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**Las Vegas Metropolitan Police Department
Forensic Laboratory**
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Firearms Technical Manual



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**LVMPD FORENSIC LABORATORY
TECHNICAL OPERATIONS MANUAL
FIREARMS DETAIL**

Title: **PREFACE**

The Firearms Detail is responsible for the examination of evidentiary firearms and the examination and comparison of ammunition components. Additional examinations performed include serial number restorations, proximity analysis (muzzle to target distance determination), and National Integrated Ballistic Information Network (NIBIN) entries. The Firearms Detail consists of a Casework Unit and a NIBIN Unit.

The goal of the Firearms Detail is to provide information to the Detective or Requestor to aid in the investigation of the criminal matter, to examine and compare physical evidence impartially, and to present evidence in courts of law thereby allowing a jury to reach a verdict based upon scientific information.

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**LVMPD FORENSIC LABORATORY
TECHNICAL OPERATIONS MANUAL
FIREARMS DETAIL**

Title: **STATEMENT of PURPOSE**

The purpose of this manual is to provide the Firearms Detail Personnel with a set of useful procedures for the examination of physical evidence. This manual is not designed to be an all-inclusive collection of every possible procedure or variation of procedure which might be used in forensic Firearm cases.

It is expected that deviations in methodology will occur at the discretion of the individual examiner as set forth in the LVMPD Forensic Laboratory Quality Manual. Due to the wide variety of evidence received by the examiner, ingenuity may be required in the analytical approach. This may require the modification of a technique or the search for a new one in order to accomplish the task of thorough evidence examination. The procedures presented in this manual are intended to provide a sound framework upon which to build.


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LVMPD FORENSIC LABORATORY TECHNICAL OPERATIONS MANUAL FIREARMS DETAIL

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NOTE: Hyperlinks were accurate at the time of manual publication

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LVMPD FORENSIC LABORATORY TECHNICAL OPERATIONS MANUAL FIREARMS DETAIL

1.01 Title: INTRODUCTION TO ADMINISTRATIVE PROCEDURES

1.01 / 01 General Administrative Procedures

The methods and procedures presented in this manual are designed to act as guidelines to assist in the proper examination of firearm evidence. Firearms personnel are additionally assisted by appropriate technical references maintained within the Forensic Laboratory, as well as private references and communications.

This technical manual is subject to continual review and procedures may be updated or replaced with new methodology after approval.


Firearms personnel responsible for firearm examinations will conform to accepted methods and procedures. Proper ethical and professional standards will be maintained by employees of the Forensic Laboratory.

To be permitted to perform casework, Firearms personnel must have completed an appropriate and approved training program, have successfully completed a practical competency test, a competency exam (written or oral) and a moot court. Upon successful completion of competency testing, Firearms personnel will be issued an authorization certificate in the specific category of testing covered by this process. Each procedure in this manual requires certain safety practices that must be adhered to at all times.

Although many of the procedures in this manual are recognized internationally as standard methods, all of them must follow a quality assurance program involving technical review.

Case documentation is an important part of the analytical process. Documentation will occur at all phases of the examination process and must be consistent with the LVMPD Forensic Laboratory Quality Manual. Worksheets/note pages will be used to ensure inclusion of all pertinent facts pertaining to this process and the submitted evidence. Refer to the Unit Record Details in the LIMS or Qualtrax for examples of worksheets used within the Firearms Detail. The analysis start date will be the date data is first entered into a worksheet. This date is automatically generated in the LIMS when a worksheet is created. If an analysis is started prior to the creation of a worksheet, the "Exams Started" date within the Details tab of the Unit Record in the LIMS will be modified to reflect the actual date the analysis was started.

The critical issues of quality, training, and technical review require that a Firearms Detail be staffed with no less than two qualified examiners. If a Firearms Detail falls below this standard, a reasonable effort should be made by the Forensic Laboratory Director to bring that Detail up to minimum staffing.

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1.01 / 02 Proficiency Testing

Proficiency testing is recognized as an important adjunct to technical review, and together they function as critical elements of the overall quality assurance program.

All Firearms personnel performing casework must complete at least one proficiency test per calendar year from a subdiscipline of the Firearms Discipline in which they conduct work. Reports generated as part of proficiency tests will be published in the LIMS.


Personnel qualified in the following subdisciplines will complete a proficiency test in each qualifying subdiscipline on the following schedule:

Firearms Detail Personnel	Subdiscipline	Testing Period
Forensic Scientists	Physical Comparison	Annual
Forensic Scientists	Determination of Functionality	Biennial
Forensic Scientists	Barrel/Overall Length Measurements	Biennial
Forensic Scientists	Trigger Pull Measurement	Biennial
Forensic Scientists	Distance Determination	Annual
Forensic Scientists	Serial Number Restoration	Biennial
Forensic Scientists	NIBIN (entry, screening, correlation)	Biennial
NIBIN Unit Personnel	DNA Swabbing / Collection	Annual
NIBIN Unit Personnel	Determination of Functionality	Annual
NIBIN Unit Personnel	NIBIN (entry, screening, correlation)	Annual
NIBIN Unit Personnel	Report writing	Annual
NIBIN Unit Personnel	Serial Number Restoration	Biennial

Internally created proficiency tests will be subjected to quality control checks to verify the validity of the test prior to issuance. The criteria for these checks and expected results will be outlined in the specific test.

1.01 / 03 Testimony Monitoring

The testimony of all Firearms personnel (for those that testify in that calendar year) will be monitored and reviewed annually by an equal or greater qualified member of the Detail or by the Manager. A testimony review form is available in Qualtrax.

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1.01 / 04 Reporting Guidelines


Reports will be written in accordance with the policies outlined in the Forensic Laboratory Quality Manual. In addition to these policies, Firearm reports will include the following when applicable:

- **Testing Dates**
For reporting and documentation purposes, the testing dates will begin on the date data is first entered into a worksheet. The end date will be the date that the case is completed and submitted for technical or administrative review. If the review process requires the analyst to conduct additional testing, the end date will be adjusted to the date that the case is resubmitted for technical or administrative review. Administrative or clerical changes do not change the testing end date.
- **NIBIN**
 - Entry of evidence and/or test fired cartridge cases into NIBIN will be reported.
 - Associations within the same event or from one event to one or more additional events will be reported.
- **Methodologies**
The methodology used to reach a reported conclusion will be reported.
- **Conclusions**
 - Conclusions will be clearly delineated as such in the report.
 - Comparison conclusions on reports will include one of the defined conclusions from the AFTE Range of Conclusions. See “Range of Conclusions” in Section 2.01.
 - **Identification Qualification**
The significance of any identifications reported will be qualified by adding the following to all identification statements on reports:

“...due to sufficient agreement of class and individual characteristics.”

For example, “The cartridge case was identified as having been fired in the firearm due to sufficient agreement of class and individual characteristics.”


See “Range of Conclusions” in Section 2.01.
 - **Inconclusive Explanation**
The reason(s) for non-conclusive results will be reported. See “Range of Conclusions” in Section 2.01.

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- **ShotSpotter Events**
The Lab Item custom description for Shotspotter cartridge cases and firearms will include “- ShotSpotter” at the end of the item description. For example, “One “WIN” 9mm Luger cartridge case – ShotSpotter” or “One Glock Model 17 9mm Luger semiautomatic pistol, serial number: 123ABC – ShotSpotter”.
- **Exams Completed by Qualified Personnel Other than the Custody Holder**
It may be necessary to have qualified laboratory personnel conduct examinations (such as DNA swabbing, test firing or NIBIN entry) of items of evidence which are not in their electronic custody. If this occurs, it will be recorded in the notes and added to the report that the exam was completed by one person while it was in the custody of the custody holder. The name and where applicable, the initials/P# of the examiner and custody holder will be recorded in the notes and reported in the report. For example, “The firearm was test fired by {name, P#} while in the custody of {name, #P}.” These exams should be performed in the presence of the custody holder. If these exams cannot be completed in the presence of both parties, electronic custody transfer will be performed.
- **Examinations performed at the Firearms Annex**
The phrase “The (test firing and/or DNA swabbing) examination(s) listed on this report were conducted at the Firearms Annex which is a non-ANAB accredited facility.” will be included in all reports where test fire generation/DNA swabbing was completed at the Firearms Annex. Once the Firearms Annex becomes an accredited facility, the phrase will be changed to “The (test firing and/or DNA swabbing) examination(s) listed in this report were conducted at the Firearms Annex.
- **Correlations completed by the National NIBIN Correlation and Training Center (NNCTC)**
If correlations are completed by the BATFE and/or the NNCTC a phrase stating that the correlations were completed by them will be added to the report. The phrase will be either “The NIBIN correlations were reviewed by the NIBIN National Correlation and Training Center and no associations were noted at this time. Future associations to other events in the network will be reported separately.” or “The NIBIN correlations were reviewed by the NIBIN National Correlation and Training Center.”

1.01 / 05 Reviews


- All Firearms cases except for NIBIN only cases (including firearms to be swabbed for DNA and/or test fired for NIBIN and evidence cartridge cases to be entered into NIBIN) will be subject to technical review.
 - The technical reviewer will ensure that:
 - Proper examination of the evidence took place.
 - All exams requested were addressed in the case.
 - Proper procedure, methodology and documentation were used in the case.

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- All conclusions are supported by the case documentation.
 - All required verifications have been completed.
- When the LIMS automatically generates a technical review for NIBIN only cases, the technical review may be withdrawn.
 - All Firearms cases will be subject to administrative review.
 - If a Firearms case is returned to the analyst and the report is cancelled following administrative review, the LIMS will generate a new technical review. This technical review must be completed prior to completion of the administrative review, unless the administrative review was returned for simple, non-technical changes such as:
 - Billing activity needing to be completed.
 - Evidence needing to be moved out of the analyst's custody.
 - Items in the Resource Manager or Object Repository needing to be added, removed or edited, as these do not require a report cancellation.
 - Notes being added to the Lab Case or Unit Record Details comments box.
 - Spelling, grammar, minor punctuation or typographical errors needing to be corrected in a manner that does not affect the results, opinions, or interpretations and does not alter the underlying meaning of the text being edited.

If any of the above or similar criteria apply, the additional technical review may be withdrawn in the LIMS.

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1.02 Title: **EVIDENCE CONTROL AND FLOW**

1.02 / 01 Evidence from LVMPD

Evidence handling practices pertaining to ordering, receipt and return/transfer of evidence will follow policies and procedures detailed in the Forensic Laboratory Quality Manual.

The following details the handling of evidence in the Firearms Detail of the Forensic Laboratory:


If the requester is not known, the Firearms Detail Manager or NIBIN Database Administrator can be designated as a customer/requestor for the purposes of generating laboratory requests to facilitate the examination of evidence in the Firearms Detail.

Upon receipt of the evidence, the assigned examiner/technician shall store the evidence in their evidence safe/locker, the Armory, or the Casework Unit/Evidence Storage Room until the time of analysis. The proximal container will be marked with a unique identifier consisting of the Lab (Case) Number, Lab Item Number, Event Number and the person's initials. Items of evidence may be marked with all or a combination of the above as deemed appropriate by the examiner/technician.

Note: If sub-itemed evidence contains multiple items, sub-subitem numbers may be created.

Due to obvious and easily distinguishable physical characteristics, the potential for sample switching with firearms evidence is innately low. To further reduce the potential for sample switching, the following steps may be taken:

- Only one case is open on the bench and being worked on at a time.
- As packages are opened, the item description is recorded in the notes, the item may be photographed, and the item (if possible) and/or the proximal container are marked with the appropriate identifier.
- The items of evidence and proximal containers should be marked in such a manner as to prevent inadvertent "rubbing off" of the marks.
- Ammunition used for test firing, except for NIBIN test fires, is engraved prior to firing.
- Evidence examinations are not "batched". Cartridge cases and bullets are marked, examined and compared one item at a time, one case at a time.
- Items of evidence are kept in their original containers or other suitably marked secondary containers when not being examined.
- Per the examiner's preference, test samples are always mounted on the same side stage and the evidence is mounted on the other stage of the comparison

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microscope for all examinations. This same mounting convention is used if the comparison involves evidence to evidence comparisons where one evidence component is designated the “master”.

- As the comparisons are completed, the test designator and item identifier from the items themselves are recorded along with the conclusion. If the record of the conclusion is not completed in LIMS at time of comparison, a handwritten or typed note page(s) will be used. This original note page will be scanned if applicable and uploaded into the UR OR in place of recording the comparisons in the result section of the UR worksheets.
- The use of a different brand of ammunition for test firing other than that represented by the evidence, while not always feasible, aids in preventing sample switches.
- All identifying information will be verified prior to sealing the evidence.

Upon completion of the analysis the evidence will be transferred to the Forensic Laboratory Evidence Vault until it is transferred out of the Forensic Laboratory back to the LVMPD Evidence Vault.

1.02 / 02 Evidence from Other Jurisdictions

Evidence from other jurisdictions will be handled in the same manner as above; however, the evidence may be brought directly to the Laboratory Evidence Vault or the Firearms Annex (for DNA swabbing and test firing only) where it can be obtained by the Firearms Detail Personnel.

1.02 / 03 Exceptions

Court ordered examinations will be examined by the Firearms Detail personnel only if a copy of a Court Order is presented. If necessary, a representative of the District Attorney's Office may transport the evidence to the Firearms Detail and take receipt of the evidence upon conclusion of the examination.


Other exceptions such as hand to hand delivery of the evidence to the Firearms Detail personnel shall not occur without approval of the Laboratory Manager or Laboratory Director. When this is necessary, every effort will be made to use the assistance of an Evidence Technician.

1.02 / 04 Transportation of Evidence to the Firearms Annex for Examination

Certain examinations may require that evidence be removed from the laboratory and transported to the Firearms Annex for testing. This practice is permissible as long as the evidence remains in the custody and control of Firearms personnel while it is outside the laboratory. Note: This section does not apply to evidence forwarded to outside laboratories for analyses involving expertise beyond the scope of the Forensic Laboratory (see Forensic Laboratory Quality Manual for further details).

1.02 / 05 Documentation and Reporting of Evidence Received

All items of evidence received by Firearms personnel will be recorded in the case notes regardless of whether or not that evidence will be examined. All evidence items will be listed on the report. A notation will be made for those items not examined.

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1.02 / 06 Consumption of Evidence

Unnecessary consumption of samples shall be avoided, but it is occasionally necessary to consume a sample, such as when test firing evidence cartridges, in order to complete the analysis. When the entire sample is consumed it will be documented in the case record by Firearms personnel.

1.02/ 07 Exams Completed by Qualified Personnel Other than the Custody Holder

It may be necessary to have qualified laboratory personnel conduct examinations (such as DNA swabbing, test firing or NIBIN entry) of items of evidence which are not in their electronic custody. If this occurs, it will be recorded in the notes and added to the report that the exam was completed by one person while it was in the custody of the custody holder. The name and where applicable, the initials/P# of the examiner and custody holder will be recorded in the notes and reported in the report. For example, "The firearm was test fired by {name, P#} while in the custody of {name, #P}." These exams should be performed in the presence of the custody holder. If these exams cannot be completed in the presence of both parties, electronic custody transfer will be performed.

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1.03 Title: PRECAUTIONS FOR HANDLING EVIDENCE

1.03 / 01 Precautions with Biological Evidence

Firearms and ammunition which bear biological material are often encountered. In such instances, the presence of the material on the item will be noted and where appropriate, collected by Firearms personnel (see 2.04 / 01 DNA Evidence for collection procedures) or a member of the Biology/DNA Detail and may be submitted to the Biology/DNA Detail for analysis. The evidence will be handled while wearing Personal Protective Equipment to prevent infection of the examiner/technician with bloodborne pathogens and to prevent the contamination of the sample.

If biological material is located on an item of evidence but is determined to be of no forensic value, the item may be cleaned in a 10% solution of bleach or other appropriate disinfectant prior to handling by the examiner/technician.

1.03 / 02 Precautions with Loaded Firearms


On occasion, personnel in the Firearms Detail will be presented with a firearm which cannot be easily checked or unloaded. This situation may occur if the firearm is malfunctioning or rusted to the point where the action cannot be opened to check or unload. The Firearms Detail personnel in these cases will render the firearm safe by dismantling the firearm, discharging the contents, or by neutralizing the ammunition. (See 2.03 / 04 Rendering Firearms Safe for procedures).

1.03 / 03 Precautions Using Chemicals and Reagents

Chemicals and reagents may be utilized by the Firearms Detail. Chemicals and the reagents prepared from those chemicals may be used beyond the Manufacturer's expiration/use by date in the Firearms Detail provided those expired chemicals pass quality control checks prior to or at the time of use. All chemicals are stored and handled according to the Chemical Hygiene Plan as set forth in the Forensic Laboratory Safety Manual.

1.03 / 04 Precautions Using Energy Dispersive X-Ray Fluorescence Spectrometer [ED-XRF]

The Innov-X hand-held ED-XRF emits ionizing radiation [x-rays] which may pose a health risk. The ED-XRF will only be operated by authorized users. For safety guidelines see the Forensic Laboratory Safety Manual regarding Ionizing Radiation.

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1.04 Title: **FACILITIES**

The Firearms Detail facilities in the Forensic Laboratory consist of two designated areas accessed by entry/exit doors with manual/electronic keypad type locks. These locks will be coded differently than the locks to the other areas of the laboratory.

Note: The Firearms Detail does not require specific environmental conditions (temperature, humidity, etc.) for the performance of general exams (microscopic comparisons, NIBIN, etc.) as the results of these exams are not impacted by environmental factors. Since environmental conditions do not impact exam results, they are not required to be recorded when exams are performed at the Forensic Laboratory, Firearms Annex or outside facilities (outdoor shooting range, ME's office, etc.).

Ventilation requirements for chemical examinations and test firing in the indoor shooting ranges are listed in those respective sections of this manual.

The Detail is divided into the following areas:

1.04 / 01 Casework Unit/NIBIN Unit General Exam Areas

These general examination areas consist of desks and work areas for the use of computers, comparison microscopes, stereo microscopes, cameras, reference materials, trigger pull measurements, barrel length and overall measurements and the examination of evidence.

1.04 / 02 Armory


A separate room within the NIBIN Unit General Exam Area, the Armory, is adjacent to the NIBIN Unit General Exam Area and is secured with a fob/proximity card sensor and separate alarm system. The purpose of this area is to house the reference collections of guns and ammunition. Large items of evidence may be stored in this area as needed.

1.04 / 03 Ballistics Laboratory

A separate room within the NIBIN Unit General Exam Area, the Ballistics Laboratory, is used for the purposes of test firing. The Ballistics Laboratory houses a stainless-steel water-filled bullet recovery tank, Lightning bullet catchers, dual bullet traps and test equipment all enclosed in a ballistically secure "Quick Range". This "Quick Range" is ventilated and designed to contain non-armor piercing bullets with velocities up to 3600 feet per second. The LVMPD or other ranges may also be used for test firing purposes if necessary. See Appendix Section 7.06 for Ballistics Laboratory clean-up procedures.

1.04 / 04 GSR Room

A separate room within the NIBIN Unit General Exam Area, the GSR room is used for the examination of evidence and test materials during distance determination testing.

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This room houses a fume hood, sink, and exam areas. The door should remain closed as to limit contamination. This room may be used for additional purposes as needed.

1.04 / 05 NIBIN BrassTrax/Matchpoint Room

Located in a separate room within the NIBIN Unit General Exam Area are the National Integrated Ballistic Information Network (NIBIN) computers.

