# OKLAHOMA STATE BUREAU OF INVESTIGATION

# FIREARMS & TOOLMARKS UNIT

# QUALITY & POLICY MANUAL

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# FIREARMS AND TOOLMARKS QUALITY MANUAL

## I. Scope

This manual details the quality assurance program in effect in the Firearm/Toolmark Unit (FATM) of the Oklahoma State Bureau of Investigation (OSBI). It is meant to be a source of information for firearm/toolmark personnel and should be referred to regularly. A system of continuous updating is built into the manual in accordance to OSBI Criminalistics Services Division (CSD) Quality Manual QP-2 – Document Control to allow changes to the documents as laboratory conditions change or as new regulations are disseminated.

If any portion(s) of this policy manual is/are unclear or if a circumstance arises outside the scope of this document, it is the responsibility of each individual to notify the FATM Technical Manager immediately to seek clarification/guidance and obtain approval. Disagreement with specific requirements or knowledge of changes causing deviation from the procedures should be discussed with the FATM Technical Manager before further work is completed. Laboratory personnel are encouraged to comment on the manual and make recommendations for more efficient procedures. The latest revision of the manual is the applicable rule.

NOTE: Hyperlink and attachment maintenance (removal, addition, or correction of hyperlinks and attachments) shall not constitute a new document revision.

## II. References

The following standards and recommendations guide the requirements set forth in this quality manual. If the reference listed does not include a date, the most recent revision of the referenced document applies.

ISO/IEC 17025:2017

ANSI National Accreditation Board (ANAB) – Accreditation Requirements for Forensic Testing and Calibration (AR 3125)

Organization of Scientific Area Committees (OSAC) for Firearms & Toolmarks Subcommittee Documents

OSBI Criminalistics Services Division Quality Manual (CSD QM)

“Minimum Required Operating Standards for National Integrated Ballistic Information Network (NIBIN) Sites.” Bureau of Alcohol, Tobacco, Firearms and Explosives. July 2018.

“Glossary of the Association of Firearm and Toolmark Examiners.” Ed. AFTE Training and Standardization Committee. 6th Edition. Association of Firearm and Toolmark Examiners. 2013.

“Uniform Language for Testimony and Reports for the Forensic Firearms/Toolmarks Discipline – Pattern Match Examination.” United States of America Department of Justice. 2019.

## III. Terms and Definitions

In addition to the terms and definitions listed below, any definition in one of the documents listed in section II also applies unless the term is defined in this section.

*IBIS*: Integrated Ballistics Identification System

*NIBIN*: National Integrated Ballistic Information System

## IV. Range of Laboratory Activities

A. The range of laboratory activities for which the FATM is accredited is documented on the Scope of Accreditation issued by ANSI National Accreditation Board (ANAB):
   1. Distance Determination
   2. Function Evaluation
   3. Individual Characteristic Database
   4. Physical Comparison
   5. Qualitative Determination
   6. Serial Number Restoration

B. If at any time, a request is made that may fall outside of the Scope of Accreditation, consult the FATM Supervisor/Technical Manager prior to analysis.

C. Based upon the above accredited parameters, the following testing should occur for each of the following types of evidence:

| | |
|---|---|
| Firearm | Function testing/test firing<br>Comparison to submitted cartridge case(s) and/or bullet(s)<br>Evaluation for suitability for BrassTRAX entry, if applicable |
| Fired cartridge case or shotshell | Comparison to submitted firearm(s)<br>Comparison to other cartridge cases/shotshells, if applicable/suitable<br>Evaluation for suitability for BrassTRAX entry, if applicable |
| Fired bullet | Caliber determination<br>Comparison to submitted firearm(s)<br>Comparison to other bullets, if applicable/suitable<br>General Rifling Characteristic (GRC) Database search, if applicable |
| Shotshell components | Gauge determination<br>Shot size determination |
| Tool | Comparison to submitted toolmark(s) |
| Item with toolmark | Comparison to submitted tool(s) |
| Unfired ammunition | Inventory; no examination (could be used in test firing of firearm) |
| Magazine | Inventory; no examination (will/could be used in test firing of firearm) |

D. The following tests will be performed upon request:
   1. Accidental discharge testing on firearms
   2. Serial number restoration
   3. Gunshot residue examination on target material
   4. Barrel and/or overall length measurement(s)
   5. NIBIN search outside of ATF-defined (default) parameters on firearms and fired ammunition components
   6. Comparison of cycling marks on unfired ammunition to other unfired ammunition or fired cartridge case/shotshell

E. The use of the test methods outlined in this document may be applied to other categories of evidence (e.g., serial restoration methods on an engine block); however, documented consultation with the FATM Supervisor/TM and/or CSD Quality Manager is necessary.

