- The Item __ fired cartridge case(s) was/were examined and microscopically compared to cartridge cases test fired from the Item __pistol with the following results:
  -The Item __ fired cartridge case(s) was/were eliminated as having been fired in the Item __ pistol.
- The Item __ fired bullets were examined and microscopically compared to each other with the following results:
  -The Items __ and __bullets were eliminated as having been fired through the barrel of the same firearm.
- Test tool marks from the Item ___ tool were examined and microscopically compared with the tool mark on Item __ with the following results:

  -The Item __ tool mark was eliminated as having been produced by the Item __ tool

.

9.3.4.3 Inconclusive

When no definitive conclusion can be reached, the report shall clearly communicate the reason for the inconclusive result.

Reporting Examples:

- The Item __ fired cartridge case(s) was/were examined and microscopically compared to cartridge cases test fired from the Item __pistol with the following results:
  -The Item __ fired cartridge case(s) was/were inconclusive as having been fired in the Item __ pistol (see Inconclusive__).
- The Item __ fired bullets were examined and microscopically compared to each other with the following results:
  -The Items __ and __bullets were inconclusive as having been fired through the barrel of the same firearm (see Inconclusive__).
- Test tool marks from the Item ___ tool were examined and microscopically compared with the tool mark on Item __ with the following results:

  -The Item __ tool mark was inconclusive as having been produced by the Item __ tool (see Inconclusive__).

9.3.4.4 Unsuitable

Reporting Example:

- The lead fragments in Item __ are unsuitable for examination.

9.3.4.5 Manufacture

The bullet in Item ___ is consistent with ___ caliber ___ bullets normally found loaded commercial into cartridges manufactured and marketed by ___.

The bullet in Item ___ is the same type and design as those manufactured by ___, and marketed under the trade name ___.

9.3.4.6 General Rifling Characteristics

The general rifling characteristics present on Item(s) ___ are common to a variety of ___ caliber firearms. Some of the more commonly encountered brands include, but are not limited to the following: ___.

The general rifling characteristics present on Item(s) are most commonly produced by firearms manufactured by ___.

Due to the mutilated condition of Item ___, or lack of discernible class characteristics, no list of suspect firearms could be produced.

9.3.4.7 Muzzle to Target Distance Determination

The area surrounding the hole in the (describe area) of Item ___ was examined microscopically and processed chemically for the presence of gunshot residues. Residues and physical effects present are consistent with those found when a firearm is discharged while in contact or near contact with a garment.

The area surrounding the hole in the (describe area) of Item ___ was examined microscopically and processed chemically for the presence of gunshot residues and a pattern of residues was found. Using the firearm in Item ___ and the cartridges in Item ___, (or) cartridges like that represented in Item ___, this pattern of residues was reproduced at a distance greater than ___ +/- 1/5" and less than ___ +/- 1/5".

The area surrounding the hole in the (describe area) of Item ___ was examined microscopically and processed chemically for the presence of gunshot residues. Residues were found which are consistent with the passage of a bullet.

Examination of the ___ in Item ___ revealed ___ hole(s) in ___area of ___. The area(s) surrounding the(se) hole(s) were examined microscopically and processed chemically for the presence of gunshot residues. No gunpowder or lead residues were found. Due to the absence of such residues, a muzzle-to-garment distance could not be determined.

The (describe area) of the ___ in Item ___ was examined and a shot pattern was found. Using the shotgun in Item ___ with shotshells from Item ___, (or) shotshells like that represented in Item ___, a similar pattern was produced at a distance greather than ___ +/- 1/5" and less than ___ +/- 1/5".

Examination of the ___ in Item ___ failed to reveal any reference bullet holes. The absence of a bullet hole precludes the determination of a muzzle-to-garment distance.

9.3.4.8 Serial Number Restoration

Using standard laboratory restoration techniques, the obliterated serial number on Item ___ was restored to read ___.

Using standard laboratory restoration techniques, the obliterated serial number on Item ___ could not be restored.

Using standard laboratory restoration techniques, the obliterated serial number on Item ___ was partially restored to read ___*___.

- The fourth digit could not be restored.
- The fourth digit could be either an 8 or a 3.

9.3.4.9 NIBIN

Images of the ___test fired cartridge cases were entered into the National Integrated Ballistic Information Network (NIBIN). No leads were found.