1.04 / 06 Microscope Room

A separate room within the Casework Unit General Exam Area houses the comparison microscopes. A BrassTrax unit is also housed in this area.

1.04 / 07 Gun Cleaning / Work Alcove

A separate area within the NIBIN Unit General Exam Area houses exam areas, equipment, a sink and a snorkel type fume hood for serial number restorations, gun cleaning/repair, and other related tasks.

1.04 / 08 Secure Storage of Evidence

The Firearms Detail has several areas to securely store evidence to include evidence safes/lockers in the NIBIN Unit area, the Armory, and the Casework Unit/Evidence Storage Room.

1.04 / 09 Firearms Annex


In addition to Forensic Laboratory facilities, the Firearms Annex has a general administrative area consisting of desks and computers. The Annex houses a modular shooting range, an area for DNA swabbing, and general work areas for processing and test firing firearms. The Annex is secured with a dedicated alarm system and fob/proximity card sensors.

Visitors, including routine building maintenance personnel, entering the Firearms Annex must complete and sign the LVMPD Visitor Log (LVMPD 518) before being granted entry. See LVMPD Forensic Laboratory Quality Manual / Appendix F – Visitors and Tours for policies on visitors.

At the time Revision 14 of the Firearms Technical Manual was adopted, this location was not accredited with ANAB. Any work conducted at the Annex will be notated in case file notes and this statement will be included in any report released where test fire generation/DNA swabbing is conducted at this facility: "The (test firing and/or DNA swabbing) examination(s) listed on this report were conducted at the Firearms Annex which is a non-ANAB accredited facility." Once the Firearms Annex is accredited, the phrase will be changed to "The (test firing and/or DNA swabbing) examination(s) listed on this report were conducted at the Firearms Annex."


Authorized personnel will maintain control of evidence while at the Firearms Annex. No evidence will be stored at this location.

Only authorized personnel are to use the modular shooting range. Authorization to use the modular shooting range is directed by the Laboratory management.

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See Appendix Section 7.06 for Ballistics Laboratory/Modular Shooting Range clean-up procedures.

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1.05 Title: **EQUIPMENT**

1.05 / 01 **Microscopes**

Forensic comparison microscopes are provided for use by the Firearms Detail personnel. These microscopes are used for examination and comparison of fired ammunition and ammunition components. Stereoscopic microscopes are also provided and are used by Firearms personnel for examination of evidence.

1.05 / 02 **Hand Tools**

Numerous hand tools are used by the examiners/technicians including pliers, cutters, hammers, screwdrivers, wrenches, drills, saws, drifts, punches, files, brushes, gauges, inertia bullet pulling equipment, hand magnifiers, measuring devices, trigger pull apparatus and other hand tools.

1.05 / 03 **Camera Equipment**


Camera equipment utilized by the examiners includes digital cameras and digital microscope cameras. A high-speed monochrome video imaging system is available when fleeting events need to be recorded for playback in slow motion or for measuring the timing of a string of gunshots such as when determining the cyclic rate of fully automatic firearms.

1.05 / 04 **Measuring Equipment**

Calipers, micrometers, thickness gauges, rulers, tape measures, electronic scales, weights and a laser measuring device are used by the examiners to take appropriate measurements of evidentiary items. A chronograph is available for measuring the velocity of projectiles.

All measuring equipment will be handled carefully to avoid damage that may affect its accuracy. This equipment will be used at or near room temperature. If a piece of equipment becomes damaged so as to affect its accuracy, it will be removed from service and replaced as needed.

1 inch and 1 mm gauge blocks are available to check the accuracy of the calipers, micrometers and thickness gauges used in the Firearms Detail. Stage micrometers are available to check the accuracy of the digital software measuring tool on the comparison microscopes. These items are stored in the Detail Manager's office. Care should be taken when using these items to ensure they are not damaged. These items will be immediately removed from service if they are damaged in a manner that may affect their accuracy.

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NIST traceable rulers are available for critical measurements (barrel length and overall length of firearms.) Care will be taken when using the rulers to ensure they are not damaged during use. Any NIST traceable ruler will be immediately removed from service if it becomes damaged in a manner that may affect its accuracy. The rulers are stored in the General Exam Area of the Casework Unit.

Non-NIST Traceable rulers and gauges such as feeler gauges which are sold by reputable vendors are deemed to have accuracy and precision sufficient for our purposes and they may be used as received. The gauges will be replaced if they show wear or damage. A Firearm Examiner may check feeler gauges with an appropriate calibrated caliper or micrometer if desired.

The calibration and/or performance check of calipers, micrometers, balances and trigger pull weights is detailed in the Appendix 7.04 - Quality Control Plan.

Calipers, gauge blocks, micrometers, rulers, laser measuring devices and trigger pull weights are considered critical supplies and will be purchased from and/or calibrated by vendors (prior to use) who meet the criteria in the Forensic Laboratory Quality Manual.


A software 'measuring tool' is available which, when used in conjunction with the digital microscope cameras, allows measurement of features being viewed through a microscope. If the software is not integrated with the microscope, care will be taken to ensure the correct objective is in use. The calibration of the software is detailed in the Appendix 7.04 -Quality Control Plan [see Leica Measuring Tool under Other Instrumentation].

A Type I Sound Level Meter is available when sound levels are of interest [as in Suppressor testing]. A Class I Sound Level Calibrator is to be used according to the Sound Level Meter's manufacturer's instructions. Prior to use, the recommended QC checks will be performed, and the results documented in the case file. See the Appendix 7.04 -Quality Control Plan for information on Sound Level Calibrator calibration.

A PACT Shooting Timer is available for measuring the timing of a string of gunshots such as when determining the cyclic rate of fully automatic firearms.

Certain analyses may require the transportation of test/measuring equipment to facilities outside of the Forensic Laboratory. When this is necessary, the manufacturer's operating manual should be referred to regarding the handling, usage, transportation and storage of the following equipment:

- PACT Timer
- Oehler Chronograph
- Redlake hi-speed video camera
- Larson-Davis sound meter
- Innov-X EDXRF
- Laser Measuring Device

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Care will be taken to ensure these devices are not damaged during transport. This equipment should be stored in its assigned carrying case (if applicable) during transport and when not in use. Prior to use, the recommended QC checks will be performed and documented.

1.05 / 05 Bullet Recovery Tank / Modular Shooting Range/ Bullet Catchers

A stainless steel, water-filled recovery tank and Lightning bullet catchers are used for the purpose of test firing firearms and retrieving the test fired bullets and test fired cartridge cases. A ventilated, rifle rated modular shooting range may be used when it is not necessary to recover the fired bullets.

1.05 / 06 Ear / Eye Protection

Earmuff and ear plug hearing protectors and plastic eye shields are provided for use during test firing.

1.05 / 07 Reference Guns, Ammunition, Books and Other Materials

Numerous reference materials including firearms, books, and ammunition samples are used by the examiners/technicians for the purpose of dismantling, repairing and checking for modifications to firearms, locating serial numbers on confiscated guns and identifying types, calibers and manufacturers of ammunition.

The Firearms Detail maintains an inventory of reference guns and ammunition. Reference guns and ammunition are uniquely identified and stored in a secure location.

See the Forensic Laboratory Quality Manual for specific information and procedures regarding the use of the reference firearms.


1.05 / 08 Ammunition

Ammunition obtained by the Firearms Detail is either purchased from retail stores, online distributors, LVMPD supply, or is received from the Evidence Vault or other agency. The packaging should be marked with the source and date obtained.

Action proving or “Dummy” cartridges should be available in all common “calibers” for safe testing of firearm function and training.

1.05 / 09 Portable X-ray Fluorescence Spectrometer

A portable Energy Dispersive X-ray Fluorescence [ED-XRF] Spectrometer is available for the use of laboratory staff who have completed the requisite safety training. The ED-XRF is used to determine qualitatively what elements are present on or near the surface of the material. As configured, the system can detect and identify elements above atomic number 13 [Al]. The instrument produces ionizing radiation and will ONLY be operated by individuals who have received safety training. [See Forensic Laboratory Quality Manual for more information].

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Authorized laboratory staff must complete annual radiation protection safety training. Records of the training will be maintained in Qualtrax.

Operation and standardization will follow the manufacturer's instruction manual supplied with the instrument. Standardization of the ED-XRF is detailed in the Appendix 7.04 – Quality Control Plan.

To Use:

1. The user must have their individually assigned dosimeter device (ring) on before continuing.
2. Turn on the power on the ED-XRF.
3. Turn on the power on the iPAQ.
4. Check the date on the iPAQ as this is how the reading is recorded in the system.
5. From the start menu, select the Innov-X software.
6. Select the "Alloy Analysis – Analytical" mode of analysis
7. Use the standardization Coupon or Clip composed of 316 Stainless Steel for calibration.
8. Place the sample in front of the window. If using while in the stand, the cover must be in place. If using as a hand held unit, insure that there is no portion of the user's or another person's body in front of the window during testing.
9. At minimum, a record of the date and reading number will be recorded in the case notes and the standardization screen shot will be included in the case file.

1.05/10 Ultrasonic Firearm Cleaning and Lubrication System

An ultrasonic firearm cleaning and lubrication system is available for Firearms personnel to clean, disinfect and lubricate firearms when deemed necessary. The cleaner will be operated according to the manufacturer's instruction manual. Cleaning, disinfecting and lubricating agents utilized will be compatible with the manufacturer's recommendations.


1.05 / 11 General and Clerical Equipment

Computers, pens, paper and other stationery supplies are used daily by the Firearms Detail for note taking, report writing, evidence sealing etc.

1.05 / 12 Magnesium Smoking

Magnesium smoking is a technique for reducing the glare of a shiny object by lightly coating the surface with fine magnesium smoke. Due to eye and fire hazard, safety is a prime consideration. The use of forceps, proper eye protection, and a leather apron is recommended.

- a) This process must be done in a properly ventilated area or under a snorkel or hood.
- b) Cut short pieces (~1 inch or less) of magnesium metal ribbon off the roll and place the remaining roll in a safe place.
- c) This technique will be done over a flame-resistant surface.

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- d) Hold one end of the magnesium strip securely with forceps or pliers.
- e) Light the other end with an open flame. The surface oxidation may need to be scraped off to facilitate lighting.
- f) Pass the object in question through the smoke.

CAUTION!!!

- **Never look directly at the magnesium flame!** Serious eye damage can occur due to the brilliant white light emitted by the burning magnesium. The magnesium flame is very hot and must be kept away from other combustible/ flammable substances and water. An ABC type fire extinguisher must be kept nearby at all times.

Examiners are responsible for knowing the health hazards involved in the use of magnesium. This chemical and its hazards can be found in the Material Safety Data Sheets/Safety Data Sheets that are on file in the laboratory.

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**LVMPD FORENSIC LABORATORY
TECHNICAL OPERATIONS MANUAL
FIREARMS DETAIL**

1.06 Title: REQUESTS FOR ANALYSIS


Property Connect or the form LVMPD 63 are the primary methods used for requests for analysis which concern the Firearms Detail.

Impounded evidence firearms and crime scene cartridge cases may be automatically examined for NIBIN entry and do not require a formal request prior to entry.

Outside Jurisdictions may use a "NIBIN List" for the submission of firearms and cartridge cases for NIBIN entry.

Alternatively, Outside Jurisdictions may bring evidence firearms directly to the Forensic Laboratory or Firearms Annex for DNA swabbing and/or test firing. In this case, DNA swabbing and/or test firing of evidence firearms will be performed in the presence of Outside Jurisdiction personnel and a formal request for analysis is not required to be submitted. See 1.02/ 07 - Exams completed by Qualified Personnel Other than the Custody Holder for further information.

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LVMPD FORENSIC LABORATORY TECHNICAL OPERATIONS MANUAL FIREARMS DETAIL

2.01 Title: INTRODUCTION TO FIREARM EXAMINATION PROCEDURES

The procedures in this section require the skills of a trained Firearm Examiner (See Section 1.01).

To ensure the accuracy and completeness of case documentation and for reporting purposes, the AFTE glossary and appropriate manufacturers' nomenclature should be used for definitions and describing firearms parts.

The standard method for associating suspect firearms with fired ammunition components is comparison microscopy. Comparisons are typically made from about 5x to 60x using fluorescent, incandescent or LED lights. Any analytical conditions deemed by the examiner to be critical to the particular examination will be recorded in notes.


The criteria for identification is an acquired skill based on experience and training in observing patterns of individual and class characteristics which result in the formation of an opinion. The counting of individual characteristics will not be required for an identification.

Evidence items will be examined and evaluated to determine the class and individual characteristics of any markings present on the item(s) and the suitability of these markings for use in the comparison process. The results of this initial evaluation will be recorded using a defined conclusion from the AFTE Range of Conclusions in the examination notes. See "Range of Conclusions" in Section 2.01.

When examining a firearm which possesses the same class characteristics as the evidence, the examiner should carefully evaluate factors such as history, variability of test firings and the possible effect of ammunition variation before eliminating the firearm.


The examiner will follow these basic procedural techniques in order to facilitate examinations:

- a) Ensure that the comparison microscope is properly adjusted for equal magnification at both stages.
- b) Adjust the illumination to fully visualize the microscopic details.
- c) Compare the test-fired components to ensure reproducibility of class and individual characteristics prior to microscopically comparing them to the evidence components. Record these comparisons in the case notes.
Note: This step is not necessary for eliminations based on significant differences in class characteristics.

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- d) Adopt a consistent procedure for the handling and documenting of comparison evidence. Photographs of comparisons will be clearly labeled to indicate evidence items and test items.
- e) During the comparison, documentation of the phase orientation (index) of test-fired and evidence components is recommended.
- f) Documentation of conclusions must include depictions or descriptions of the agreement or disagreement of individual and/or class characteristics to the extent that another qualified examiner, without the benefit of the evidence itself, can review the case record, understand what was compared, and evaluate why the examiner arrived at the reported conclusion. The supporting documentation of one comparison may be used for additional evidence within a case, provided the agreement described or depicted is representative of the additional comparison(s).
- g) When performing comparative examinations, a logical sequence should be followed to ensure that the examinations are completed thoroughly and efficiently. Some examples are included below for guidance:
- a. If Item A is a test fire from an evidence firearm and Items B, C and D are evidence items, the comparative exam should proceed as:
 - i. A compared to B
 - ii. A compared to C
 - iii. A compared to D
 - b. Variability in ammunition manufacturer and composition, variability in imparted markings and the condition of the evidence items may impact the sequence of comparisons. For example, if Item A is a test fire from an evidence firearm and Items B, C, D and E are evidence items and the items exhibit variability, the comparative exam should proceed as:
 - i. A compared to B
 - ii. A compared to C and examiner determines that based on C's appearance he would like to use C in his subsequent comparisons
 - iii. C compared to D
 - iv. C compared to E

In this example, if B and C are identified as having been fired by A, and D and E are identified as having been fired by the same firearm that fired C, this means that B, C, D and E are all identified as having been fired by A. Additional direct comparisons (for example, A compared to D and A compared to E) would be unnecessary.
 - c. Inconclusive results may necessitate additional comparisons. For example, if Item A is a test fire from an evidence firearm and Items B and C are evidence items, the comparative exam should proceed as:
 - i. A compared to item B with an inconclusive result
 - ii. A compared to item C with an inconclusive result
 - iii. B compared to C to determine result

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In this example, Items B and C could each be inconclusive as having been fired by Item A but may be identified, eliminated or inconclusive to each other.

These examples should be used as guidelines. Examiners should use their discretion when determining the sequence of comparisons as variability in evidence items may necessitate a modification in their planned progression through the required comparisons. However, the sequence of comparisons should remain thorough, logical and efficient.

AFTE Theory of Identification


The following was adopted by the Association of Firearm and Tool Mark Examiners (AFTE) in 2011 and pertains to the comparison process followed by the members of the Firearms Detail.

1. The theory of identification as it pertains to the comparison of toolmarks (includes bullets and cartridge cases) enables opinions of common origin to be made when the unique surface contours of two toolmarks are in “sufficient agreement.”
2. This “sufficient agreement” is related to the significant duplication of random toolmarks as evidenced by the correspondence of a pattern or combination of patterns of surface contours. Significance is determined by the comparative examination of two or more sets of surface contour patterns comprised of individual peaks, ridges and furrows. Specifically, the relative height or depth, width, curvature and spatial relationship of the individual peaks, ridges and furrows within one set of surface contours are defined and compared to the corresponding features in the second set of surface contours. Agreement is significant when the agreement in individual characteristics exceeds the best agreement demonstrated between toolmarks known to have been produced by different tools and is consistent with agreement demonstrated by toolmarks known to have been produced by the same tool. The statement that “sufficient agreement” exists between two toolmarks means that the agreement of individual characteristics is of a quantity and quality that the likelihood another tool could have made the mark is so remote as to be considered a practical impossibility.
3. Currently the interpretation of individualization/identification is subjective in nature, founded on scientific principles and based on the examiner’s training and experience.

Verifications

Verifications will be performed for all comparisons of evidence items which result in a conclusion of identification, inconclusive or elimination. Verifications will be conducted by laboratory personnel authorized to perform examinations in the specific area of testing covering the verification request. Verifications are not required to be performed on items of no comparison value.

Verifications are not considered to be examinations and are normally completed in the presence of both examiners. Therefore, they do not require evidence moves or marks on the items or packages by the verifier. If the verifications cannot be completed in the presence of both parties or require overnight storage by the verifier, evidence transfers will be performed. The conclusions of the consulting examiner will be noted in the

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primary examiner's case notes in the comments field of the Verification Review window in the LIMS. The verification documentation will include the identity of the consulting examiner, the date the verification was performed, and the Lab Item numbers of the items verified.

Disagreements During Verification

During the verification process, if the reviewing examiner does not agree with the case examiner on a result/conclusion, it will be documented in the comment/note section of the Verification window in the LIMS prior to discussing the results with the case examiner. If the case examiner and reviewer reach a consensus on the result/conclusion, the case examiner can simply document the results of the discussion and update the notes and/or report with the revised conclusion(s), if any, and the date.

If the case examiner does not concur and a more comprehensive discussion is needed to achieve a consensus, the Forensic Laboratory Manager/Supervisor will be notified. The Forensic Laboratory Manager/Supervisor will determine the appropriate course of action. If resolution cannot be reached, it will be brought to the attention of the Laboratory Director.

If an actual error in conclusion and/or interpretation is noted which may indicate a deficiency in the training or abilities of the examiner, the report will be submitted to the respective Forensic Laboratory Manager. The Forensic Laboratory Manager will evaluate the situation and determine the needed course of action. See the Forensic Laboratory Quality Manual for further details.

AFTE Range of Conclusions Identification

Agreement of all discernible class characteristics and sufficient agreement of a combination of individual 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


Significant disagreement of discernible class characteristics and/or individual characteristics.

Inconclusive

- a) Agreement of all discernible class characteristics and some agreement of individual characteristics, but insufficient for an identification.
- b) Agreement of all discernible class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, damage, or lack of reproducibility.
- c) Agreement of all discernible class characteristics and disagreement of individual characteristics, but insufficient for an elimination.

Unsuitable

Unsuitable for examination.

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2.02 Title: **USE OF PHOTOGRAPHY**

Representative photomicrographs documenting identifications will be taken. Identifications are not made from these photomicrographs; hence, it is recognized that photography is primarily for recording purposes and generally documents only selected portions of an identification. Photography is inherently limited in its ability to record all of the observed detail.