F. Airsoft guns, BB guns, paintball guns and blackpowder/muzzleloading firearms will not be function tested. They are to be inventoried and documented on a FATM-QMA2.2_NIBIN Firearm form; however, they will not be test fired.

## V. Resource Requirements

A. When additional resources (e.g., ammunition, chemicals) are required, it is the examiner's responsibility to inform the FATM Supervisor/Technical Manager of these needs.

B. The FATM Training Manual is used to train employees in the knowledge, skills and abilities necessary to perform analysis, handle evidence and/or perform quality control processes. If at any time, a procedure is not clear, the Training Manual should be considered a resource for review.

C. Examiners are required to successfully complete a competency test prior to performing testing or specific tasks that create items which could be used for testing (i.e., test fires). Once a competency test is completed, the examiner's Authorization to Work (ATW) memo will be updated. Ensure the ATW is updated prior to beginning any new type of testing.

D. Good housekeeping should be maintained in the FATM area. In addition to OSBI Policies 121.0 through 121.5, the following tasks should be performed periodically:
   - Wipe down all counters with 1:10 bleach/water or known tuberculocidal disinfectant
   - Sweep and mop range floor
   - Drain, vacuum and refill Projectile Recovery Tank
   - Add one or two crushed 1" chlorine tabs to the Projectile Recovery Tank and run pump until dissolved

   [Documentation of these tasks is not required.]

E. The chemicals currently used for the reagents in serial number restoration and gunshot residue examination are considered critical. A list of these critical reagents and their approved suppliers can be found here.

F. Reference Collections

1. The firearms and ammunition collections housed in the FATM are maintained and documented in the Chemical Inventory List via the BEAST.

    a. The firearm and ammunition reference collections are maintained to aid the examiner in casework. If a reference collection firearm, firearm part or accessory is used in casework, it should be documented in the case notes, at minimum.
    b. The firearms and ammunition collections will be handled in a manner to protect their characteristics.

2. The collection of fired bullets, cartridge cases and shotshells currently housed in Room L251 of the FATM laboratory is maintained for training purposes only and shall not be used in casework.

## VI. Calibration and Handling of Equipment

A. The FATM Unit shall follow OSBI CSD QP-24 – Calibration and Handling of Equipment and the applicable procedures outlined in this policy manual.

1. Whenever equipment is taken out of service, an entry will be made in the Maintenance Log including the 'out of service' date and the 'in service' date. Said equipment must have an 'out of service' sign placed on it or be otherwise isolated and/or identified to prevent use until it is placed back into service.

B. Equipment which requires calibration:
- Comparison microscopes with stage micrometers
- Gage blocks
- Scales
- Steel rule

C. The micrometers (mounted on comparison microscopes), gage blocks, scales and steel rule will be calibrated annually by an external vendor that is accredited to ISO/IEC 17025 by an accrediting body that is a signatory to the ILAC Mutual Recognition Arrangement, with the calibration to be performed listed in the scope of accreditation.

1. The annual Certificate of Measurement Traceability, Certificate of Accreditation to ISO/IEC 17025, and Scope of Accreditation to ISO/IEC 17025 for these competent calibrating laboratories will be maintained by the FATM Supervisor/Technical Manager.

2. The calibration certificates issued shall contain the measurement results, including the measurement uncertainty and/or a statement of compliance with an identified metrological specification.

3. The competent calibrating laboratory's acceptance criteria will be reviewed annually. By using the vendor, it is inferred this acceptance criteria are approved.