Images of the Item __fired cartridge case were entered into the National Integrated Ballistic Information Network (NIBIN) and no leads were found.

Images of a test fired cartridge case from Item ___ were entered into the NIBIN database. A lead was made with Item __ CL-__ (Agency #) and CL-__(Agency #), Item__. No microscopic comparisons have been conducted at this time. This information is being provided as an investigative lead only. Upon request, the evidence can be resubmitted for microscopic confirmation.

Images of the Item__ fired cartridge case(s) was/were entered into NIBIN. A lead was made with Item __ CL-__ (Agency #) and CL-__(Agency #), Item__. No microscopic comparisons have been conducted at this time. This information is being provided as an investigative lead only. Upon request, the evidence can be resubmitted for microscopic confirmation.

The Item__ fired cartridge case was not suitable for entry into NIBIN.

10. Verifications and Casework Reviews

10.1 Introduction

Verifications, technical reviews, administrative reviews and reporting shall be in compliance with the MNPD-CL management system documents.

This guideline is intended to provide procedures for the verification, technical reviews, and administrative reviews of casework and documentation produced by forensic scientists in the Firearm and Toolmark Identification Unit (FTIU) of the MNPD Crime Laboratory. All verifications, technical reviews, and administrative reviews shall be performed prior to the issuance of an official Firearms Report. On occasion, a request may be made for preliminary results, prior to completion of the case. The release of results under these circumstances will be in compliance with MNPD-CL documents. See Quality Manual 7.8 Reporting the results.

10.2 Definitions

Verifications: Provision of objective evidence that a given item fulfils specified requirements. An independent check on a critical finding. The procedure used to evaluate the validity of a test result/opinion reached by re-performing the comparison between the unknown and the known or an unknown to another unknown.

Critical Finding: a decision about an association between items based on observable class and individual characteristics of the items.

Qualified Examiner: Forensic Scientists who have fulfilled the requirements of the MNPD-FTIU Training Program, have been competency tested and are routinely proficiency tested in Firearm and Toolmark examinations. The qualified examiner would also be authorized to perform verifications, technical reviews, and administrative reviews.

Verifier: An individual having expertise gained through training and casework experience in the category of testing.

Primary Examiner (Author): That examiner (forensic scientist) who has been assigned the case and is the author of the case examination records and issuing the Official Firearms Report.

10.3 Verification

All conclusions resulting from microscopic comparisons, results of serial number restorations, and results of distance determination analysis will be verified by a second, qualified firearms examiner.

Forensic Scientists will be authorized prior to performing any independent verifications.

The examiner shall document in their notes which items were verified, who performed the verification, and the date the verification was completed.

The Verification Worksheet shall be utilized and uploaded directly into the Laboratory Information Management System (LIMS) by the verifier.

10.3.1 Identifications

All evidentiary microscopic identifications **must be verified** (i.e. question bullet compared with test bullet, questioned toolmark with test toolmark) by a second qualified examiner.

10.3.2 Eliminations

All evidentiary eliminations must be verified by a second qualified examiner.

10.3.3 Inconclusive

All inconclusive results must be verified by a second qualified examiner.

10.3.4 Serial Number Restorations

All serial number restorations must be verified by a second qualified examiner by physically viewing the serial number.

10.3.5 Distance Determinations

All reporting muzzle to garment distances will be verified by a second qualified examiner.

Verification may include confirmation of chemical tests on evidence items, comparisons to test patterns and resulting chemical tests

10.4 Technical Review

See MNPD-CL QM §7.7 for minimum requirements for technical reviews.

10.4.1 Technical Review of Firearm/Ballistic Request Cases

Technical reviews for all Firearm and Toolmark related requests will include a review of all examination records and the test report to ensure the following minimum criteria:

- Proper Chain of Custody
- Examination notes adequately describe evidence packaging
- Examination notes include a complete description of items
- Conformance with proper technical procedures and applicable laboratory policies and procedures
- Proper analytical tests performed and documented
- Appropriate Quality Controls used
- Appropriate checks conducted on all calculations
- Conclusions are properly qualified
- Verification(s) performed and properly documented
- Proper results, opinions, and interpretations are reached in the test report and are supported by data in case record

- Report is properly completed and contains all required information
- Conclusions are reasonable and within the constraints of validated scientific knowledge and supported by review of the questions above

The verification is considered separate from the technical review

The technical review will be documented by use of either the Technical Review Checklist or the Technical/Administrative Review Checklist

If a technical error is identified in the case record, the reviewer should select the option to 'Reject Findings' in LIMS and describe the needed correction in the 'Reviewer Notes' for the request as 'Technical' with their initials and date.