Firearm Examiners do not use photomicrographs to reach conclusions because:


- a. A photograph is a two-dimensional image of an object that is three dimensional.
- b. Photographs often contain insignificant detail which may confuse people not trained in microscopic comparison.
- c. A photograph is still and freezes the cursor (hairline). An actual comparison is very dynamic, and continuous movement of the cursor is an integral part of the examination process.
- d. Photographs can be falsified or altered.
- e. Photographs provide an incomplete representation of the entire comparison process.
- f. Visual data in photographs, particularly when magnified, can be misinterpreted by people not trained in firearm examination.
- g. The incorrect interpretation of a photograph may endanger the accused, particularly on a probable identification.

General Evidence Photography

Photography can be a useful addition to note taking and evidence documentation. Good forensic practices such as the use of scales, special lighting or filters may be employed. Notes should reflect significant techniques used. Photographs/images taken should be of a reasonable quality taking into consideration aspects such as lighting, focus, and positioning.

Digital Photography


Digital photography and electronic image capture and processing can be used in the same way standard photography is used. The ability to enhance or otherwise edit images accomplishes the same things that can be done to traditional photographs in a darkroom but with greater control, speed and convenience.

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It is inappropriate to edit an image with the intended purpose of misrepresenting the evidence or the results of comparisons or examinations of the evidence. When digital images are used for purposes other than simple documentation of the appearance of an item of evidence, an unedited, full digital image file should be retained in addition to the edited files. These digital image files will be stored in the Unit Record Object Repository. Edited, enhanced or composited image files may also be stored with the unedited file. Digital images inserted in a LIMS worksheet should be saved as a JPEG or PDF file.

Simple edits which do not significantly alter a photograph such as adjusting the size or lighting of the image are permitted without requiring the retention of the original photograph.

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2.03 Title: **SAFE FIREARM HANDLING**

2.03 / 01 Introduction


Firearm evidence is not dangerous if handled correctly and treated with respect. Occasionally, loaded firearms are received in evidence for examination or brought to the Firearms Detail for unloading. (See 2.03 / 04 Rendering Firearms Safe for procedures).

All firearms will be treated as though they are loaded, until the examiner proves they are not. This rule cannot be overstressed and must be followed at all times, whether it is at an evidence reception area, in the vault, firearms Detail, range, or court. Safe gun-handling here corresponds exactly with safe gun-handling in general. Prevent accidents by practicing safety at all times.

A rule that needs strict adherence is to keep the muzzle pointed in a safe direction at all times! Some firearms are received containing live ammunition and, therefore, this precaution is extremely important and makes common sense.

2.03 / 02 Laboratory and Firearms Annex / Firearms Detail Safety Rules

- No one will be down range/in front of the shooter while a firearm is being loaded, unloaded or fired.
- Firearms will be loaded and unloaded in the test firing area.
- Ear and eye protection must be worn by all persons present during live firing.
- Appropriate notice (i.e., verbal) shall be given prior to test-firing.
- Questions of safety have to be resolved prior to the procedure continuing.
- No loaded firearms will be placed or stored in the Evidence Vault or returned to any agency.
- The shooting area is equipped with video surveillance which is to be checked prior to entering the Ballistics Laboratory or Modular Shooting Range (MSR) and monitored during shooting to quickly detect any injury or problem.
- The use of the Ballistics Laboratory or Modular Shooting Range will be limited to qualified Firearms Detail personnel. Other individuals are permitted to use the Ballistic Laboratory or Modular Shooting Range only under the direct supervision

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of qualified Firearms Detail personnel or after approval of Laboratory management.


- No projectiles exceeding the specified limits of the range bullet trap [3600 fps, no steel core, no armor piercing ammunition] will be fired into the trap.
- No “bean bag” type projectiles will be fired into the shooting traps of the Ballistics Laboratory or the MSR, as these can clog the traps. Ammunition containing bean bags may be fired in the Ballistics Laboratory or MSR, but it should be fired at the linatex curtain so that the bean bags are blocked from entering the traps. After firing, the bean bags should be picked up by hand from the range for disposal.
- The range blower should be running during shooting. If the blower is not functioning properly, stop shooting until the blower is repaired/operational.
- The top of the Annex shooting range should only be routinely accessed by appropriate maintenance personnel to maintain the equipment. There may be a rare occasion when laboratory personnel need to access the top of the range. If this occurs, laboratory personnel will exercise caution and take all appropriate safety measures.

2.03 / 03 Pre-Firing Safety Check

It is the responsibility of Firearms Detail personnel to ensure that appropriate safety function checks are performed on a firearm prior to test-firing. The following is a list of safety checks which may be considered. Firearms Detail personnel should be mindful that individual situations may require more extensive safety checks than that which are listed here. Firearms personnel are reminded to be careful not to lose or destroy trace potential evidence while performing the safety check.

FOR ALL FIREARMS:

- 1) Is the firearm unloaded? (Check tubular magazines carefully.)
- 2) General Examinations
 - Is the chamber/bore clear?
 - Are there any loose, damaged or missing parts?
CAUTION: Use caution when handling firearms with sighting systems as they may either be missing or off.
 - Are there any dangerous modifications?
 - Is the barrel bulged, obstructed or loose?
 - Are there any loose or missing screws?
CAUTION: Movement or replacement of parts may make the firearm safer but may also significantly alter the operational characteristics.
 - Are there any firearm recall notices that should be considered?
- 3) Trigger Function
 - Does trigger return reliably?
 - Does the trigger function as designed?
- 4) Hammer
 - Will it push off?

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- Does the half cock notch catch? (if applicable)
 - Will the hammer fall from the half cock notch when the trigger is pulled?
 - Does the hammer rebound when the trigger is pulled?
 - Are there any false seating positions?
 - Will the hammer/striker release when the bolt is closed?
- 5) Firing Pin
 - Is it free to retract and not binding?
 - 6) Safeties/Types of Safeties
 - Do they operate? (Check each safety independently.)
 - 7) Feeding (Check with dummy ammunition.)
 - 8) Drop/Impact (jar off) testing is a recognized procedure (See ANSI/SAAMI Z299.5-1996)
 - 9) Examination and restoring evidence firearms to safe operating conditions is a recognized procedure.
 - 10) Examination/Disassembly of damaged/altered firearms for operating condition is a recognized procedure

FOR REVOLVERS:

- 1) Cylinder
 - Is the cylinder secure when closed?
 - Do the chambers align with the barrel?
 - Is the cylinder bulged?
- 2) Cylinder Rotation
 - Does the cylinder bind?
 - Does it lock up in both single action and double action?
 - Does it skip chambers with partial trigger return?
 - Does the chamber align correctly with the forcing cone?


FOR NON-REVOLVER FIREARMS:

- 1) Disconnector
 - Is one present?
 - Is it functional?

CAUTION: When pulling the trigger to check the disconnector, it is imperative that the examiner/technician assure that the firearm is not loaded (chamber and magazine) and that the muzzle is pointed in a safe direction. Complacency can result in an unintentional discharge and will not be tolerated at any time. Examiners and technicians may use a clearing barrel or the shooting range to conduct the disconnector exam.
- 2) Lock-up
 - Does the slide/bolt engage tightly?
 - Will it fire out of battery?
- 3) Magazine
 - Does it seat properly?
 - Is the magazine operable?

AMMUNITION

- Is it reloaded? As a general policy, reloads will not be used unless necessary and if so, remote firing is strongly recommended.

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- Was the firearm designed for the ammunition to be used (i.e., re-chambering, wildcat cartridges, +P rounds)?
- Was the firearm originally designed for black powder loads (i.e., Damascus barrels)?
- Are there any ammunition recall notices that should be considered?

2.03 / 04 Rendering Firearms Safe

Per Department Manual 5/210.02, personnel in the Firearms Detail will assist in rendering a firearm safe prior to impound. This should be completed in a timely manner. The preferred method would be to receive the firearm unsealed to allow unencumbered access to the firearm. The firearm will be unloaded, and serial number obtained if easily accessible during this process. All other examinations requested may be addressed at a later time or at the direction of the Firearms Detail Manager.

If department personnel brings a firearm to be rendered safe to qualified Firearms Detail personnel and the impounding personnel can remain on premises, the firearm can be rendered safe in their presence and the firearm will be returned to them.

If firearms brought in by department personnel require extensive handling to be rendered safe (beyond standard mechanical manipulation), a Rendering Firearms Safe form containing the following information will be generated.

- Who the firearm was obtained from
- Make, model and serial number of the firearm
- The general steps necessary to render the firearm safe
- What PPE was worn
- Who and/or where the firearms was released to


This form will be uploaded to OnBase and will be kept in the Object Repository of the Unit Record.

If the department personnel cannot be present, then he/she must leave a completed Impound Report, evidence label or tag and the firearm with the Firearms Detail personnel directly or in the CSA temporary hold locker. A Rendering Firearms Safe form will be completed. Once the firearm has been rendered safe, the applicable steps should be taken:

- Any ammunition will be removed from the chamber or cylinder
 - Place ammunition in a package and label "removed from... by initial"
 - Add the ammunition to the Officer's Impound Report (initial line item(s))
 - Add the ammunition to the package label and initial
- Package and seal the item(s)
- Relinquish the package and Impound Report to the Forensic Laboratory Vault to be data entered and sent to the Main Vault.

Firearms under Other Jurisdiction custody

The Other Jurisdiction (OJ) personnel will work with the Evidence Technician to enter the firearm into the evidence management system and submit a laboratory request. This laboratory request will be forwarded to the appropriate LEST to be entered into the LIMS. The Firearms Detail personnel may take possession of the firearm during this

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time to begin the unloading process. Once the firearm has been rendered safe, the applicable steps will be taken:

- Any ammunition will be removed from the chamber or cylinder
 - Place ammunition in a package and label “removed from... by initial”
 - Add the ammunition to the package label and mark with your initials and “LVMPD Lab”
- Package and seal the item
- Sign the package chain of custody
- Relinquish the package to the Evidence Technician and inform them if it should be placed in the “OJ-In” or “OJ-Out” location. OJ-In is for evidence that has outstanding forensic requests. OJ-Out is for evidence that does not need any further forensic testing.

Notes regarding any work done to the item should be reported in the Unit Record and a laboratory report will be issued in lieu of a Rendering Firearms Safe form.

2.03 / 05 Firearms Evidence Saturated in Blood / Biohazardous Material

Department personnel may bring firearms and magazines saturated with blood or biohazardous material to Firearms Detail personnel for cleaning prior to impound. Prior to cleaning, a determination as to whether DNA swabbing is needed must be made.

If the impounding personnel can remain on premises, the evidence can be cleaned in their presence and the firearm will be returned to them.


If impounding personnel cannot be present, then they must leave a completed Impound Report, evidence label or tag and the evidence with Firearms Detail personnel directly or in an unsealed plastic evidence bag in the CSA temporary hold locker.

If the evidence is left in the temporary hold locker, Firearms Detail personnel will retrieve the evidence, rinse it with water ensuring that the firearm’s barrel is cleaned to remove the blood / biohazardous material, wipe the evidence dry or spray it with canned air to remove the water and then spray the evidence with a water displacing oil such as WD-40 and wipe it down.

Firearms Personnel collecting and cleaning the evidence will notify the CSI Director, CSI Manager and all CSA Supervisors that the evidence has been collected and cleaned. Personnel will complete the Rendering Firearms Safe form to be uploaded to OnBase.

Once the evidence has been cleaned, the following applicable steps should be taken:

- Any ammunition removed from the chamber or cylinder will be:
 - Placed in a package and labeled “removed from... by initials/P#”
 - Added to the Officer’s Impound Report (initial line item(s))
 - Added to the package label and initial
- Package and seal the item(s)
- Relinquish the package and Impound Report to the Forensic Laboratory Vault.

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LVMPD FORENSIC LABORATORY TECHNICAL OPERATIONS MANUAL FIREARMS DETAIL

2.04 Title: **DNA AND TRACE EVIDENCE**

Firearm evidence is often submitted with debris that may cover its characteristics and which may have other significance to the case. In order to determine class characteristics or compare individual characteristics of the firearm evidence, this debris may have to be removed. This debris may consist of blood, tissue, paint, fibers, glass, etc. The value of this debris as trace evidence should be considered during this examination. Firearms personnel are cautioned that this type of evidence may present a health hazard.


The biological or trace material should be removed and collected to protect the integrity of the material and packaged appropriately. Mark the package as to the type of material removed and from which item it was removed. If the packaged material can be returned to the original packaging, do so. If the material cannot be returned to the original packaging or needs to be examined by another Detail, follow the evidence handling guidelines detailed in the Forensic Laboratory Quality Manual.

2.04 / 01 **DNA – Firearms Evidence**

Determination if Swabbing is Needed

DNA evidence cannot be obtained once an evidence item has been handled by members of the Firearms Detail. Requests for examination are screened prior to being assigned for analysis. However, requests for DNA examinations may be added after the requests are screened. Therefore, it is imperative that all personnel abide by the following procedures to determine if DNA swabbing is required prior to handling evidence.

- Check the impound package label to determine if “DNA” is written on it, indicating that the evidence needs to be swabbed.
 - When working auto-routed firearms evidence, it is recommended that personnel separate their evidence into “DNA” and “non-DNA” areas to prevent inadvertent mix-ups after the labels have been checked.
- Check the Unit Record Details for any notes indicating that DNA swabbing is needed.
- Check the priority code box for a “6” indicating that DNA analysis is requested.
- View the DNA Unit Record to determine if the items have been previously swabbed.
- Check the OR for a screenshot of the Property Connect request to determine if DNA analysis is requested.
- Check the Laboratory Requests tab in the LIMS for a DNA request.
- If there are any questions as to whether DNA swabbing is needed prior to handling firearms evidence, the examiner should not open the package and

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should resolve the questions with a Manager/Supervisor or other appropriate person prior to beginning the examination.

Swabbing Procedure

The following procedure will be followed when collecting DNA evidence, including bloodstains, saliva, semen, skin cells, and additional biological material. DNA evidence swabbing will occur prior to any latent print processing.

When swabbing for DNA, the work area must be clean to prevent cross contamination. Clean the work area with 10% diluted bleach or a suitable commercial disinfectant solution and place the evidence on a clean sheet of bench/butcher paper. The examiner/technician will use swabs moistened with Molecular Grade Water (MGW) provided by the Biology/DNA Detail for collecting possible DNA material from firearms evidence.

Firearms evidence wrapped in an item that will contaminate the firearm will not be swabbed for DNA and will be noted in the case file (for example, a sock or clothing item that has been worn in which the firearm is placed).


Gloves, mask and laboratory coat will be worn during this process

1. Biological stain - collect the sample with one moistened swab, concentrating the stain on one area of the swab. Use additional swabs if necessary.
2. Firearms (Possible DNA material)- collect a DNA sample with one or two moistened swabs from the entire exterior surface of the firearm
3. Magazines (possible DNA material)- collect a DNA sample with one moistened swab from the entire exterior surface of the magazine

If latent print processing will be required swab only the following areas:

- a. Revolvers- One moistened swab from the trigger, hammer, cylinder release, ridged surfaces on the cylinder, and grip (with the grip sample last)
- b. Semiautomatic handguns - One moistened swab from the trigger, slide serrations, hammer, and grip (with the grip sample last)
- c. Firearms Magazines - One moistened swab from the bottom of magazine and the feeding area
- d. Rifles and Shotguns - One moistened swab from the trigger, stock, and forestock

Swabs will be packaged using a LVMPD Biological Material envelope (LVMPD 523) placed inside a standard evidence envelope. The following additional information will be recorded:

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On the Biological Material Envelope, fill in the appropriate fields and add the LIMS Lab number below the Event Number field.

On the evidence label on the outer envelope, the description of the item swabbed should include the Lab number and Lab Item number in parenthesis at the end of the description.

The examiner/technician will document the pertinent information regarding the swabbing in the case notes. Pertinent information includes the items swabbed and who swabbed the items. The lot number of the molecular grade water used for swabbing will be added to the Resources.

A DNA collection statement will be added to the Laboratory Report listing the items swabbed. For example: "Prior to test firing, the pistol and associated magazine were swabbed for DNA."

A note will also be placed in the Lab Case Details and Unit Record Details Comments field reflecting that the firearm was swabbed for DNA with P#/initials and date.

The DNA Manager and/or LEST responsible for updating examination requests in the LIMS will be added to the list of Requestors.


2.04 / 02 DNA – Cartridge Cases

Cartridge Cases Recovered by CSI from Homicide Scenes

In order to preserve DNA from expended cartridge cases for possible future analysis, the following procedure shall be followed when evaluating homicide cartridge cases for NIBIN entry that were recovered by CSI.

While evaluating cartridge cases for NIBIN entry:

- Masks will be worn at all times.
- Gloves will be worn at all times.
- Gloves will be changed in between each package.
- Handling of the cartridge cases should be limited as much as possible to the case mouth, rim and headstamp areas.
- Handling the sides of the cartridge cases should be avoided as much as possible.
- The cartridge cases being evaluated should not be placed onto a table or other similar surface once they have been removed from their containers for examination. They should be removed from their containers and handled with gloved hands, viewed under the stereoscope and/or comparison microscope, and then immediately placed back into their original containers replacing the lids as soon as possible.
- The cartridge case or cases entered into NIBIN will be marked so as to clearly designate that they were entered and will not be preserved for future DNA analysis.

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When evaluating cartridge cases for NIBIN entry while using these procedures to preserve DNA for future analysis, notes will be added to the LIMS documenting that the cartridge cases were evaluated while wearing a mask and gloves.

If cartridge cases recovered by CSI from homicide scenes are requested for additional analyses such as microscopic comparison or confirmation of a NIBIN association, they will not be preserved for future DNA analysis.

Swabbing Procedure

Cartridge cases will not be routinely swabbed for DNA. In limited circumstances with management approval, DNA swabbing of cartridge cases may be requested. If cartridge cases are to be swabbed for DNA, the following procedure will be followed:

Wet/Dry Method

- Group the cartridge cases by class characteristics, either by observing the breechface and firing pin markings through the plastic vial or by evaluating them while wearing a mask and gloves, following the handling procedure listed above.
- Cartridge cases will be swabbed in groups. Up to five (5) cartridge cases with similar class characteristics may be swabbed together.
- Swab the sides of the cartridge cases, using only the tip of one wet swab, followed by only the tip of one dry swab.
- The dry swab will immediately follow the wet swab, ideally while the item is still damp.
- Wet and dry swabs will be booked together as one item. It is not necessary to delineate which swab was the wet swab and which swab was the dry swab.

Swabs will be packaged using a LVMPD Biological Material envelope (LVMPD 523) placed inside a standard evidence envelope. The following additional information will be recorded:


On the Biological Material Envelope, fill in the appropriate fields and add the LIMS Lab number below the Event Number field.

On the evidence label on the outer envelope, the description of the item swabbed should include the Lab number and Lab Item number of that item in parenthesis at the end of the description.

The examiner/technician will document the pertinent information regarding the swabbing in the case notes. Pertinent information includes the items swabbed and who swabbed the items. The lot number of the molecular grade water used for swabbing will be added to the Resources.

A DNA collection statement will be added to the Laboratory Report listing the items swabbed. For example: "Prior to examination, the cartridge cases were swabbed for DNA."

A note will also be placed in the Lab Case Details and Unit Record Details Comments field reflecting that the cartridge cases were swabbed for DNA with P#/initials and date.

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The DNA Manager and/or LEST responsible for updating examination requests in the LIMS will be added to the list of Requestors.

2.04 / 03 Trace Evidence


Trace evidence will be collected using generally accepted evidence collection procedures.

After collection or if trace material is determined not to be of forensic value, the item may be cleaned by mechanical means or using the following lists of reagents:

- Methanol
- Ten percent dilution of bleach
- Soap and water
- "Booker Dip"
- Peroxide-Acetic Acid bullet cleaner
- Acetone
- Isopropyl Alcohol
- Dispatch® or other commercial cleaner/disinfectant
- Microcide SQ™ or other commercial cleaner intended for use in an ultrasonic cleaner

Firearms personnel are responsible for knowing the health hazards involved in the use of the chemicals named above. These chemicals and their hazards can be found in the Material Safety Data Sheets/SDS that are on file in the laboratory.

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2.05 Title: **CASES WITHOUT FIREARMS**

Firearms personnel may be asked to determine the class characteristics of fired ammunition components. Examples of these class characteristics include but are not limited to:

Caliber, weight, type, direction of twist, number of lands and grooves and their widths, extractor/ejector mark locations, and unique breech face signatures.

These characteristics should be compared to appropriate data files (such as General Rifling Characteristic Databases) and laboratory data in order to generate a list of possible firearms that could have fired the evidence ammunition components.

When a list of firearms is reported, appropriate qualifying statements will be included to reflect any limitations of the data. (For example, "Possible firearms include, but are not limited to the following...")

Examiners shall use their knowledge of firearms manufacturers as well as the Firearms Reference Collection to include common firearm manufacturers in the reported list of possible firearms while excluding less common firearm manufacturers from the reported list.


Pellet size determination is normally conducted by one or more of the three procedures listed:

- a) Direct comparison with known shot sizes.
- b) Weighing a specific number of shot in comparison to the same number of known shot sizes, or values established in a reference source.
- c) Measuring diameter and comparing to known shot sizes or an established reference source.

Wad gauge determination will be conducted in direct comparison with known standards and/or measure the diameter and compare to values established in a reference source. The direct comparison method may also be used for brand, type, and design identification.


The expended bullets, cartridge cases, and fired shotshells in a case submission should be compared in order to determine the number of possible firearms involved. Cartridge cases submitted for NIBIN entry only are exempt from this provision.

Expanded hollow point or controlled expansion bullets may have to be straightened/unfolded to observe class and individual characteristics. Documentation

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through the use of notes and/or photography will be utilized to record the condition of these bullets prior to straightening/unfolding.

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2.06 Title: **CASES WITH FIREARMS**

Firearms personnel will document a case with notes, worksheets, and sketches or photographs noting the condition of the submitted firearm (i.e., safety positions, smoke rings, action position) and fired components.

Firearms personnel will perform appropriate safety tests prior to test-firing (see 2.03/03 - Pre-Firing Safety Check).

If a firearm is submitted with a gun lock that impedes the test firing of the firearm and no key is readily available, the gun lock may be removed/cut off prior to testing.

The purpose of test firing a firearm is to obtain exemplars for comparison purposes and/or NIBIN entry and when specifically requested, to test the functional aspects of the firearm. Firearm functionality examinations are case dependent and may include aspects such as operability, trigger pull, magazine capacity, function of safeties, barrel and overall lengths, etc. Test firing performed for NIBIN entry can establish firearm operability (i.e. is the firearm capable of firing) and may satisfy many laboratory requests for function examinations.

Prior to test-firing, Firearms personnel will evaluate the need for the collection of foreign material on or in the firearm.

If needing to test fire down-loaded ammunition, firearms personnel should be aware of the dangers of firing down-loaded ammunition and the possible change in stria on these bullets.


Firearms personnel should test fire a minimum of two cartridges so that suitable test components are available for comparison. Prior to being fired, the test components will be engraved with the Lab Item number of the firearm being test fired and a sequential alpha designator (e.g. 1A, 1B, 1C, etc.), except for NIBIN test fires where engraving is not needed. After the completion of the case, these test fires will be booked as evidence in accordance with LVMPD policy under the same event number as the firearm.

Casework Unit

When packaging the test fires, the test fired bullets will be placed in one plastic bag, the test fired cartridge cases will be placed in a second plastic bag.

These plastic bags (proximal containers) will be labeled as follows:

Event #XXXXXX-XXXX
 Test fires from Lab #XX-XXXXX Item #X (may be written as XX-XXXXX-X)
 Initials


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The Item # is the LIMS item number of the gun. These two plastic bags may be placed in one larger clear plastic bag (Note: this larger bag does not need to be labeled if the writing on the interior packages is visible) and then placed in the evidence envelope. The above is the minimum amount of information that must be placed on the plastic bags. It is left to the examining employee's discretion to add more.

NIBIN Unit

The test fired cartridge cases will be placed into a plastic bag or envelope with the Event#, Lab#, Lab Item#, make and model of the firearm, and P#/initials of the NIBIN Unit member test firing the firearm.

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LVMPD FORENSIC LABORATORY TECHNICAL OPERATIONS MANUAL FIREARMS DETAIL

2.07 Title: **SILENCERS (SOUND SUPPRESSORS)**

Firearms personnel will evaluate the device as to structure and design, as well as its effectiveness as a silencer. This includes identifying components and structural configurations which indicate an attempt to diminish the report of a firearm.

Prior to testing, the device shall be examined for prior usage and its suitability for safe testing. This examination will include consideration of:

- The structural integrity of the device
- The proper attachment of the device to the firearm (if submitted)
- The proper alignment and clearance of the device with the bore of the firearm
- The components and material(s) used to fabricate the device and their visible characteristics.


This may include both external and internal examinations using specialized equipment (e.g. borescopes) and chemical testing for trace material (e.g. sodium rhodizonate for lead)

During the examination process, it may be beneficial to x-ray the device in question. If x-rays are desired/needed, the Firearms Detail has a working relationship with the Clark County Office of the Coroner/Medical Examiner (CCOCME) to provide this service. The Forensic Scientist should contact personnel at the CCOCME and arrange a mutually convenient time to have the device x-rayed. The Forensic Scientist will personally transport the device to the CCOCME and maintain custody and control of the device during this process. Copies of the x-rays will be placed in the Unit Record Object Repository in the LIMS.

When using an x-ray device to document any internal components of a suspected suppressor, a known suppressor from the Firearms Reference Collection will also be x-ray'd as a control to verify that the x-ray device is working properly.

In testing silencers, it is recommended that testing equipment (such as an impulse noise level meter) be used in determining sound levels (quantitative) although an audible reduction (qualitative) may satisfy most courts.


- Quantitative: The firearm's report is recorded and calculated with an impulse noise level meter with and without the device attached.
- Qualitative: An audible reduction in sound is noted when shots are fired with and without the device attached.

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If the device is permanently attached to the firearm, it is acceptable to compare the report of the evidence firearm with the device attached, to a comparable reference firearm without the device. If this is done, every effort will be taken into consideration to closely replicate the evidence firearm (i.e. make, model, caliber, barrel length, etc.) and ammunition.

After testing is complete, it is an acceptable practice to disassemble these devices to study the design and construction of the internal parts.

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**LVMPD FORENSIC LABORATORY
TECHNICAL OPERATIONS MANUAL
FIREARMS DETAIL**

2.08 Title: FULL-AUTOMATIC FIREARMS AND CONVERSIONS

Prior to test firing, the examiner should evaluate the design and test the mechanical function of the firearm or component to determine the possibility of full automatic function.


Extreme caution should be used in the test firing of any suspected full automatic firearm. Firearms converted to full automatic modes of fire are susceptible to a wide range of malfunctions.

It is recommended that while test-firing for the collection of samples, no more than two cartridges be loaded into the firearm. Test-firing for the rate of fire will be conducted at a range adequate to accommodate full automatic fire of the caliber being fired.

It is a recognized practice to disassemble full automatic firearms to study the design and to identify any altered internal parts.

A shot timer and/or a high-speed video camera is available for measuring the timing of a string of gunshots such as when determining the cyclic rate of fully automatic firearms as necessary.

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2.09 Title: **BARREL LENGTHS AND OVERALL LENGTHS**

Introduction

Barrel length is defined as the distance between the end of the barrel (aka: muzzle) and the face of the closed breechblock or bolt for firearms other than revolvers. On revolvers, it is the overall length of the barrel including the threaded portion within the frame but excluding the cylinder.

Overall length of a firearm is defined as the dimension measured parallel to the axis of the bore from the muzzle to a line at right angle to the axis of the bore and tangent at the rearmost point of the firearm. Firearms with collapsible stocks should be measured collapsed and fully extended.

Barrel and overall length normally include compensators, flash hiders, etc., if permanently affixed. However, removable barrel extensions, chokes, flash hiders, compensators, etc., are not part of the measured barrel or overall length. If the muzzle of the firearm is uneven, barrel length is measured using the farthest extending portion of the muzzle.


Procedure

Overall length

- Position the bore of the firearm parallel to a ruler.
- Use a solid surface perpendicular to the certified ruler to establish the tangential line at the rearmost point of the firearm.
- Measure the distance from the butt (or other rearmost point) to the muzzle using the 1/16" scale of the ruler. The reading may be recorded as a simplified fraction. If the length falls between graduations of the 1/16" scale, round up to the nearest graduation.
- A 'T-square' or similar object provided for this purpose may be used at the muzzle to ensure a perpendicular reading in relation to the ruler.

Barrel Length (all firearms excluding revolvers)

- With the breech in a closed and locked position, place a non-marring rod down the barrel of the firearm until it contacts the breech face.
- Slide a cursor (stopper) down the rod until it contacts the muzzle.
- Remove the rod from the barrel.

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- Using the 1/16” scale of a ruler, measure the distance between the end of the rod that was positioned against the breech face of the firearm and the cursor device or noted muzzle location on the rod.
- Record this measurement as the barrel length. If the length falls between graduations of the 1/16” scale, the examiner will round up to the nearest graduation.
- Alternately, for non-critical measurements, a non-marring unmarked rod may be used. The rod is placed down the barrel until it contacts the breech face and the length to the muzzle can be read directly off the rod. The muzzle location is indexed on the rod and the length read against a suitable measuring device.

Barrel Length (Revolvers)


- The barrel length is measured from the rearmost end of the barrel (forcing cone) to the muzzle.
- If possible, the barrel length may be measured without the use of a rod by placing a ruler directly on the barrel. Alternatively, a non-marring rod and cursor device may be used to measure the barrel length, as long as the rod does not protrude past the rearmost end of the barrel. A block or other device at the rearmost end of the barrel can be used to ensure that the rod does not extend past the end of the barrel.

Critical Measurements

The barrel length and overall length recorded on the Firearms Worksheet are typically for descriptive purposes and do not require the use of a NIST traceable ruler. However, when barrel and/or overall length measurements are made for the purpose of determining whether or not these length measurements meet certain statutory definitions or legal requirements, the use of a NIST traceable ruler is required. This is recommended for barrel and/or overall lengths which are within +/- one inch of the statutory definitions or legal requirements. The examiner shall use the procedures described above and record the identity of the NIST traceable ruler in the case file.

An uncertainty of measurement was calculated for barrel length and/or overall length. The study and the results, along with the procedure for determining the uncertainty of measurement when measuring barrel lengths, can be found in the Firearms Detail's Validation and Uncertainty Binder located in the Detail Manager's office and/or in Qualtrax.

Effective at the time of adoption of this version of the Firearm Technical Manual, the uncertainty of measurement (UoM) for barrel and overall lengths is +/- 1/16 inch at an approximate 95% confidence interval. At a minimum, the uncertainty budget shall be reviewed upon recalibration of a measurement device, replacement of a measurement device, significant changes to the analytical method, or personnel change within the Firearms Detail.


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When the reported barrel and/or overall length measurements are subject to the evaluation of a statute, legal requirement, or is measured upon customer request, the UoM for that value will be included in the formal laboratory report by checking the box "NIST ruler used" in the firearms worksheet. The barrel and/or overall length measurements will be reported as $y \pm U$ where y = the measured value and U = the associated expanded uncertainty. The following statement will be included in the report:

"NOTE: The barrel/overall length uncertainty is based on a combined standard uncertainty multiplied by a coverage factor $K=2$ providing a confidence level of ~95%."

If the barrel and/or overall lengths are not subject to a legal requirement or are not measured upon a customer request, they can be listed in the formal laboratory report as descriptors. In these reports, the lengths will be listed as approximate. The UoM values do not need to be included when the barrel length and overall length are listed as approximate.

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LVMPD FORENSIC LABORATORY TECHNICAL OPERATIONS MANUAL FIREARMS DETAIL

2.10 Title: **TRIGGER PULL EXAMINATION**

One of the routine examinations conducted in a firearms examination is determining the trigger pull of a firearm. Trigger pull is defined as the amount of force that must be applied to the trigger of a firearm to cause sear release. This examination can provide important information regarding the mechanical operating condition of the firearm.

The trigger pull examination should normally be conducted after the firearm has been successfully test fired. There is a remote possibility that the firearm may be damaged during this examination. When practical, measuring the trigger pull of a rimfire firearm shall not be performed on an empty chamber. An inert cartridge shall be used. The examiner must also take into consideration the potential for damage of a centerfire firearm during testing and may wish to use an inert cartridge in this instance as well.


Single Action Trigger Pull

- a) Add weights to the standard trigger weight
- b) Ensure that the firearm is unloaded.
- c) Cock the firearm.
- d) Hold the firearm with the bore perpendicular to the floor with the muzzle pointed upward. Rest the trigger hook of the standard trigger weight hanger on the trigger where the average finger would normally rest. Make sure the hanger is not touching any other part of the firearm and the weights are hanging parallel to the bore of the firearm.
- e) Gently lift the firearm until the sear releases.
- f) Repeat at least once to confirm results or continue to repeat until a consistent value is obtained. Reset the sear connection after each attempt. If a consistent value cannot be obtained through repetition, the trigger pull will be reported as a range consisting of the lowest and highest values measured.
- g) Record the lightest weight required for sear release. Noting any revolver cylinder chamber (or other special circumstance) that results in a different trigger pull value is recommended.

Double Action Trigger Pull

- a) Without cocking the firearm, proceed as above, adding weights until the weights pull the trigger through the double action sequence and the sear releases. The trigger system should be reset as necessary. If a consistent value cannot be obtained through repetition, a range will be reported as described above.

When reporting the results of the trigger pull examination, the methodology used will be reported. (For example, "The trigger pull was measured using dead weights and was determined to be y +/- U pounds.")

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Trigger Pull uncertainty

An uncertainty of measurement was calculated for trigger pulls. The study and the results, along with the procedure for determining the uncertainty of measurement when measuring trigger pulls, can be found in the Firearms Detail's Validation and Uncertainty Binder located in the Detail Manager's office and/or in Qualtrax.


Effective at the time of adoption of this version of the Firearm Technical Manual, the uncertainty of measurement (UoM) trigger pulls is $\pm \frac{3}{4}$ pounds at an approximate 95% confidence interval. At a minimum, the uncertainty shall be reviewed upon recalibration of a measurement device, replacement of a measurement device, significant changes to the analytical method, or personnel change within the Firearms Detail.

When the trigger pull measurement is included in the formal laboratory report, it will be reported as $y \pm U$ where y = the measured value and U = the associated expanded uncertainty. When a range is reported, both the lowest and highest values will be reported in the $y \pm U$ format.

The following statement will be included on all formal laboratory reports where the trigger pull measurement is included:

"NOTE: The trigger pull uncertainty is based on a combined standard uncertainty multiplied by a coverage factor $K=2$ providing a confidence level of ~95%."

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2.11 Title: BORE AND CHAMBER CASTINGS

Occasionally, firearms are received with unknown calibers or calibers that may differ from the designation on the firearm and in the literature. In order to gain more information about the firearm and to fire test shots that are of correct caliber, it may be necessary to make a bore or chamber cast. Then, by measuring the cast, the correct cartridge can be determined.

Several methods are available which use a variety of casting materials (such as low melting point metals and silicone rubber compounds*). The specific method will be at the discretion of the examiner.

*Mikrosil, Forensic Sil, silicone rubber, and Duplicast or similar products can be used for this process. Follow the manufacturer's mixing instructions for proper usage.

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2.12 Title: **LAND AND GROOVE MEASUREMENTS**

General Rifling Characteristic (GRC) determinations may entail measurements of land and groove widths. Several instruments are available for making such measurements, and the technique of measurement is approximately the same in each. The critical parameters are the points used for beginning and end of a measurement. Use one or more of the methods listed below:

a) Air Gap Method – Comparison Microscope

Mount the fired bullet on one stage of the comparison microscope. Mount the measuring device (micrometer) on the other stage. Both stages must use the same magnification level (objective setting) and be in focus on the top center portion of the micrometer spindle and bullet surface.

Adjust the measurement gap (opening) between the spindle and anvil of the micrometer to align with the reference points of the appropriate land or groove impression. Record the value to the nearest hundredth of an inch (or appropriate measurement).

b) Air Gap Method – Stereo Microscope


Place the fired bullet beneath the stereo microscope. Place the land or groove impression of the fired bullet in the topmost vertical position aligned with the opening of the micrometer or caliper.

Move the micrometer's/caliper's measuring point to the next reference point and record the measured width. Record the value to the nearest hundredth of an inch (or appropriate measurement).

c) Stage micrometer

Mount the fired bullet on one stage of the comparison microscope. Mount the stage micrometer (microscale) on the other stage. Both stages must use the same magnification level (objective setting) and be in focus on the top center portion of the bullet surface and on the stage micrometer (microscale) markings.

Place the land or groove impression of the fired bullet in the topmost vertical position with one of the reference points corresponding with a mark on the stage micrometer (microscale). Record the measured width to the next reference point. Record the value to the nearest hundredth of an inch (or appropriate measurement).

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d) Leica Live Measure Software or software “measuring tool”

Mount the fired bullet on the comparison microscope Ensure proper lighting and orientation and that both objectives are on the same magnification. Use the software to determine land and groove width measurements. Record the value to the nearest hundredth of an inch (or appropriate measurement).

e) Point to Point Measurement (LEEDS microscopes with stage-mounted LCD measuring scale and cross hair eyepiece)


- i) Remove the right eyepiece and replace it with the eyepiece that has the cross hairs.
- ii) Rotate the eyepiece so that the cross hairs are running vertically and horizontally
- iii) Mount the object to be measured on the left stage.
- iv) Turn the power on to the LCD measuring scale
- v) Move the left stage forward or back to align the cross hair in eyepiece to the starting edge of feature to be measured (land or groove impression)
 - (1) Note: it may be necessary to slightly rotate the eyepiece or the object in order to align the cross hair to the starting edge of the feature being measured.
- vi) Zero the LCD measuring scale (press zero button)
- vii) Move the left stage forward or back to align the cross hair in eyepiece to the final edge of feature to be measured
- viii) Record value to nearest hundredth of an inch (or appropriate measurement.
- ix) To measure an additional feature on the same object, begin again at step v.

The caliber and GRC (number, width, and direction of twist of the rifling impressions) on a fired bullet can be entered into a GRC database* of characteristics to produce a list of firearms the bullet may have been fired from. When searching a database* for possible firearms, a minimum range of +/- 0.002 inches should be added to the measured land and groove impression widths.

All numbers and calculations used to determine the bullet caliber from the measurement of the rifling impressions will be listed and recorded in the analyst's notes.

Bullets which are requested for comparison that are not identified to a specific firearm should have their GRC entered into a GRC database to obtain a list of possible firearms that the bullet may have been fired from so that this information can be included in the report. See Section 2.05 – Cases Without Firearms, for more information.