If no discrepancies or needed corrections are identified, or once all identified discrepancies or needed corrections have been corrected, the reviewer will check the Technical Review LIMS milestone.

10.4.2 Worksheet for technical review of Firearm/Ballistic Requests

The Technical Review Checklist or Technical/Administrative Review Checklist worksheet will be used during the review process. These worksheets consist of the required components listed in the FTIU QM section 10.4.1 for technical review in a checklist format.

The checklist worksheet is to be filled out, and uploaded directly into LIMS by the technical reviewer. The technical review milestone will be checked to record the information electronically.

10.4.3 Technical Review of NIBIN Only Request Cases

Technical review of NIBIN Only Request cases will include a review of all notes and the NIBIN notification to ensure the following minimum criteria:

- Proper Chain of Custody
- Notes adequately describe evidence packaging
- Notes include a complete description of items
- Conformance with proper technical procedures and applicable laboratory policies and procedures
- Exhibit entry printout included and checked for accurate entry and case information
- If applicable, side by side association printout is included and initialed by the reviewing examiner
- Notification contains all required information

NIBIN Only technical reviews will be performed exclusively in LIMS. If a needed correction is identified, the reviewer will select the option to 'Reject Findings' in LIMS and describe the needed correction in the 'Reviewer Notes' for the NIBIN Only request. After corrections are made, or if there are no corrections needed, the reviewer will set the technical review milestone in LIMS indicating that the review is complete. Checking the LIMS milestone for

technical review is equivalent to having checked all the requirements for technical review as outlined above.

10.5 Administrative Review

See MNPD-CL QM §Appendix B for minimum requirements for administrative reviews.

10.5.1 Administrative Review of Firearm/Ballistic and NIBIN Only Requests

Administrative reviews for all Firearm and Toolmark related Requests and NIBIN Only Requests will include a review of all examination records and the test report/notification to ensure the following criteria:

- All technical records are appropriately numbered and contain the examiner's initials (or electronic equivalent)
- Examination records are initialed and labeled with unique case identifier
- Technical review has been performed and properly documented
- Corrections by examiner are properly remediated and tracked
- All footer information is present in all worksheets
- Case documentation reflects starting and ending dates of testing
- Report/notification is properly completed and contains all required information
- Report/notification spelling and grammar is correct
- Signature of report/notification author is present
- Stats completed in LIMS

Administrative reviews for Firearm and Toolmark related requests will be documented by use of either the Administrative Review Checklist or the Technical/Administrative Review Checklist.

If an administrative error is identified in the report, the reviewer should select the option to 'Reject Findings' in LIMS and describe the needed correction in the 'Reviewer Notes' for the request as 'Administrative' with their initials and date.

If no discrepancies or needed corrections are identified, or once all identified discrepancies or needed corrections have been corrected, the reviewer will check the Administrative Review LIMS milestone.

10.5.2 Administrative review conducted in LIMS

The administrative reviewer may conduct the review exclusively in LIMS for NIBIN Only requests. If the administrative review is being conducted separately from the technical review, any needed corrections identified during the administrative review should be noted in the 'Reviewer Notes' field and designated separately from the technical review.

Checking the LIMS milestone for administrative review is equivalent to having checked all the applicable requirements for administrative review as outlined above.

11. Worksheets

Laboratory work sheets serve several purposes, and can include: documenting the evidence, documenting the examinations, as a useful aid in guiding the examination, and serving as an archive for future reference.

In general, documentation to support conclusions shall be such that in the absence of the examiner, another competent examiner could evaluate what was done, interpret the data, and come to the same conclusions. It is at the examiner's discretion to prepare either computer generated or hand-written notes, and worksheets may be completed electronically or by hand.

Note: It will be acceptable for drawings in the case file to be completed in pencil. However, supporting documentation shall be in ink.