*Commonly referenced databases include those available from the FBI and the Association of Firearm and Toolmark Examiners (AFTE).

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2.13 Title: NIBIN (National Integrated Ballistic Information Network)

2.13 / 01 NIBIN General Information

NIBIN is an image-based database system provided by the BATFE (Bureau of Alcohol, Tobacco, Firearms and Explosives) designed to allow images of evidence cartridge cases and test fired cartridge cases to be searched against other images in the NIBIN database. This system will be used in a secure location in the forensic laboratory and will follow the security and access procedures as outlined in the Forensic Laboratory Quality Manual. In addition, the security system will be checked quarterly.


The laboratory building security alarm will be checked by triggering the alarm system manually. Prior to triggering the alarm, the alarm company, LVMPD dispatch and any laboratory personnel in the building will be notified. Alternatively, the alarm may be tested by the alarm company. The date and success/failure of the test will be recorded in the Alarm Testing Log in Qualtrax.

As a NIBIN site, the Firearms Detail of the LVMPD strives to meet the BATFE's Minimum Required Operating Standards (MROS) that went into effect July 2018 as they relate to ensuring the quality, integrity, and timeliness of the ballistic data shared in NIBIN.

A qualified NIBIN user that has completed acquisition and correlation training will be designated as the NIBIN Program Administrator. The NIBIN Program Administrator shall oversee the NIBIN program and has the authority to initiate, suspend and resume NIBIN operations for the Forensic Laboratory or an individual. The NIBIN Program Administrator shall also evaluate and document approval of all methods used and will assist in proposing new or modified procedures as needed. The NIBIN Program Administrator will review training records for new NIBIN users, and in conjunction with the Quality Unit will approve their qualifications prior to the user performing acquisitions or correlations. The NIBIN Program Administrator will document this review and approval in Qualtrax.

Procedures and requirements for personnel to make entries into the NIBIN database and to conduct correlations are controlled and determined by the BATFE. All users must complete the BATFE Integrated Ballistics Identification System Course offered by the BATFE, Forensic Technologies and/or a NIBIN Authorized Trainer and be authorized by BATFE to log into the NIBIN system. An online procedure manual for using the system is available on the IBIS computer workstation. Records of this training will be maintained in Qualtrax.

Qualified NIBIN users will enter test fired and/or evidence cartridge cases into the NIBIN database at their discretion, knowing that not all ammunition components or firearms will

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fit the criteria needed to use NIBIN most effectively. All required information pertaining to the evidence will be accurately entered into NIBIN database during the acquisition process. Firearms submitted for entry into the NIBIN database will be examined and test fired following the procedures and protocols established in Sections 2.03 SAFE FIREARM HANDLING IN THE LABORATORY and 2.06 CASES WITH FIREARMS.

Entries

The following criteria will act as a guide in determining which cartridge cases should be entered into NIBIN

- Any firearm of any caliber that ejects the fired cartridge case during its cycle of operation may be appropriate for entry.
- Any cartridge case with a discernible pattern of individual characteristics in the breechface marks and/or firing pin impression may be appropriate for entry.
- Multiple cartridge cases submitted for NIBIN entry only:
 - The cartridge cases will be visually screened and grouped according to class characteristics. If one or more groups are found to be visually distinguishable from each other, one cartridge case from each group may be entered. Multiple cartridge case screening is performed by qualified personnel authorized to screen cartridge cases.
- For ShotSpotter events, the NIBIN entry exhibit number will be the Lab item # - SST (for example: 3 - SST or 3 TF – SST).

Correlations

In addition to the automatic default correlation, a manual correlation of the local databases or other site locations may be launched.


Correlation results in NIBIN will be reviewed by personnel qualified to perform correlations. If correlations are reviewed at the Forensic Laboratory, at a minimum, the top 30 “rank sorted” candidates will be reviewed. If a potential NIBIN Lead is made by laboratory personnel, a secondary review of this NIBIN Lead will be performed by a qualified NIBIN user that has completed both NIBIN entry and correlation training. The secondary review will be recorded in the NIBIN Lead window on the MatchPoint database and include, at least, the reviewer’s P#/initials, date, and the results of the review.

For internal hits made by laboratory personnel that are within the same NIBIN case, the correlation reviewer will have the secondary reviewer record on the NIBIN Lead printout or in the Unit Record Details the secondary reviewer’s P#/initials, date, and the results of the review.

The correlations may also be reviewed by the BATFE and/or the NIBIN National Correlation and Training Center (NNCTC).

All correlation results will be documented in the appropriate worksheet in the LIMS. The following information will be recorded:

- Date that the correlations were reviewed (either the date that the NNCTC reviewed them or the date that the qualified laboratory personnel reviewed them).
- Record if there were any associations.

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- Associations provided by the NNCTC will be reviewed by a qualified person prior to reporting.
- The person reviewing the NNCTC provided association/s will note in the UR Details the results of the review and will include the reviewer's P#/initials and date.
- If upon review, the person reviewing the NNCTC provided association/s disagrees that there is an association, the association will be deleted from MatchPoint and a note will be placed in the UR Details with the the results of the review and will include the reviewer's P#/initials and date.
- Upload the NIBIN Hit info sheet(s) into the OR; or
- Upload the NNCTC no-lead report into the OR if the NNCTC completed the correlations.
- Record the P#/initials of the personnel who reviewed the correlations or recorded the correlation results from NNCTC.

Following the review of the correlations of NIBIN entries a report will be written and disseminated.

The NIBIN unit will follow the Forensic Laboratory Quality Manual regarding corrective actions following internal audits, external audits, or when a quality issue arises. Audits/assessments will be conducted as stated in the Forensic Laboratory Quality Manual and/or in accordance with BATFE requirements.

2.13 / 02 NIBIN Unit


To facilitate a shorter turnaround time for the entry of impounded firearms into NIBIN, the Forensic Laboratory can utilize Police Officers, Laboratory Technologists and part time Investigative Aides. These individuals are assigned to the NIBIN Unit and are within the chain of command of the Forensic Laboratory. The job duties of the personnel in the NIBIN Unit are to test fire impounded firearms and screen cartridge cases for entry into NIBIN. In addition, qualified personnel may perform DNA swabbing on guns, and review NIBIN correlations and issue reports. NIBIN Unit personnel are considered laboratory members and are subject to the same accreditation standards followed by the other members of the Forensic Laboratory. As such, they will follow the administrative and safety procedures outlined in Sections 1, 2 and 7 of this manual along with all sections of the Forensic Laboratory Quality Manual.

Note: The recovery of fired bullets is not necessary for firearms examined for NIBIN entry only.


If a firearm is submitted with a gun lock that impedes the test firing of the firearm and no key is readily available, the gun lock may be removed/cut off prior to testing.

The process for the test firing of firearms and subsequent NIBIN entry is as follows:

Test fire entry for firearms electronically booked (applies to both Forensic Laboratory and Firearms Annex operations):

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- Firearms to be test fired for NIBIN entry can be requested or be automatically transferred by the evidence vault.
- If NIBIN entry is requested, the Unit Record (UR) is assigned to NIBIN Unit personnel and the evidence will be transferred to the Laboratory vault.
- If a firearm is automatically transferred and a request has not been created in LIMS, a NIBIN-only request for the appropriate evidence submitted will be created.
- Once the evidence is received, the NIBIN Unit personnel will confirm that the outer package information and the information in LIMS are consistent.
- If DNA swabbing is needed, the NIBIN Unit personnel will swab the firearm and magazine for DNA per the procedure in Section 2.04 /01 of this manual.
- On the NIBIN worksheet, personnel will:
 - Complete the NIBIN packaging and test fire sections.
 - Enter packaging information and sealed condition.
 - Enter the charge listed on the evidence label to the outer package comments field.
 - Select the items to be examined – it is only necessary to add notes to the Item Notes field if there is an issue with evidence descriptions, serial numbers, etc. and/or to add comments regarding DNA swabbing. If there is an issue, please make a note regarding the correct information and that the vault and/or Detail Manager was notified.
 - If additional items are in the packaging, add under “Items Not Requested.” Add a brief description and impound number of the additional items.
 - If a cartridge case consult is needed, add the item and request a consult. If the cartridge case is not associated to test fires, enter it using the NIBIN worksheet.
 - For the firearms section of the worksheet choose the correct item and fill in the fields regarding:
 - Make
 - Model
 - Caliber
 - Type
 - Serial Number
 - Importer (if applicable)
 - For the test fire section of the worksheet fill in the fields regarding:
 - Date fired
 - Function
 - Fill in the Notes section at the bottom of the worksheet with the P#/initials of the technician performing the test firing.
 - Prior to test firing, the NIBIN Unit member will confirm that the firearm is safe to fire, choose the appropriate caliber of ammunition for that firearm and test fire the firearm. The ammunition should be free of manufacturer marks. The test fires will be packaged as described in section 2.06 of this manual.

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- If the firearm is not functional, the NIBIN Unit member will generate a report regarding non-functionality and submit for administrative review.
- If the firearm is functional, a test fired cartridge case will be entered into NIBIN using standard acquisition protocols. The cartridge case to be entered will be marked for future reference by the person entering in the cartridge case.
 - Complete the NIBIN test fire section of worksheet:
 - Check the NIBIN entry radio button and add the date of entry
 - In the Notes section at the bottom record the P#/initials of the NIBIN Unit member performing the NIBIN entry
 - If the test fires cannot be entered by the personnel test firing the firearm or in their custody, the test fired cartridge cases will be booked and placed in short-term storage (FTM0 – TEST) and change the discipline code of the UR to **20**. Another NIBIN Unit member authorized to entered cartridge cases into NIBIN will complete the UR.
- Run a manual correlation of the local databases or other site locations of the NIBIN entry, if needed.
- Review the Correlations or NNCTC correlation(s) report.
 - If the correlations cannot be entered by the personnel entering the test fire into NIBIN, change the discipline code of the UR to **30**. Another NIBIN Unit member authorized to review correlations will complete the UR.
- Complete the Correlation sections of Worksheet:
 - Date of correlation review and if there were any associations. Upload the NIBIN Hit info sheet(s) into the OR the NNCTC no-lead report that is associated with the Laboratory Case.
 - In the Notes section at the bottom record the P#/initials of the NIBIN Unit member reviewing the correlations or inputting correlation results from NNCTC.
- Return the firearm evidence and test fires to the laboratory evidence vault.
- Draft a report and submit for review.

Test Fire Entry into NIBIN:

- If the test fired cartridge cases were booked and placed in short-term storage (FTM0 – TEST), the UR will be transferred to a NIBIN Unit member responsible for NIBIN entry.
- Transfer the test fired cartridge cases from FTM0-TEST to the custody of the NIBIN Unit member who will perform the NIBIN entry.
- Enter a test fired cartridge case into NIBIN using standard acquisition protocols. The cartridge case to be entered will be marked for future reference by the person entering in the cartridge case.
- Complete the NIBIN test fire section of worksheet:
 - Check the NIBIN entry radio button and add the date of entry.
 - In the Notes section at the bottom record the P#/initials of the NIBIN Unit member performing the NIBIN entry

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- Run a manual correlation of the local databases or other site locations of the NIBIN entry, if needed.
- Review the Correlations or NNCTC correlation(s) report.
 - If the correlations cannot be entered by the personnel entering the test fire into NIBIN, change the discipline code of the UR to **30**. Another NIBIN Unit member authorized to review correlations will complete the UR.
- Complete the Correlation sections of Worksheet:
 - Date of correlation review and if there were any associations. Upload the NIBIN Hit info sheet(s) into the OR or the NNCTC no-lead report that is associated with the Laboratory Case.
 - In the Notes section at the bottom record the P#/initials of the NIBIN Unit member reviewing the correlations or inputting correlation results from NNCTC.
- Return the test fired evidence to vault.
- Draft a report and submit for review.

Correlation Review:

- If applicable, the UR is transferred to the NIBIN Unit member reviewing the correlations or inputting the results from the NNCTC.
- Review the Correlations or NNCTC correlation(s) report.
 - If the correlations cannot be entered by the personnel entering the test fire into NIBIN, change the discipline code of the UR to **30**. Another NIBIN Unit member authorized to review correlations will complete the UR.
- Complete the Correlation sections of Worksheet:
 - Date of correlation review and if there were any associations. Upload the NIBIN Hit info sheet(s) into the OR or the NNCTC no-lead report that is associated with the Laboratory Case.
 - In the Notes section at the bottom record the P#/initials of the NIBIN Unit member reviewing the correlations or inputting correlation results from NNCTC.
- Draft a report and submit for review.

**Test fire entry for firearms test fired by OJs at the Firearms Annex/
Test fire entry for firearms test fired for OJs by Firearms Detail Personnel at the Firearms Annex or at the Forensic Laboratory:**


- Note: All OJ personnel will be accompanied by a member of the Firearms Detail to ensure the safety at the Firearms Annex and the test firing of firearms.
- If DNA swabbing is needed, OJ personnel can swab their evidence prior to bringing the evidence to the Laboratory or Annex for test firing. Or the DNA swabbing can be conducted by qualified LVMPD Forensic Laboratory personnel prior to test firing.
- A NIBIN Unit member will check for safety the firearms to be test fired and choose the appropriate caliber ammunition for test firing the firearm.

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- An envelope with the OJ event#, impound #, charge, make, model, caliber, serial number, firearm type, and date fired will be filled out and verified for accuracy.
- The Firearms Detail personnel or the OJ personnel (when appropriate) will test fire the firearm in the presence of the OJ personnel
- If the firearm is not functional, no further work will be completed by the NIBIN Unit.
- If the firearm is functional, the test fired cartridge cases will be packaged by the NIBIN Unit member.
- A NIBIN-only request for the test fire will be created in LIMS.
- The test fires will then be entered into NIBIN by a NIBIN Unit member using the NIBIN worksheet, by following the above procedures for Test Fire Entry into NIBIN and Correlation Review.
- The test fires will be booked at the Laboratory Evidence Vault.

Cartridge cases:

- Cartridge cases collected from LVMPD events and OJs will be electronically entered in the evidence management system and can be automatically transferred by the evidence vault and placed into short-term storage (FTM0-FAST) or can be requested for NIBIN entry.
- If NIBIN cartridge case entry is requested, the Unit Record (UR) is assigned to a NIBIN Unit member and the evidence will be transferred to the Laboratory vault.
- If a cartridge case(s) is automatically transferred and a request has not been created in LIMS, a NIBIN-only request for the appropriate evidence submitted will be created.
- Once the evidence is received, the NIBIN Unit member will confirm that the outer package information and the information in LIMS are consistent.
- Complete the NIBIN packaging and Fastrack sections of the Worksheet.
- Enter packaging information and sealed condition.
- Enter in the charge listed on the evidence label to the outer package comments field.
- Select the items to be examined – it is only necessary to add notes to the Item Notes field if there is an issue with evidence descriptions. If there is an issue, please make a note regarding the correct information and that the vault and/or Detail Manager/NIBIN Database Administrator was notified.
- If additional items are in the packaging, add under “Items Not Requested.” Add a brief description and impound number of the additional items.
- For the Fastrack section of the worksheet choose the correct item(s) and fill in the fields regarding:
 - Caliber
 - Quantity of cartridge cases
 - In the Notes field entered in notes regarding screening results, if any, and item#(s) to be entered.
 - In the Lab Markings field, indicate how the proximal containers were labeled and how the item(s) entered into NIBIN were entered.

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- The selected cartridge case(s) will be entered into NIBIN using standard acquisition protocols.
 - Check the NIBIN entry radio button and add the date of entry
 - In the Notes section record the P#/initials of the NIBIN Unit member performing the NIBIN entry and change the discipline code to **40**.
- Return the evidence to the laboratory evidence vault.
- Run a manual correlation of the local databases of the NIBIN entry, if needed.
- Review the Correlations or NNCTC correlation(s) report.
 - If the correlations cannot be entered by the personnel entering the test fire into NIBIN, change the discipline code of the UR to **30**. Another NIBIN Unit member authorized to review correlations will complete the UR.
- Complete the Correlation sections of Worksheet:
 - Date of correlation review and if there were any associations. Upload the NIBIN Hit info sheet(s) into the OR or the NNCTC no-lead report that is associated with the Laboratory Case.
 - In the Notes section at the bottom record the P#/initials of the NIBIN Unit member reviewing the correlations or inputting correlation results from NNCTC.
- Draft a report and submit for review.

The discipline codes **30** and **40**, can have the following descriptors.


“C” – correlation complete (no lead) and the case notes have been updated

“H” – correlation complete (lead) and the case notes have been updated

“R” – correlation complete by NNCTC, the NNCTC report is in the OR and the case notes may/or may not be updated

Additionally, the following discipline codes may be used:

- **31** to indicate a case that has gone back to the original examiner to update a portion of the case.
- SST will be placed in front of the discipline code to indicate that the case is a ShotSpotter event
- 15 to indicate that DNA swabbing has been completed

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3.01 Title: INTRODUCTION TO SERIAL NUMBER RESTORATION PROCEDURES

Many items, notably firearms, require that a serial number be present. Numbers which have been deliberately removed to prevent tracing, inadvertently removed due to damage or repair or which may have become unreadable due to corrosion (as in buried guns or guns recovered from bodies of water) may be restored in a variety of ways.


Firearms personnel should be aware of a variety of means by which numbers may be applied and locations where duplicate or hidden, secret numbers may be applied. Reporting such numbers should avoid the use of terms such as “hidden” or “secret” to preserve their utility which is dependent on a lack of public knowledge of their existence.

Serial numbers on most firearms, as well as many other objects, are usually die-stamped. This process produces a compression of the material in the area immediately surrounding and a short distance below the penetration of the die. Even though the number is obliterated by filing or grinding, restoration may be possible if the removal of the material is not past this compression area. If the obliteration is beyond this area, restoration is impossible for die-stamped, as well as etched or engraved numbers.

The most commonly employed procedures involve the use of chemical etching solutions. The recipes for etching solutions used by the Forensic Laboratory are contained in 7.01-RECIPES. These solutions may be diluted as necessary. Additional methods, reagents and restoration techniques can be found in the Handbook of Methods for the Restoration of Obliterated Serial Numbers.

The chemical-etching technique is generally the same for all metals, but the reagents differ depending on the type of metal or alloy. The most important step is to thoroughly clean and polish the surface to be restored to a mirror-like finish. (Sometimes this step alone will make part or all of a number visible.) Examination with low magnification and oblique lighting may also be helpful. Materials other than metal may require another technique.

CAUTION: Because the reagents are etching solutions and contain acids or bases, they are potentially dangerous. They should be used under a fume hood, snorkel, or in a well-ventilated area only by qualified, trained personnel. Storage of these reagents when not in use should be in the appropriate chemical storage area.


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3.02 Title: **PROCEDURE FOR CHEMICAL-ETCHING**

- a) Make a tape lift of (with black fingerprint powder), and/or photograph the obliterated surface prior to the restoration attempt. This serves to illustrate the original starting condition.
- b) Polish the metal surface by hand using a series of abrasives from medium to ultra-fine grade. It is best to polish in one direction. Deep gouges may require the use of an electric wheel fitted with emery paper or similar polishing compound. Take care not to heat the working surface due to friction.
- c) The ideal final polished surface should be mirror-like, with cuts and blemishes removed to the extent possible (deep cuts might not be completely removed).
- d) The surface may be cleaned with acetone or another solvent.
- e) Prior to the application of the etching solution(s), control test(s) will be conducted on an area of the firearm/evidence item (or similar reference material) away from the questioned area. The control area will be prepped in the same manner as the questioned area followed by the application of the appropriate reagent(s). A visible reaction (bubbling, color change, vapors, etc.) will be considered a positive control test. The results of this control test along with the name of the reagent(s) and lot number(s) will be recorded in the examiner's notes.
- f) Apply the appropriate solution(s). Observe the etching action of the solution(s) carefully.
- g) When numbers appear, wipe off the solution, or rinse the solution off with water. Write down, photograph or otherwise document the numbers as they appear. Sometimes the numbers can be seen better if the surface is moistened with water, glycerin, or oil.
- h) If the numbers are not clear, re-polish the surface, and repeat steps f and g. It may take several attempts to adequately restore the entire number. If necessary, steps e-g may be repeated using other suitable etching solutions.
- i) Photographs should be taken throughout and at the conclusion of the restoration process.

If the restored number is not readily visible and not able to be recorded photographically, the examiner will request a verification of the number by a second examiner. Verifications are not considered examinations; they are normally completed in the presence of both examiners and do not require


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evidence custody moves or marks on the items or packages. If the verification cannot be completed in the presence of both parties or requires overnight storage by the verifier, evidence custody transfers will be performed. The conclusions of the consulting examiner will be noted in the primary examiner's case notes in the comments field of the Verification Review window in the LIMS. The verification documentation will include the identity of the consulting examiner, the date the verification was performed, and the Lab Item Number(s) of the item(s) verified. During the verification process, if the reviewing examiner does not agree with the case examiner on a result/conclusion, it will be documented in the comment/note section of the verification window in the LIMS prior to discussing the results with the case examiner. If the case examiner and reviewer reach a consensus on the result/conclusion, the case examiner can simply document the results of the discussion and update the notes and/or report with the revised conclusion(s), if any, and the date.

If the case examiner does not concur and a more comprehensive discussion is needed to arrive at a consensus, the Forensic Laboratory Manager/Supervisor will be notified. The Forensic Laboratory Manager/Supervisor will determine the appropriate course of action. If resolution cannot be reached, it will be brought to the attention of the Laboratory Director.

- j) Once the procedure is completed, lightly oil the restored surface to prevent rust/corrosion.

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4.01 Title: INTRODUCTION TO PROXIMITY ANALYSIS PROCEDURES

Applying the procedures in this section to casework requires the skills of a trained Firearm Examiner. To be considered trained; the Examiner must have completed an appropriate and approved training program for the procedures in this section along with the successful completion of a competency test including the issuance of a certificate of competency.

To help ensure the accuracy and completeness of case documentation, it is recommended that the AFTE glossary be utilized for appropriate definitions.

Worksheets will be used to ensure recording of all pertinent facts pertaining to the submitted evidence.

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LVMPD FORENSIC LABORATORY TECHNICAL OPERATIONS MANUAL FIREARMS DETAIL

4.02 Title: MUZZLE-TO-TARGET DISTANCE DETERMINATION

Introduction

Conclusions concerning firearm-related defects and approximate muzzle-to-target distances involved in a shooting incident are achieved through the examination and evaluation of gunshot residues, projectile defects, and shot pellet distribution patterns on submitted evidence. Patterns created at known distances can be compared to the evidence patterns to determine an approximate muzzle-to-target distance.

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

- Unburned and/or partially burned gunpowder particles
- Soot and/or vaporous lead
- Nitrite residues
- Particulate metals and other materials

These gunshot residues, along with the morphology of the bullet defect, can be used to determine the possible muzzle-to-target distance.


Evidence items frequently encountered include clothing, autopsy photographs and/or reports, the actual firearm and ammunition, and other objects. In most cases, the outermost layer of clothing will be examined.

The basic objectives of performing muzzle-to-target distance determination are to:

- Identify defects caused by the passage of a bullet, pellet(s) or slug.
- Identify gunshot residues and shot patterns.
- Re-create, as closely as possible, the conditions in which the evidence pattern was produced when creating test patterns at known muzzle-to-target distances for comparison. This may involve:
 - Evaluating the firearm and ammunition components
 - Performing microscopic comparisons of the fired ammunition components
 - Obtaining test material similar to the evidence
 - Obtaining permission to test fire the evidence ammunition if deemed necessary

Any deviations from the use of the actual case firearm, ammunition, or target material similar to the evidence when conducting distance determination tests must be documented in the notes.

All distance determinations for ranges other than contact or near contact will be reported using upper and lower limits.

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Distance Determination Uncertainty

An uncertainty of measurement was calculated for distance determination. The study and the results, along with the procedure for determining the uncertainty of measurement when performing distance determination examinations, can be found in Qualtrax.

Effective with the Firearm Technical Manual Revision Number 9 adoption, the uncertainty of measurement (UoM) for the muzzle-to-target distance is +/- 1/4 inches at an approximate 95% confidence interval. This UofM has been calculated for distances under 8 meters (315 inches) due to limitations of the equipment calibrations. For muzzle-to-target distances greater than 315 inches, a statement will be included in the notes and report that the UofM at that distance has not been calculated. At a minimum, the uncertainty shall be reviewed upon recalibration of a measurement device, replacement of a measurement device, significant changes to the analytical method, or personnel change within the Firearms Detail.

When a muzzle-to-target distance is included in the formal laboratory report, it will be reported as $y \pm U$ where y = the measured value and U = the associated expanded uncertainty.

The following statement will be included on all formal laboratory reports where the muzzle-to-target distance is included:

NOTE: The muzzle-to-target distance uncertainty is based on a combined standard uncertainty multiplied by a coverage factor $K=2$ providing a confidence level of ~95%.

General Procedure


Perform a visual examination of the evidence item. Describe and document the item and any observable physical characteristics (e.g. defect appearance, powder morphology, visible residues, etc.) on the item. A microscopic examination (stereoscope or other magnifier) should also be performed and any further observations documented. Documentation can include notes, sketches, overlays and photographs. If an item of clothing has been cut severely during medical intervention, it may be necessary to “sew” the garment back together. It is acceptable to use staples for this process.

Chemical testing is not required if:

- There is a clearly visible pellet pattern.
- The distance is determined by direct observation to be “contact” or “near contact”

Chemical testing is generally considered destructive to the evidence. Chemical testing may consist of tests for nitrites (Modified Griess) and lead (sodium rhodizonate).

These chemical tests can identify bullet wipe, lead residue patterns, and particulate GSR patterns. Nitrite residues may be detected on items that have interacted with burned gunpowder particles, even if the particles have been removed or dislodged by handling or other processing.

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The appropriate sequence of performing the most commonly used tests is:

1. Visual, and microscopic
2. Modified Griess
3. Sodium Rhodizonate

A description of the items used (including, but not limited to firearm, ammunition type and/or source, target material, and reagents) and the muzzle-to-target distances of the test shots will be recorded. A minimum of two separate test shots will be fired at each set distance. The determination of the initial distances at which test targets will be shot can be based on the observations of the evidence item and previous experience with similar firearm and ammunition combinations. These test panels will be examined and processed in the same manner as the evidence item. Chemical test results should also be consistent with one another at a particular known distance and with any physical effects present. Based on the results, additional test shots may be required.


Conclusions may be limited due to the following factors:

- Damage to the evidence item not related to the shooting (cuts due to medical intervention, normal wear and tear, etc.)
- Elongated patterns caused by angled discharges
- Incomplete patterns caused by intervening objects
- Partial patterns caused by other clothing articles (e.g. folds in clothing, rolled up sleeves, etc.)
- Partial patterns caused by the relationship of pattern-to-target (e.g. half pattern caused by an over the shoulder discharge)
- Insufficient evidence information or availability (e.g. specific type of ammunition)
- Interference due to biological contamination*

The absence of gunshot residue is not a basis for expressing a distance determination. Prior to issuing conclusions, the examiner should understand that shooting events are dynamic and must consider the possibility of intervening objects or other limitations when determining a maximum (drop-off) distance for gunshot residue deposits. These limiting factors may be expressed in the report at the discretion of the examiner.

During the verification process, if the reviewing examiner does not agree with the case examiner on a result/conclusion, it will be documented in the comment/note section of the Verification window in the LIMS prior to discussing the results with the case examiner. If the case examiner and reviewer reach a consensus on the result/conclusion, the case examiner can simply document the results of the discussion and update the notes and/or report with the revised conclusion(s), if any, and the date.

If the case examiner does not concur and a more comprehensive discussion is needed to arrive at a consensus, the Forensic Laboratory Manager/Supervisor will be notified. The Forensic Laboratory Manager/Supervisor will determine the appropriate course of action. If resolution cannot be reached, it will be brought to the attention of the Laboratory Director.

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If an error in conclusion and/or interpretation is noted which may indicate a deficiency in the training or abilities of the examiner, the report will be submitted to the respective Forensic Laboratory Manager. The Forensic Laboratory Manager will evaluate the situation and determine the needed course of action. See the Forensic Laboratory Quality Manual for further details.

* Pre-processing of blood-soaked clothing

The presence of blood can obscure the visual components of the gunshot residue pattern and interfere with the chemical processing for nitrite compounds and lead. In these instances, the following method should be used to remove the blood from the item of clothing:

- Soak the item of clothing and the test panels fired from a known distance in separate containers of cold tap water for approximately six hours.
 - Change and gently agitate the water every two hours.
- Allow the item of clothing and the test panels to air dry.
- Process for GSR utilizing the procedures outlined in section 4.03- *Chemical Processing of Clothing for Distance Determination* in this manual.

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LVMPD FORENSIC LABORATORY TECHNICAL OPERATIONS MANUAL FIREARMS DETAIL

4.03 Title: **CHEMICAL PROCESSING OF CLOTHING FOR DISTANCE DETERMINATION**

This technical supplement is to provide the Firearm Examiner with a reference for using the Modified Griess and Sodium Rhodizonate Tests. The Modified Griess Test is a color test for the nitrite containing compounds produced as a combustion product of smokeless powder. The Griess Test does not chemically interfere with the Sodium Rhodizonate Test for lead residue. The Griess Test must be performed first, since the converse is not true.

In general, the chemical reactions that occur in the Griess Test involve converting the nitrite compounds on the garment to an orange dye. These dye pigments are preserved in a medium (desensitized photographic paper) for future side-by-side comparisons with test patterns of known distances.


The process of converting the nitrites is done by exposing the compounds to vaporous acetic acid using an acid solution and heat (dry iron) to form nitrous acid. This nitrous acid then combines with sulfanilic acid in the test media (photographic paper) to form a diazonium salt of sulfanilic acid. The diazonium salt then binds with alpha-naphthol (1-naphthol), also in the test media, to form the orange azo dye.

The Sodium Rhodizonate Test uses a reagent (sodium rhodizonate) to react with any lead or other heavy metals present on the garment producing a pink color. The specificity for the lead is to apply an additional acid solution (5 % hydrochloric acid) to the area. If lead is present, then the pink areas will change to a blue-violet color. The chemistry involved is thought to be a chelating of the metal to the rhodizonate molecule and that the blue color is a molecular complex consisting of lead rhodizonate and hydrochloride.

The following instructions are for reagent and test media preparation for the Modified Griess Test for nitrite residues and the Sodium Rhodizonate test for lead. Good laboratory practice dictates the use of appropriate precautions to preclude inhalation, ingestion, or skin contact with chemicals. The use of a hood/proper ventilation, protective gloves, and hand washing after handling chemicals are required. Prepared chemicals and test media should be stored in closed/covered containers until needed.

Many of the procedures which follow involve the spraying of reagents in an aerosol form. This can be accomplished by using spray bottles, cans of compressed gas or an airbrush. All spraying shall be done in a chemical fume hood that has sufficient air flow to prevent back-flow of the reagents into the work area.

The recipes for the reagents used in these processes are listed in Section 7.01 RECIPES, of this manual.

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The evidence items and test media along with all positive test results will be thoroughly documented with narratives, sketches, overlays and/or photographs.

After case completion, test and evidence media showing positive results will be booked as evidence in accordance with LVMPD policy under the same event number as the questioned item. Test media relating to negative results need not be retained.

The Modified Griess Test

- It is noted that the desensitized photo paper mentioned below is simply photographic print paper which has been exposed to a hypo solution and thus no longer bears light sensitive silver salts in its surface emulsion. If this material is not available, several varieties of photo type printer paper have been shown to be suitable replacements (see the Firearms/Toolmarks Detail Validation Study “*Modified Griess - Paper Source*” completed February 2015). As a result of this study, the following papers were deemed to have the best contrast and sensitivity for this process:
 1. Epson Premium Photo Inkjet, Product # S042183
 2. Epson Premium Semi-Glossy, Product # S041331
 3. Epson Glossy, Product # S041141
 4. HP Advanced Photo Paper, Product #Q7852A


In addition to the validation of replacement papers, this study demonstrated that the preparation and processing of the paper test media should be performed contemporaneously with the examination process.

1. Processing of desensitized photographic or inkjet paper

- a. Pour the Griess reagent into a non-reactive photo processing tray and briefly dip the paper into the tray. Simply submerge the sheets completely and remove them.
- b. Set the sheets aside on an uncontaminated surface or hang to dry.
- c. Note: In lieu of desensitized photographic paper, ordinary laboratory filter paper may be processed in the same manner for use in the Modified Griess Test.

2. Procedure for a Modified Griess Test

- a. Positive and Negative control testing shall be performed prior to testing the evidence or known-distance test items. Place a nitrite treated swab/filter paper square on each of the four corners of the emulsion-coated side of the chemically treated photographic paper. Cover with a piece of filter paper and then 15% acetic acid-soaked cheesecloth and iron as described below (step “d”). An orange color should appear at each corner, confirming nitrite sensitivity (positive control) and no other orange reactions should be present (negative control).
- b. Place the evidence or known-distance test questioned side down on the emulsion-coated side of the treated photographic paper. Index seams, buttons, button holes, rips, pockets, suspected bullet holes, tears, cuts, etc., for possible future reference in court by marking with a lead pencil.


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DO NOT USE INK at this point because it may transfer back onto the tested item.

- c. Nitrite controls will be used on the treated photographic paper used for evidence testing. This can be done by placing a nitrite test swab/treated filter paper square on at least one corner of the treated photographic paper (under the evidence/test item) or by dabbing an acetic acid moistened square or swab on a corner of the paper and observing a positive reaction.
- d. Soak a piece of nitrite-free cheesecloth in the 15% acetic acid solution (in a large beaker) and wring it out. Place the cheesecloth on the questioned item or known-distance test as the third layer on the “sandwich”. Cover the cheesecloth with filter paper and press the “sandwich” with a hot iron. On many irons the setting for “cotton” is appropriate. Note: That nitrite-contaminated cheesecloth will cause a generalized orange background coloration. Although undesirable, this is not a fatal flaw as long as individual point reactions are still visible against the background.
- e. Discard the cheesecloth and separate the questioned item or known-distance test-firings from the photographic paper. Any orange indications on the paper are the result of a chromophoric reaction chemically specific for the presence of nitrite residues. Note that such reactions for nitrite residues may indicate visible nitrite sources (partially burned gunpowder), nitrite deposits which cannot be visually observed, or nitrite-coated unburned powder particles. While it is also possible that in a given case a spurious source of nitrite residues (not firearms-related) could be introduced. It is unlikely that it would alter the meaning of the total array of point reactions around a suspected bullet hole. Often such spurious nitrite sources are manifested as background haze in the test media as opposed to an array of point reactions. In view of these factors, it is normally not productive and often not possible to attempt to relate a given positive point reaction on the test medium to a corresponding visible point source on evidence items.
- f. Document any photographic paper showing positive results as a part of the raw data for inclusion in your notes. When dry, the photographic paper shall be marked appropriately in ink with your initials and case/file number.

3. Procedure for a reverse Modified Griess Test for thick or otherwise non-porous materials through which the acetic acid solution “steam” will not penetrate

- a. Tape a piece of filter paper or other appropriate nitrite-free substitute to the back of a piece of desensitized and treated photographic paper. Test as usual using the nitrite test swabs/treated filter paper squares.
- b. Place the photographic paper emulsion side down on the questioned surface and use a pencil to index seams, buttons, suspected bullet holes, pockets, rips, tears, cuts, etc., for possible future courtroom reference.
- c. Wipe the emulsion-coated side of the photographic paper with a piece of cheesecloth saturated with a 15% acetic acid solution. Apply the solution to the entire surface, but lightly. Too much will cause indistinct or hazy results due to pigment migration.

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- d. Immediately place the photographic paper emulsion side down on the questioned surface. Apply a hot iron to the back of the photographic paper. Note that the back should be covered by filter paper or an appropriate substitute; otherwise the paper may stick to the iron.
- e. Separate the photographic paper and the questioned item. Any orange indications on the photographic paper are the result of a chromophoric reaction chemically specific for the presence of nitrite residues.
- f. When dry, mark and document any positive results as in the previously described normal Modified Griess Test.

The Sodium Rhodizonate Test

1. Preparation of the Sodium Rhodizonate Solution


- a. Mix a small amount of sodium rhodizonate in water in an appropriate container to make a saturated solution approximately the color of strong tea. The solution is saturated if a slight sediment is noted on the bottom of the container. Make only enough solution for immediate use and do not store the solution. The shelf life beyond immediate use is currently unknown.

2. Procedure for a Sodium Rhodizonate Test - Direct application to an item of evidence

- a. Positive and Negative control testing shall be performed prior to testing the evidence or known-distance test items. Use a lead standard to “mark” a blank piece of filter paper and treat as described below (steps b-d). A blue-violet should appear at the “mark” confirming the presence of lead (positive control). No other color reactions should appear (negative control).
- b. Spray the appropriate area of the questioned item with a previously prepared saturated solution of sodium rhodizonate in water.
- c. Spray the same area of the questioned item with the previously prepared tartaric acid/sodium bitartrate buffer solution. This solution will eliminate the general yellow background color caused by the sodium rhodizonate, establish a local pH of 2.8, and turn any lead and a few other metals which may be present to a pink color. Document any positive result.
- d. Test or treat a representative area with 5% hydrochloric acid solution. The presence of lead is specifically determined wherever the previous pink color fades out and leaves a blue-violet color in its place. This indicates lead and only lead. Be aware of the fact that a positive (blue-violet) result may abruptly fade. Document the reaction immediately after applying the dilute hydrochloric acid solution.

3. Procedure for the Bashinski transfer method (for dark-colored items which would mask the blue-violet coloration of a positive test result)

- a. Place a piece of filter paper over the appropriate area of the questioned item.
- b. Index the filter paper relative to the garment or other item to indicate the location of suspected bullet holes, seams, buttons, button holes, pockets, rips, tears, etc. for possible future reference in court. Indexing in pencil is

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preferable in that this will preclude the bleeding of ink pigments during the application of reagents.

- c. Uniformly dampen the filter paper while on the questioned item by spraying with a 15% solution of acetic acid or can dampen the filter paper and then place the filter paper on the area in question. As previously noted, if the Modified Griess Test is performed, it must be done before the Sodium Rhodizonate Test.
- d. Cover the dampened filter paper with several layers of dry filter paper. Apply a hot iron to the filter paper and iron until the paper is dry. Can also remove filter paper while wet, if the paper has been held for a sufficient amount of time.
- e. Remove the filter paper which was in direct contact with the evidence item and process it as in the direct application method. Note that any positive (blue-violet) indications are a "mirror image" of the deposition on the questioned item.
- f. Note what is indicated by the positive result: vaporous lead, particulate lead, "bullet wipe", or a combination of these lead residues. Prompt documentation is essential in that sometimes, positive results can/do fade rapidly and unpredictably. When dry, this filter paper will be appropriately marked in ink for future identification with your symbol or initials and case/file or other identifying numbers.