Worksheets which are available include:

- Administrative Review Checklist
- Bullet Examination Worksheet
- Cartridge/Cartridge Case Worksheet
- Firearms Worksheet
- Gunshot Residue Examination Worksheets
- IBIS Hit Log
- NIBIN Firearms Worksheet
- Notes Template
- Serial Number Restoration Worksheet
- Technical & Administrative Review Checklist
- Technical Review Checklist
- Test Patterns Worksheets
- Verification Worksheet

All worksheets are available in the Quality Management System.

Additional worksheets or adjustments to current worksheets may be utilized upon review and approval of the FTIU Supervisor. After approval, these updated worksheets or new worksheets must be uploaded to the Quality Management System before use.

Worksheets should be named in the following format when possible:

Worksheet Name in the Quality Management System	Abbreviation for LIMS	Example:
Admin Review Checklist	ARV WS	CL-21-001234 ARV WS
Bullet Worksheet	B WS	CL-21-001234 B WS
Cartridge Case Worksheet	CC WS	CL-21-001234 CC WS
Firearms Worksheet	FA WS	CL-21-001234 FA WS
GSR Worksheet	GSR WS	CL-21-001234 GSR WS
Notes Template	NOTES WS	CL-21-001234 NOTES WS
SNR Worksheet	SNR WS	CL-21-001234 SNR WS
Tech & Admin Review Checklist	T-ARV WS	CL-21-001234 T-ARV WS
Tech Review Checklist	TRV WS	CL-21-001234 TRV WS
Test Pattern Worksheet	GSR-TP WS	CL-21-001234 GSR-TP WS
Verification	VRF WS	CL-21-001234 VRF WS
NIBIN Printouts	NIBIN	CL-21-001234 NIBIN

Any corrected or updated version of the original worksheet should be named by following the same format and then adding the version number to the end. Example: CL-21-001234 B WS V2 for the first updated/corrected version.

12. Abbreviations

The Forensic Scientists and Forensic Technicians assigned to the MNPD Firearm and Toolmark Identification Unit (FTIU) may use abbreviations to streamline and speed up the note taking process. These abbreviations have been approved by the FTIU Technical Leader/Unit Supervisor. Chemical symbols, common abbreviations, and common acronyms may not be included in this list, but may also be used.

Abbreviations	Complete Word(s)
ADA	Assistant District Attorney
ADJ	Adjustable
AE	American Eagle
Agcy	Agency
Agg.	aggravated
Agg. Aslt., AA, Agg Ass	aggravated assault
Al, alum	Aluminum
ambi	ambidextrous
Amer.	American
ammo	ammunition
app	apparent
approx	approximately
assoc's/assoc'd	associations/associated
auto	automatic
Avg., avg	average
b, B	bullet, submachine gun, machine pistol
BATF, ATF, BATFE	Bureau of Alcohol, Tobacco, Firearms & Explosives
bbl	barrel
beb, BEB	brass enclosed bullet, brass enclosed base
bf, BF	breech face
Bfm	Breech face marks
bjhp, BJHP	Brass Jacketed Hollow Point
blk., bk, bl	black
bpb	brown paper bag
br, Br	brass
brt, BRT	bullet recovery tank
BTHP	Boat-tail Hollow Point
bw	Brass washed
C	cylinder choke, rifle-shotgun combination
c, c>, cont., c/	contains, containing
cal	caliber
Cann	cannelure
cart., c, ctg	cartridge
cc, c. case, cart. case	cartridge case
CC, CCs	class characteristics
CCI	Cascade Cartridge Corporation
ccl, CCL	copper coated lead
ccw ,	counter clockwise
CF	clean-fire
chars.	characteristics
chem	chemical
chm, CM	chamber marks
circ, C	circular
circum	circumference
cj	copper jacket
cl, clr	clear
clplb	clear plastic bag
CLR	Calcium, Lime, & Rust cleaner
comp.	compare, compared, comparison, comparative
conc. cir	concentric circle
cond	condition
conj.	conjunction
cons	consistent
consw/, c/w, cw/, cw, CW	consistent with