4. Procedure for a Sodium Rhodizonate test - Standard transfer method (normally a last resort)

- a. Process the questioned item with sodium rhodizonate.
- b. Blot the appropriate area of the questioned item using untreated filter paper.
- c. Note and document any positive results.

NOTE: For the Sodium Rhodizonate test, whichever of the above methods (2-4) is deemed most appropriate for the particular evidence being processed shall be applied to the test media as well.

The reagents, test media preparations, and procedures for these tests are outlined in the references listed in Section 7.01 – Recipes.

Examiners are reminded that they are responsible for knowing the requirements and safety practices outlined in the LVMPD Forensic Laboratory Safety Manual Chemical Hygiene Plan 3.4. Examiners are also responsible for knowing the health hazards involved in the use of the chemicals named above. These chemicals and their hazards can be found in the Material Safety Data Sheets/Safety Data Sheets that are on file in the laboratory.


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LVMPD FORENSIC LABORATORY TECHNICAL OPERATIONS MANUAL FIREARMS DETAIL

4.04 Title: **SHOTGUN/STIPLING PATTERN RANGE DETERMINATION**

In order to perform a muzzle-to-target distance determination involving a shotshell pellet or stippling pattern, it is necessary to produce patterns similar to those present on the evidence items. This is accomplished by shooting test patterns at varying distances for comparison to the pellet/stippling pattern present on the evidence item. It is an essential prerequisite that the evidence firearm, and ammunition consistent with the evidence ammunition, be utilized for production of the test patterns. The following steps will be followed for this examination:

- Tests will be shot one pattern per piece of target media.
- The test media for shotshell pellet/stippling test patterns is an appropriately sized cardboard target backer, paper, poster board or similar material which visualizes the actual pellet/stippling pattern in a safe reproducible manner.
- A minimum of two test shots should be made at each distance to account for variability in shot-to-shot pattern size.
- Test patterns will be shot in increasing or decreasing range increments until a distance is established, both shorter and longer, than that which produces a pellet/stippling pattern similar to that on the evidence item.
- This bracketing technique is necessary to determine at what distance a smaller known pattern is consistently produced and at what distance a larger known pattern is consistently produced.
- Comparison of pellet/stippling patterns can be done using one or more of the following methods:
 - Visual (side-by-side) comparison of test and evidence pellet/stippling patterns
Note: Overlays and scaled photographs can also be used for the side-by-side comparisons
 - Comparison of measured pattern sizes
 - Use of the "performance envelope" of the shotgun/ shotshell combination. This can be done by a graphical analysis of the data collected from the test-firing process.
- Document all observations and conclusions in the case notes. Documentation of the evidence patterns will include notes, and photographs or overlays. Documentation of the test patterns will include notes; photographs and/or overlays; tables and/or graphs.
- The distance determination conclusion will be reported as a minimum and maximum distance based on the bracketed test patterns noted above.
- Stippling patterns will be examined in a fashion analogous to shotgun patterns. Pictures depicting stippling patterns with scale can be compared to test patterns fired into Benchkote (or similar) test media with the filter side facing the shooter.

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LVMPD FORENSIC LABORATORY TECHNICAL OPERATIONS MANUAL FIREARMS DETAIL

4.05 Title: **CARTRIDGE CASE EJECTION PATTERNS**

A cartridge case ejection pattern examination is used to determine where a particular firearm ejects the fired cartridge cases under specific test conditions. Variables affecting the ejection pattern of fired cartridge cases include, but are not necessarily limited to, the firearm, the type of ammunition, the shooter's grip on the firearm, the location and orientation of the firearm, and the surface on which the cartridge case lands.

PROCEDURE FOR PERFORMING A CARTRIDGE CASE EJECTION PATTERN

- The same firearm and ammunition represented in the shooting scenario should be used in the testing.
- The firearm must be fired from the same location for each shot. The firearm must also be fired in the same direction for each shot toward a reference point, with the barrel parallel to the ground.
- X-Y coordinates can be laid out on the ground for subsequent plotting of either the impact point or final resting point of each expended cartridge case, or to determine the angle of ejection from the point of aim and the distance the cartridge ejects from the pistol.
- A minimum of two full magazines or ten shots will be fired to generate an ejection pattern.
- If needed, multiple series of shots can be carried out varying one parameter at a time, such as height of the gun, firm vs. loose hold on the gun, pointing the firearm in a different orientation, speed of firing shots, or varying the surfaces (e.g., pavement vs. grass). The use of a tripod or similar device is recommended for maintaining position of X, Y and Z coordinates.
- The limiting factors in a cartridge case ejection pattern determination may be included in the report at the discretion of the examiner.

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5.0 Title: REFERENCE COLLECTION

Reference collections are required to assist the Firearms personnel to properly accomplish the mission of providing the examination and analysis of submitted evidence. These collections include the firearm reference collection and the ammunition reference collection


The firearms reference collection is tracked using the Departments WASP based inventory tracking system.

The ammunition / reference collection is tracked with barcode labels utilizing a database located on the H:drive.

The reference collections will be maintained, updated and evaluated by the members of the Firearms Detail.

If reference collection items become damaged beyond use, they will be removed from the collection.

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6.0 Title: **TRAINING**

The following guidelines will be used for technical training of personnel in the Firearms Detail.


All other training issues will follow the guidelines set forth in the LVMPD Forensic Laboratory Quality Manual.

All training in the Firearms Detail will be conducted and supervised by personnel qualified in all of the procedures of this manual at the level of Forensic Scientist II and higher.

Training programs and outlines should be flexible and attempt to address the infinite variables involved in modern forensic firearm identification.

To ensure the accuracy and completeness of training, the following recommendations are made:

- a) The use of the AFTE glossary for appropriate definitions.
- b) The use of appropriate manufacturers' nomenclature for describing firearm parts and ammunition components.
- c) The use of an established training manual.
- d) Documentation of completed training to be retained by the laboratory and trainee.
- e) Peer review of the training prior to completion by an examiner other than the primary trainer at regular established intervals with the following goals:
 - To ensure documentation is complete.
 - To evaluate strengths and weaknesses in a timely manner.
 - To evaluate testimony.
 - To determine if the trainee has reached an acceptable level of performance.
- f) The training goals are:
 - To provide the Firearm Examiner trainee with a high level of confidence in his/her ability to perform the job procedures.
 - To ensure the laboratory system that the trainee is producing a high-quality verifiable work product.
 - To ensure the judicial system benefits from professional, ethical, and honest interpretation and reporting of firearm evidence.

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7.01 Title: RECIPES

Fill in the blank recipe forms for the following reagents are available in the Firearms Forms folder located in Qualtrax. These forms include preparation instructions and define the expiration date for each reagent. Note: The reagents used in the Firearms Detail do not require special storage conditions and are stored in appropriate containers at room temperature. Quality control checks for these reagents are performed at the time of use to verify that the reagent is working as expected and the results are documented in the case file. The manner in which this is to be completed for each reagent is detailed on the applicable worksheet. If a reagent with an assigned internal lot number fails to give the expected result after a repeated QC check, discard the reagent, remake it, and document it in the Reagent Preparation Log in the Resource Manager.

7.01 / 01 Cleaning

Booker Dip

25 mL ammonium hydroxide
25 mL oleic acid
450 mL water

Peroxide-Acetic Acid Bullet Cleaner

10 mL acetic acid
2 mL hydrogen peroxide (30%)
70 mL water

7.01 / 02 Distance Determination

Griess Reagent


Prepare a solution of 0.5 grams of sulfanilic acid in 100 mL of deionized water (Solution "A").

Prepare a solution of 0.28 grams of alpha-naphthol in 100 mL of methanol (Solution "B"). Combine the equal volumes of the above solutions at the time of testing.

Expiration date: two months from the reagent preparation date (combined A & B)

Preparation of nitrite test swabs/filter paper

1. Prepare a solution of 9.3 grains (0.6 grams) of sodium nitrite in 100 milliliters of distilled water.
2. Soak the cotton-tipped ends of six-inch swabs or filter paper in the solution.
3. Use immediately or set the swabs/filter paper aside to dry. Once dry, cut the filter paper into small squares. Store the swabs/filter paper in a sealed container.
 - a. Expiration date: Six months from reagent preparation date.

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2.8 pH BUFFER - Na Bitartrate/Tartaric Acid

Dissolve 1.9 grams of sodium bitartrate and 1.5 grams tartaric acid per 100 mL of deionized water. This usually requires both heat and agitation to complete in a reasonable period of time.

5% HCl

5 mL concentrated hydrochloric acid
95 mL deionized water

15% Acetic Acid

150 mL of glacial acetic acid
850 mL of deionized water

7.01 / 03 Serial Number Restoration Solutions for Acid Etching

Steel

Heyn's Solution

Cupric ammonium chloride	1 gram
Con. Hydrochloric acid	12 mL
Deionized water	12 mL

Fry's Solution

Cupric chloride	90 grams
Con. hydrochloric acid	120 mL
Deionized water	100 mL

Alternative solutions:

Cupric chloride	5 grams
Ethanol	25 mL
Con. hydrochloric acid	40 mL
Deionized water	30 mL

Ferric chloride	6 grams
Deionized water	100 mL


Ammonium persulfate	10 grams
Deionized water	100 mL

Cast Iron

Heyn's solution (as above)
Ammonium persulfate (as above)

Stainless Steel

Ferric chloride	5 grams
Con. hydrochloric acid	50 mL
Deionized water	100 mL

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Alternative Solution:

Ferric chloride	25 grams
Con. Hydrochloric Acid	25 mL
Water	100 mL

Zinc Alloys

Solution #1

Phosphoric acid (85%)	98 mL
Con. nitric acid	2 mL

Solution #2

Con. nitric acid	5 mL
Water	95 mL

Solution #1 is applied for 10 seconds, then wiped off. Solution #2 is then applied, and the number should appear within 30 seconds. See the AFTE article written by Mike Knowles.

Aluminum

Sodium hydroxide	5 grams
Deionized water	100 mL

Alternative Solution:

Heyn's solution (as above)	1 part
Deionized water	5 parts

Copper Alloys

Nitric acid from concentrated to various dilutions with water. (Depends on the rate of reaction for the particular alloy.)

Nickel Alloys


Con. nitric acid	5 mL
Deionized water	95 mL
Accelerated by DC voltage	

Brass

Sodium sulfate	1.5 grams
Chromic acid	20 grams
Deionized water	100 mL


Lead Alloys

Molybdc acid	100 grams
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Ammonium hydroxide	140 mL
Deionized water	240 mL
filter then add	
Con. nitric acid	60 mL

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7.02 Title: **WASTE DISPOSAL PROCEDURE**

The Firearms Detail strives to comply with safe environmental practices by adhering to the following:

- Dispose of liquid waste in the appropriate container that is stored under the chemical hood in the GSR Room.
- Keep used swabs separated (those used with acids from bases) and dispose of the swabs in the correct **solid** waste bin located in the Chemical Storage Room, attaching a disposal sheet as necessary.
- New waste bottles must be marked either “Base Waste” or “Acid Waste” and indicate the first date that waste is added.
- Mark the appropriate chemical or reagent on the appropriate disposal sheet.
 - Current disposal sheets should be taped to the glass of the chemical hood.
 - Sheets are located under the hood or can be printed from <H:\Criminalistics\Forensics\General\SAFETY DETAIL INFO\Safety\Waste Logs>
 - Reagents or chemicals can be added to the printed disposal list as needed.
- Waste bottles must be disposed of within a year from the start date by placing it in the appropriate liquid waste bin in the Chemical Storage Room, along with the current disposal sheet.

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7.03 Title: **ABBREVIATIONS**

The firearms industry is notable in its use of acronyms and abbreviations. Many are common and can be considered universally understood within the field and therefore are not listed below. When abbreviations are used in reports, they should always be defined at their first appearance.

Abbreviations are used in note taking. A number of commonly used abbreviations are listed here for convenience. Other new or not readily discernible abbreviations will be defined in notes.

#(R/L)	number of lands & grooves and direction of twist (right/left)
AFTE	Association of Firearms and Tool Mark Examiners
Amb/ambi	ambidextrous
amt	amount
AP	armor piercing
approx.	
or approx	approximate
Assoc	association
auto	automatic
BATFE	Bureau of Alcohol, Tobacco, Firearms and Explosives
bbl	barrel
bc or b/c	bar code
BEB	brass enclosed base
BF	breech face
bk	back
bl	blue/blued
blk	black
BLS	blood-like substance
BM	bunter mark
BP	black powder
BT	boat tail
bu	bullet
cal	caliber
cap	capacity
cart	cartridge
cc	cartridge case
char	characteristics
cl	class
CM	chamber marks
CMS	consecutive matching stria
comp	comparison/compare
const.	construction
cont	contain, contained, containing
cpv	clear plastic vial

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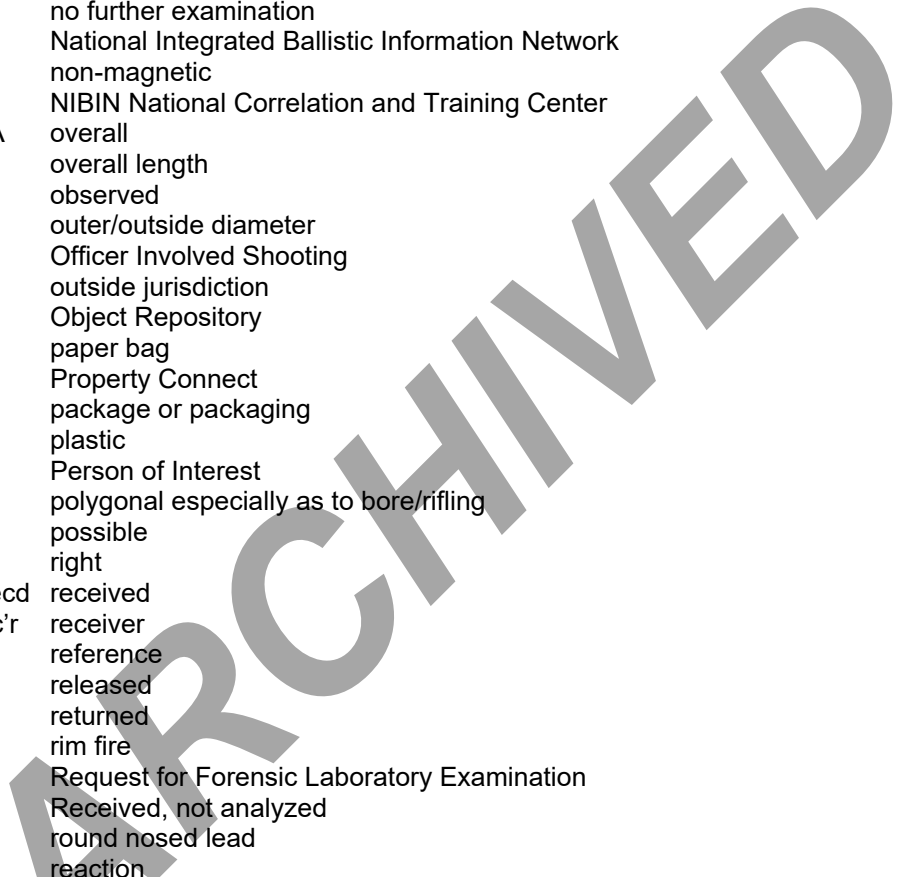
CW, C/W or C.W.

	consistent with
Cyl	Cylinder
DA	double action
DAO	double action only
dbl	double
dia. or dia	diameter
e-tape	evidence tape
ejr	ejector
elim	elimination
env	envelope
epm	ejection port mark
EV#	Event number
evid	evidence
exp	exposed
ext	extractor
fm	feed marks
FA	Firearm(s)
FRED	Forensic Request and Examination Database
FMJ	full metal jacket
Fp	firing pin
fpi	firing pin impression
frag	fragment
frt	front
FTE	failure to eject
FTF	failure to fire
fxn or fxns	function/functional/functions
G	groove
GDHP	Gold Dot Hollow Point
GI or GIMP	groove impression
GIW	groove impression width
gp	gunpowder
gr	grain
GRC	general rifling characteristics
GSR	gunshot residue
hemi	hemispherical
HP	hollow point
HS	headstamp
IBIS	Integrated Ballistics Identification System
ID	inside diameter/identification
ifo	in front of
imp	impression
inc	inconclusive
ind or indiv	individual
insuff	insufficient
int	interior
inv	inventory
JHP	jacketed hollow point
JKT	jacket
JSP	jacketed soft point
K	knurled
L	land or left or long
lf or lft or lt	left
LI or LIMP	land impression



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LIMS	Laboratory Information Management System
LIW	land impression width
LLM	Leica Live Measure Software
LR	long rifle
LRN	lead round nose
mag	magazine or magnum
ME	manila envelope
mfg	manufactured or manufacturer
NaRho	sodium rhodizonate
NCV	no comparison value
NFE	no further examination
NIBIN	National Integrated Ballistic Information Network
nm	non-magnetic
NNCTC	NIBIN National Correlation and Training Center
OA or O/A	overall
OAL	overall length
obsv	observed
OD	outer/outside diameter
OIS	Officer Involved Shooting
OJ	outside jurisdiction
OR	Object Repository
PPB	paper bag
PC	Property Connect
pkg	package or packaging
pl or plas	plastic
POI	Person of Interest
poly	polygonal especially as to bore/rifling
poss	possible
R or rt	right
rec'd or recd	received
recr or rec'r	receiver
ref	reference
rel'd	released
ret'd	returned
rf	rim fire
RFLE	Request for Forensic Laboratory Examination
RNA	Received, not analyzed
RNL	round nosed lead
rxn	reaction
S	smooth or short or sealed
SA	single action
Sgp	smokeless gunpowder
sig	significant
sim	similar
SJHP	semi jacketed hollow point
slt	slight
SN	serial number
sngl	single
soln	solution
SP	soft point
spl	special
STHP	silver tip hollow point
stc	said to contain
std	standard





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stk	stack
SST, sst	Shotspotter
suff	sufficient
supp	supplemental
SWC	semi wad cutter
T	tracer or test
TC	truncated cone
TF	test fired or test fire(s)
tg	trigger guard
TM	toolmarks
TMJ	total metal jacket
trig	trigger
tw	total weight
und	under or underneath
UR	Unit Record
vis	visible
vs	versus
WC	wad cutter
w/in	within
WS	worksheets
wt	weight
zl or z/l	ziploc

Additional common abbreviations from NCIC, common units of measurement, manufacturer's designations, standard chemical and mathematical abbreviations and symbols, as well as common government abbreviations may be used without being listed above.