cont.	continued
ct, CT	clear tape
CTF	copper/tin frangible
cu, Cu	copper
cw	clockwise
cwf	consistent with Federal
cww	consistent with Winchester
cyl.	cylinder
D	double
da, DA	double-action
DAG	District Attorney General
DAO	double-action only
dbl	double, double-action
DE	dram equivalent
dia, d, f	diameter
dt, DT, DD, dist. deter.	distance determination
disc.	discernable
DTF	drug task force
EFMJ	Expanding Full Metal Jacket
ejt, ej	ejector
Ellip	Elliptical
env, e	envelope
ER, ERU	evidence receiving unit
esl, ESL	evidence storage location
et, ET, etape	evidence tape
EtOH	Ethanol
evid	evidence
ex#	exhibit number
ex, exh	exhibit
exam	exam, examination, examined
Exc	excellent
excl	exclude
exp	expanded, exposed
ext	extractor
F	full choke
f.p., FP	firing pin
fpa	firing pin aperture
fpas	firing pin aperture shear
FA Ref Coll., FRC	Firearms Reference Collection
FRT	Firearms Reference Table
fa, fae, FA	firearm
FBI	Federal Bureau of Investigation
FC	Federal Cartridge, Flight Control
Fed	Federal
FMC	Full Metal Case
FMJ	Full Metal Jacket
FN	Fabrique National, flat nose
fpi, fp imp., FPI	firing pin impression
Fp	Firing pin
frag(s)	fragment(s)
FS	Forensic Scientist, Flight Stopper
FT	Forensic Technician
FTI	Forensic Technology, Inc.
fx	firearm
func., fxn	function
G	groove
ga, GA	gauge
GDHP	Gold Dot Hollow Point
gi, GI, gimp	groove impression
GMB	Glock Marking Barrel
gr., gr, gn	grain
Gran	granular
GRC	General Rifling Characteristics
GSH	gunshot hole
GSR	Gunshot residue
GSW	gunshot wound
HB	high brass
HCl	Hydrochloric Acid
hemi, H	hemispherical
hp, HP	hollow point
hs, H/S	headstamp
IBIS	Integrated Ballistics Identification System
ICC	improved cylinder choke
ic, IC, ICs, indiv. Char	individual characteristics
id, ID, id'd	identification, identified

IM	improved modified choke
Imp	impression
in.	inches
info	information
init.	initials, initialed
ins, insuff.	insufficient
irreg	irregular
jhp, JHP	jacketed hollow point
jkt	jacket
jsp, JSP	jacketed soft point
k	knurled
Kn	knurled
L	land, long, length
l.imp, LI, limp, li	land impression
l.side, LS	left side
Lab#	laboratory number
lag	land and groove
LB	low brass, left back
LE	leading edge, law enforcement
LEO	law enforcement officer
lf, LF	left front
lft., Lft., L	left
lg.	large
loc	location
LP	Latent Prints
lr, LR	long rifle
M	modified choke
m->, mk, mkd., mk'd, mkd	marked
MA	machine gun
Mag, MAG	magnum
mag, mz	magazine
Maj.	Major
Mak	Makarov
man	manual
man env, ME	manila envelope
mat'l	material
MCD	Machine Gun Conversion Device
ME, me	Medical Examiner
mech	Mechanism, mechanical
MeOH	Methanol

mfg, manu	manufacturer, manufacturing, manufactured
Mfi	Marked for identification
micro., mic	microscopically, microscopic
Misc	miscellaneous
MK, mkr.	marker
Mod	model
myID	my identification
N.A.A., NAA	North American Arms
n/a, NA, N/A	not applicable, not available
naf, NAF	no association found
NaRho	Sodium Rhodizonate
NCIC	National Crime Information Center
neg, Neg, -	negative
NF, non-func., nonfxnal	non-functional
Ni	Nickel
NIBIN	National Integrated Ballistics Information Network
NLDC	Nitride Diamondlike Coating
NiPl	Nickel-plated
NMCV	no marks of comparison value
Nmfi	Not marked for identification
not ID'd	not identified to, not identified
NP, not pres.	not present
Npmfi	Not previously marked for identification
NR	non-reloadable
nsn	no serial number
NT	non-toxic
oblit., OBL	obliterated
op cond.	operating condition
orig.	original
OEM	Original equipment manufacturer
oz, oz.	ounce

P&E	property & evidence
Para.	Parabellum
para	parallel
Pb	Lead
pc	piece
PD	Police Department
pd, PD, derr.	derringer
PEV	primary evidence vault
pg#	page number
pg.	page
PI	pistol, semi-automatic pistol
pkg	package
pl	plated
pl, plstc.	plastic
plbg, plb	plastic bag
PMF	Privately Made Firearm
pmfi	Previously marked for identification
poly	polygonal, polygonal rifling
Pos, +	Positive
Poss	Possible
PR	revolver
prel, prelim	preliminary
prop	property
PS	single-shot pistol, primer sealant
PSL	Personal Storage Location
PSN	Project Safe Neighborhood
pt.	point
PX	pistol, four or more barrels
QA, QAM	quality assurance manual
R	rifle
r.side, RS	right side
RA	automatic/select fire rifle
RB	bolt-action rifle, right back
rbs, RBS	reddish brown stain
RC	carbine
rds.	rounds

RE	double-barrel rifle, rectangular/elliptical
rec., rec'd, rcvd	received
Rect.	rectangular, rectangle
Ref Coll	Reference Collection
Ref., ref	Reference
Rem.	Remington
Ret'd, rtnd	returned
rf, RF	right front
rh, RH	right hand
RI	semi-automatic rifle
RL	lever-action rifle
RN	round nose
rnl, RNL	round nose lead
RP	pump-action rifle
R-P	Remington-Peters
RS	single-shot rifle
Rt., rt., R	right
RTC	reported to contain
rxn	reaction
S	sealed, shotgun, short, semi-circular,
sld	sealed
S&W	Smith & Wesson
s.p., sp, SP	soft point
sa, SA	single action
suf ag	sufficient agreement
SAAMI	Sporting Arms & Ammunition Manufacturers' Institute
SB	bolt-action shotgun
sbb	sealed brown box
sbox	sealed box
sbpb	sealed brown paper bag
SD	Sheriff's Department
SDS	Safety Data Sheets
SE, se	double-barrel shotgun, sealed envelope
SGW	shotgun wad, shotgun wound
sh, SH	shotgun
SI	semi-automatic shotgun
sim	similar
sjhp, SJHP	semi-jacketed hollow point

slt., sl	slight, slightly
sm	small
smye(s)	small yellow envelope(s)
sn, ser. no., S/N, s/n	serial number
snr, SNR	serial number restoration
SO	Sheriff's Office
soln	solution
SOP, SOPs	standard operating procedures
SP	pump-action shotgun
spec	specimen
Spl	Special
splbg, splb	sealed plastic bag
SPP	shot pellet pattern
SS	single-shot shotgun, shotshell
ssc, SSC	shotshell case
ssw, SSW	shotshell wad
ssye, smsye	small sealed yellow envelope
St	steel
st steel, SS, ss	stainless steel
std(s)	standard(s)
STHP	Silvertip Hollow Point
suff.	sufficient
suit.	suitable
sw	sealed with
sw/ct	sealed with clear tape
swb, smwbox	small white box
swbox, swb	sealed white box
SWC	semi-wadcutter
SXT	Supreme Expansion Technology
sye	sealed yellow envelope
szlb	sealed ziploc bag
TBI	Tennessee Bureau of Investigation
TCW	Tula Cartridge Works
tcw, TCW, T.C.W.	total cartridge weight
TE	trailing edge
tech.	technician
tm, TM, tlmk	toolmark
TMJ	Total Metal Jacket
TPM	technical procedures manual
traj.	trajectory
ttl.	total
tw, TW	total weight
TWS	tool working surface
TPWS	trigger pull weight set
UMC	Union Metallic Corporation
unk	unknown
UTD	unable to determine
v	very
V or Vic	victim
vis	visible
vlt	vault
VWC	victim witness coordinator
w/	with
w/o	without
wbox	white box
WC	wadcutter
WCC, WIN, Win.	Winchester Cartridge Company
wht., wh, w	white
wks, wrksht	worksheet
WMR	Winchester Magnum Rimfire
WRF	Winchester Rim Fire
Wt.	weight
W-W	Winchester-Western
y, yell	yellow
ye(s)	yellow envelope(s)
zlb, zlock	ziploc bag, ziplock
Zn	zinc
&	and
~	approximately
@	at
'	feet
"	inches
$	money
#	number
ll	parallel
%	percentage
+/-	positive/negative, plus/minus

>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
1k	one knurled

1s	one straight
2d, 2D, 2°	two dimensional
3d, 3D, 3°	three dimensional