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7.04 Title: QUALITY CONTROL PLAN


	Instrument	Frequency	Criteria	Corrective Action
Balances	FA # 3 Dillon Precision D-Terminator Grain Scale #1019101050299	External: Annually Precise Weighing Systems (661) 250-9044 Mettler Toledo, Inc. 1-800-523-5123 ASTM 1 weight sets are available to laboratory personnel if they wish to check the balances at any time	Meet external vendor criteria Vendor certificates for all balances are kept in Resource Manager	If a balance is not operating properly: 1. Tag out of use 2. Advise Laboratory Manager to arrange for repair 3. Document problem on a Corrective Action Report if needed
	FA # 4 Dillon Precision D-Terminator Grain Scale #1019101050166			
	FA # 5 Dillon Precision D-Terminator Grain Scale #1019101050074			
	FA # 6 Dillon Precision D-Terminator Grain Scale #1054240970440			
	FA # 7 Dillon Precision D-Terminator Grain Scale #1093310790062			
Fume Hoods	FA # 2 Labconco Model: 722801003726 Serial # 981160459	External: Annually For annual certification: Vendor Options: Controlled Environment Management (480) 836-4144	Meet external vendor criteria Vendor certifications are kept for all fume hoods in the "Fume Hoods" binder in the Quality Manager's	If a fume hood is not operating properly: 1. Tag out of use 2. Advise Laboratory Manager

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	Instrument	Frequency	Criteria	Corrective Action
	Snorkel – FA#1 Nederman Model # CTR 05240-00 Serial # ART 70502134	For repairs and maintenance: Vendor Options: Thomas and Mack 896-7035	office or in Resource Manager.	
Calipers, Micrometers & Thickness Gauges	FA # 2 Mitutoyo Calipers (manual) (Formerly RG #1)	External: Annually Critical Service For annual calibration: Vendor options: CAL-LABS 1-800-373-1759 Heusser Neweigh, LLC 1-925-798-8900 Integrated Service Solutions, Inc. 1-610-287-3433	Meet external vendor criteria. Vendor certificates are kept in Resource Manager	If the calipers or micrometers do not meet criteria: 1. Tag out of use 2. Replace 3. Document problem on a Corrective Action Report if needed
	FA # 3 Aerospace Calipers (manual) #0708085			
	FA # 5 Mitutoyo Calipers (electronic) #0263086			
	FA # 7 Mitutoyo Thickness Gauge #353770			
	FA # 8 Mitutoyo Thickness Gauge #249081			
	FA # 10 Mitutoyo Thickness Gauge #7304S; FBK 161			
	FA # 11 Mitutoyo Thickness Gauge #7304S; FBK 100			
	FA # 15 Mitutoyo Thickness Gauge #73045			
	FA # 16 Mitutoyo Digital Caliper #07089475			

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	Instrument	Frequency	Criteria	Corrective Action
	FA # 17 Mitutoyo Digital Caliper #05065572			
	FA #19 Mitutoyo Electronic Micrometer #07379766			
	FA #20 Mitutoyo Electronic Micrometer #45235974			
	FA #21 Mitutoyo Electronic Micrometer #45246612			
	FA #22 VWR Electronic Caliper #111604360 (Formerly Trace #1)			
	FA #23 Starrett Digital Micrometer #03031602 (Formerly LP #1)			
	FA #24 Mitutoyo LCD Ruler Model 1600 Serial #170085 (Mounted on comparison microscope FA #20)			
FA #25 Mitutoyo LCD Ruler Model 1600 Serial #170063 Mounted on comparison microscope FA #21)	Preventative Maintenance Agreement for two years from date of install (11/20/2018)			
Measuring Devices	Starrett 48" Steel Rule Model # C404R-48 Serial # 13432092 NIST Test # 683/282436	External: Every five years Critical Service Steel Rules will be calibrated or replaced every five years	Must meet external criteria for NIST Traceability QC information is maintained for the NIST Traceable Steel Rule in the Resource Manager in LIMS	If the Steel Rule appears to be damaged or exhibit any characteristics that may affect accuracy: 1. Tag out of use 2. Replace
	Starrett 48" Steel Rule Model # C604R-48 ID # PY1406-15	Vendor Options: Transcat www.transcat.com 800-800-5001 Starrett www.starrett.com 978-249-3551		

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	Instrument	Frequency	Criteria	Corrective Action
	Starrett 18" Steel Rule #FA 18A	Heusser Neweigh, LLC 1-925-798-8900		
	Starrett 18" Steel Rule #FA 18B	CAL-LABS 1-714-522-8915 Integrated Service Solutions, Inc. 1-610-287-3433 No internal calibration or maintenance is performed		
	FA #26 Fluke 414D Laser Distance Meter Serial # 42480233	External: Annually Vendor: Integrated Service Solutions, Inc. (610) 287-3433 www.integratedservicesolutions.com Global Test Supply (888) 610-7664 www.GlobalTestSupply.com	Meet external vendor criteria. Vendor certificates are kept in Resource Manager	If the laser meter does not meet criteria: 1. Tag out of use 2. Replace 3. Document problem on a Corrective Action Report if needed
Gauge Blocks	FA #2 1" Mitutoyo Gauge Block (Micrometer Standard)	External: Every five years Critical Service Micrometer standards will be calibrated or replaced every five years	Must meet external criteria for NIST Traceability QC information is maintained for the NIST Traceable Micrometer standards in the Resource Manager in LIMS	If the Micrometer standard appears to be damaged or exhibits any characteristics that may affect accuracy: 1. Tag out of use 2. Replace
	FA #3 1mm Mitutoyo Gauge Block (Micrometer Standard)	Vendor Options: Mitutoyo (through VWR) CAL-LABS 1-800-373-1759 Heusser Neweigh, LLC 1-925-798-8900		
Reference Weights	FA # 4 Dillon 50-gram weight (with balance FA # 3)	Internal: One time, performed with NIST certified weight sets	Internal: These weights are considered a reference only, there are no legal issues concerning data	If the reference weight appears to be damaged or

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	Instrument	Frequency	Criteria	Corrective Action
	FA # 5 Dillon 50-gram weight (with balance FA # 4)		obtained QC information is maintained in the Resource Manager in LIMS	exhibits any characteristics that may affect accuracy: 1. Tag "Out of use" 2. Replace
	FA # 6 Dillon 50-gram weight (with balance FA # 5)			
	FA # 7 Dillon 50-gram weight (with balance FA # 6)			
	FA #10 Dillon 50-gram weight (with balance FA #7)			
	Trigger Pull weight sets ¼ lbs to 5 lbs FA #1 (red) FA #2 (yellow) FA #3 (blue)	<p>Critical Service</p> <p>External: Every five years</p> <p>Note: Any event leading to significant/visible damage of the weights requires an internal performance check of the affected weight(s) on a calibrated balance. Use "Trigger Pull Weight Verification Log" Form found in H:\LaboratoryForms\ QC Checks</p> <p>Heusser Neweigh, LLC 1-925-798-8900</p> <p>Quality Control Services, Inc. 1-800-843-1237</p>	<p>External/Internal: +/- 2%</p> <p>External vendor certificates are kept in Resource Manager</p>	<p>If the trigger pull weights do not meet criteria:</p> <ol style="list-style-type: none"> 1. Repeat test 2. Adjust/repair if possible 3. Tag out of use 4. Document problem on a Corrective Action Report if needed
Microscopes	FA # 1 Meiji Techno Model: EMZ-8TR Serial # 410234	<p>External: Annually</p> <p>McBain Systems (805) 581-6800</p> <p>Western Scientific Company, Inc. (WESCO) 1-661-295-5040</p>	<p>Meet external vendor criteria</p> <p>Vendor certificates for all microscopes are kept in the Quality Assurance Standards binder in the Quality Manager's Office or in</p>	<p>If a microscope is not operating properly:</p> <ol style="list-style-type: none"> 1. Tag out of use 2. Advise Laboratory Manager to arrange for repair
	FA # 2 Meiji Techno Model: EMZ-TR LVMPD # 32549 Serial # 58334			



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Instrument	Frequency	Criteria	Corrective Action
FA # 3 Meiji Techno Model; EMZ-TR LVMPD # 30851 Serial # 58276		Resource Manager	
FA # 5 Meiji Techno Model: EMZ-8TR Serial # 410232			
FA # 6 Meiji Techno Model: EMZ-TR LVMPD # 30871 Serial # 49128			
FA # 7 Meiji Techno Model: EMZ-TR LVMPD 3 30853 Serial # 58253			
FA # 8 Meiji Techno Model: EMZ-TR Serial # 71447			
FA # 9 Leica Model: FSC LVMPD # 51694 Serial #11581051/284670			
FA # 10 Leica Model: FSC LVMPD # 51690 Serial #11581051/283092			
FA # 11 Reichert Model: K2700LF LVMPD # 26091 Serial # 144			
FA # 12 Leica Model: K2700 LVMPD # 34005 Serial # 319			


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	Instrument	Frequency	Criteria	Corrective Action
	FA # 13 Leica Model: K2700 Serial # 332			
	FA # 15 Leica Model: FSC LVMPD # 10838 Serial # 319553			
	FA #16 Leica Model: S6E / KL1500LCD Serial # 241984			
	FA #17 Leica Model: FSC Serial #442698			
	FA #18 Meiji Techno Model EMZ-TR LVMPD #26090			
	FA #19 Olympus Serial #4G01060			
	FA #20 Olympus Model LCF3/Leeds Serial #489032 LVMPD #19806	External: Annually Leeds Precision Instruments, Inc./Leeds Forensic Systems (763)-398-7126 Preventative Maintenance Agreement for two years from date of install (11/20/2018)		
	FA #21 Olympus Model LCF3/Leeds Serial #489033 LVMPD #19807			

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	Instrument	Frequency	Criteria	Corrective Action
Other Instrumentation	Innov-X Energy Dispersive X-ray Spectrometer Model α4000SL Serial #6845	Internal: Before each use and every four hours while in use Additional standardization is at the user's discretion	Must meet the manufacturer's recommendations as outlined in their documentation	If the ED-XRF will not standardize after following all software and manufacturer's instructions, the user should: 1. Contact the Innov-X service center for assistance 2. Tag out of service 3. Advise the Laboratory Manager to arrange for repair 4. Document problem on a Corrective Action Report if needed
	Larson-Davis Sound Level Meter Model 820SLM Serial #1622	Internal: The sound level calibrator will be used before each series of sound level measurements. Its use is described in the Sound Level Meter Reference Manual	See the model 820 User's Manual, Chapter-Calibration Original certificate of Calibration and Conformance maintained by the Quality Manager or in Resource Manager	When the Sound Level Meter will not calibrate properly: 1. Follow the instructions in the Reference manual on adjusting the meter 2. Tag out of service 3. Advise the Laboratory Manger to arrange for repair 4. Document problem on a Corrective Action Report if needed
	Larson-Davis Sound Level Calibrator Model CAL200 Serial #5124	External: Annually Vendor: Larson Davis (888) 258-3222 or (801) 375-0177	To meet external vendor's criteria Certificate of Calibration and Conformance maintained by the Quality Manager or in Resource Manager	

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	Instrument	Frequency	Criteria	Corrective Action
	Leica measuring tool (software)	<p>External: Upon installation of the software</p> <p>Annually</p> <p>It will also be checked after microscope maintenance or repair, after software reloads or at the analyst's discretion</p>	The measuring tool must give the correct measurement within specified tolerances when using the calibration standard (Leica part 11581080)	<p>If the measured result falls outside the specified tolerance:</p> <ol style="list-style-type: none"> 1. Follow the manufacturer's recalibration / trouble shooting procedures 2. Tag out of service 3. Advise the Laboratory Manager to arrange for repair 4. Document problem on a Corrective Action Report if needed
	SPOT Imaging Software (Installed on comparison microscopes FA #20 and FA #21)	<p>External: Upon installation of the software</p> <p>Annually</p> <p>It will also be checked after microscope maintenance or repair, after software reloads or at the analyst's discretion</p>	The measuring tool must give the correct measurement within specified tolerances when using the calibration standard	

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7.05 Title: REFERENCES

A technical reference library (books, periodicals, etc.) is maintained in the Firearm Detail. In addition, the scientists in the Detail who are members of the Association of Firearm and Tool Mark Examiners (AFTE) have access to the resources available on the Association website (afte.org). Other resources on the internet are available but their veracity must be verified before being considered for use.

In addition, the following specifically mentioned references are available in Qualtrax:

Knowles, Mike - *Instant Recovery of Obliterated Serial Numbers*, AFTE Journal, Vol. 17, No. 3, July 1985;

Dillon, John H., *The Modified Griess Test: A Chemically Specific Chromophoric Test for Nitrite Compounds in Gunshot Residues*, AFTE Journal, Vol 22, No. 3, July 1990;

Dillon, John H., *The Sodium Rhodizonate Test: A Chemically Specific Chromophoric Test for Lead Compounds in Gunshot Residues*, AFTE Journal, Vol 22, No. 3, July 1990;

Dillon, John H., *A Protocol for Gunshot Residue Examinations in Muzzle-to-Target Distance Determinations*, AFTE Journal, Vol 22, No. 3, July 1990.

Dillon, John H., *Graphical Analysis of the Shotgun/Shotshell Performance Envelope in Distance Determination Cases*, AFTE Journal, Vol 21, No. 4 October 1989


Treptow, Richard S., *Handbook of Methods for the Restoration of Obliterated Serial Numbers*, NASA, January 1978. To order, contact: Stanley G. Young, Project Manager, Materials & Structures Division, NASA Lewis Research Center, Ohio 44135 (Grant NSG 3036 (3030); NASA Contract Report CR-1353)

Manufacturer/Instrument Manuals

The following Manufacturer's/Instrument Manuals are located in Qualtrax:

Innov-X Systems XRF Manual-August 2005/Version 2.1

Crest Ultrasonic Model F1436T Cleaning and Lubricating System - Rev. B 2/23/2007

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LAS User Manual - version 3.3/2008 (on CD)

Larson Davis Model 820 Sound Meter - Rev. C/2003

P.A.C.T. Timer & Chronograph - 2005

Oehler Model 35P Chronograph - 1991

CyberNational Bullet Recovery System

Dillion D-Terminator Electronic Scale - V2.0/2002

Leica FSC Operating Manual – 2003

Lightning Bullet Catcher - Kevlar Trap

Perma Gel ballistic gelatin

Stack-On Safe

Presto PL and RL Series Hydraulic Lift Table

Ransom Master Series handgun rest

Minuteman X829 Series Vacuum


Shooting Ranges International Quick Range

Dillon's D-Terminator Electronic Scale V 2.0

The AFTE Glossary

*The AFTE Glossary is available at:

<https://afte.org/members/afte-manuals>

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7.06 Title: **Ballistics Laboratory/Modular Shooting Range Maintenance & Clean-up Procedure**

The Ballistics Laboratory/Modular Shooting Range (MSR) should be cleaned and maintained to minimize lead exposure, to ensure the traps are in suitable condition, and to ensure the floor remains clear of firearms-related debris. The cleaning and maintenance of the Ballistics Laboratory/MSR will be logged on the Range Maintenance Log, and the recyclable lead and lead contaminated waste will be logged on the Lead Waste Log. Blank and completed logs are stored in Qualtrax, and the active logs will be maintained in the H:Drive under H:\CB\Forensic\Firearms\Indoor Ranges\Range Maintenance & lead waste. The proper cleanup procedure will be followed as closely as possible to minimize exposure to lead. A sign shall be displayed on the door to the range indicating that the range is closed during maintenance.


- Approved personnel will don a respirator or gas mask that has been fit tested, disposable gloves, and disposable Tyvek type coveralls suitable for lead particulate exposure.
- Range blowers will be turned on and the range doors will be closed during cleaning and maintenance to prevent lead contamination of neighboring areas.
- Appropriate skin cleaning will be done immediately following cleanup.

Cleaning and Maintenance Tasks

The following tasks are recommended to be completed when the Ballistics Laboratory/MSR are being used regularly. If the ranges have not been used regularly, the listed tasks may not all need to be performed. At a minimum, the range traps and curtains shall be inspected monthly for damage, use and wear. It shall be documented on the Range Maintenance Log that the range was inspected and that no further maintenance was performed due to the range not being used regularly.

Monthly Tasks

- In the main range area, any large debris will be picked up by gloved hands and placed into a plastic bag. The floor shall never be swept because it agitates the settled lead contaminates and increases the potential lead exposure for the person cleaning as well as others nearby.
- The range traps and curtain will be inspected for damage, paying particular attention to the central blade between the traps. Damage to the traps shall be documented on the Range Maintenance Log. If the damage includes deformation of the traps or dividing blade, the Detail Manager and/or Detail Safety Assistant will be notified to determine if repairs are necessary. If the range curtain is in disrepair, the curtain may be replaced.

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- The range traps should be cleaned and wiped down with a specialized cleaner for lead removal. Subsequently, the traps shall be lubricated with a thin coating of mineral or vegetable oil.
- The top layer of the contamination control mats on the floor outside the range may be disposed of at this time.
- Other waste generated from cleaning and maintenance, including any plastic bags, rags/towels, large debris from the range floor, contamination mats, gloves and coveralls will be placed in an appropriate waste disposal container (not in regular trash) and labeled as lead waste with a start and end date for hazardous waste disposal.

Bi-Monthly Tasks

- The area behind the range traps will be accessed to collect and remove lead from the buckets under the traps. Individually, the lid to the collection bucket will be raised and the level of the lead waste inspected prior to moving the bucket out from under the trap to prevent debris from falling on the floor. If necessary, a second bucket may be placed under the trap while the contents of the original bucket are transferred.
- The waste bucket lid will be removed to conduct a physical and visual inspection of the range trap interior to ensure that the traps are clear of debris. A picture will be taken from the mouth of the trap funnel(s) up into the trap to verify that the traps are clear of debris. When viewing this picture, if the traps are clogged, personnel shall remove the clog by hand or using a tool and allowing the debris to fall into a lead waste bucket.
- With the range blowers on and the rear access door closed, the lead waste may be transferred to a secondary container for disposal/recycling; OR the lead waste may be carried to the interior of the shooting range and transferred to a secondary container (bucket with a secure lid) with the range blowers on and the range door closed. The dust from the transfer should be allowed to settle (approximately 3 minutes) prior to opening the range doors. The lead waste from the trap collection will be placed in a bucket with a secure lid and transported to the main LVMPD Range for recycling. Prior to replacing the lead waste buckets under the trap, the exterior of the buckets shall be wiped down with lead cleaner to prevent contamination. The transfer container(s) (bucket with a secure lid) will also be wiped down to prevent contamination.

Additional cleaning measures may include the use of an approved explosion-proof HEPA vacuum. If a vacuum is used, the following instructions shall be followed:

- Only an explosion-proof HEPA vacuum suitable for range cleaning may be used.
- A sign shall be displayed on the door to the range indicating that the range is closed during maintenance.
- Approved personnel will don a respirator or gas mask that has been fit tested, disposable gloves, and disposable Tyvek type coveralls suitable for lead particulate exposure during this process.
- Range blowers will be turned on and the range doors will be closed during cleaning and maintenance to prevent lead contamination of neighboring areas.
- While vacuuming, the operator should work in one direction with the vacuum positioned between the operator and the trap end of the range. This will allow the

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blowers to move the potentially lead contaminated air away from the vacuum operator and therefore minimize potential exposure.

- After completion of cleanup, allow the vacuum to run for approximately 45 seconds to bring remaining lead particulates from the hoses and tools up and into the filter.
- The vacuum and attachments will be returned to their appropriate storage location.
- The HEPA Filter vacuum will be cleaned out when needed to minimize exposure, and in accordance with proper lead disposal procedures. The resulting waste will be placed in an appropriate waste disposal container (not in regular trash) and labeled as lead waste with a start and end date for hazardous waste disposal.
- Appropriate skin cleaning will be done immediately following cleanup.

Additional instructions on assembly, disassembly, cleaning, repair and service are available. Please refer to the product manuals which can be found in the Firearms Equipment Manuals folder in Qualtrax.

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