D. Function Verification / Performance Checks / Maintenance

1. Micrometers

    a. Annual calibration will be accompanied by preventative maintenance provided by the microscope manufacturer (Leeds). The completion of this preventative maintenance serves as a performance check of the micrometers and documentation of this calibration and maintenance and any repairs can be found in the maintenance log.

    b. The manufacturer's service report will be reviewed prior to the equipment being placed back into service. If any issues are identified, they shall be documented in the maintenance log, and the equipment shall not be placed back into service until resolved.

2. Gage blocks and steel rule

    a. Will be visually inspected for any damage prior to being placed back into service. If any damage is identified, it shall be documented in the maintenance log, and the equipment shall not be placed back into service until resolved or replaced.

3. Calipers

    a. Will be verified annually using the calibrated gage blocks. If any issues are identified, they shall be documented in the maintenance log, and the equipment shall not be placed back into service until resolved.

        1. Ensure the jaws of the caliper are clean and free of any dirt or residue.

        2. Perform at least two difference size measurements of a currently-calibrated gage block.

        3. Record results in the Equipment Performance Check spreadsheet. Record all digits displayed on caliper.

        4. If the observed measurements are not withing 0.005" of the gage block, it must be removed from service, documented in the maintenance log and not placed back into service until resolved.

4. Scales

    a. The calibration certificate will be reviewed prior to the equipment being placed back into service. If any issues are identified, they shall be documented in the maintenance log, and the equipment shall not be placed back into service until resolved.

Note: It is the examiner's responsibility to ensure all equipment is within current calibration or verification, and proper working order, before use in casework. Any unresolvable malfunctions of equipment should be reported as soon as practical to the FATM Supervisor/Technical Manager. OSBI CSD QP 24 – Calibration and Handling of Equipment shall be followed, and the FATM Supervisor/Technical Manager or designee will arrange for service or replacement.

E. Documentation

1. Current accreditation certificates for approved external vendors
2. Calibration / verification documentation
3. Equipment assignments
4. Equipment maintenance log

F. Storage and Handling

1. All calibrated equipment will be handled, transported, stored, used and maintained according to manufacturer's recommendations, which ensure they are kept free from contamination, deterioration or damage.

2. Gage blocks will be stored in a moisture absorbing agent, such as cupric sulfate, when not in use and when being transported for calibration. When the color of the moisture absorbing agent has significantly faced, it will be reheated by microwaving for 60 seconds.

3. The steel rule is to remain in the measuring apparatus unless being transported for calibration or used in test panel production in distance determination casework. When being transported for calibration, it will be stored in a capped PVC pipe.

## VII. Case Record Documentation

A. Forms

1. OSBI FATM forms as found in QMS shall be used to document all firearms-related evidence. FATM-QMA10: General Images/Notes can be used at the examiner's discretion for any item not fitting one of the other forms or for any additional documentation needs.

2. The completion of each evidence-type form serves to document the condition, characteristics and/or suitability for comparison of each item, as applicable.

3. Prior to Technical Review, these documentation forms shall be saved as PDFs and uploaded to the image vault within the BEAST.

4. Use only the information present on or about the evidence to complete documentation worksheets; do not rely on the RFLE. If additional information about the evidence is documented, its source should be included in the case notes. This is

not required when expanding manufacturer's abbreviations on cartridge case headstamps.

B. See specific protocols for additional documentation requirements.

C. All fired evidence or unknown toolmarks shall be inventoried, examined and documented prior to comparison to any known.

D. Prior to use, all equipment shall be confirmed as currently calibrated or verified. If no documentation is made in the maintenance / calibration logs, it is assumed all equipment was currently calibrated or verified at the time of examination.

E. Evidence can be labeled on any surface, as long as the label does not obstruct or cover any manufacturer's marks, marks used for comparison, etc. Only test fires shall be engraved. All evidence items should be marked using permanent marker, marked tape, etc. At the examiner's discretion, the outer container of an evidence item may be labeled (e.g., the bag/envelope which contains loose live ammunition).

F. The start date of analysis will be defined as the date the Firearms assignment is assigned to the examiner. The end date of analysis will be defined as the date that the report is approved.

G. Test fired ammunition components and test cuts/marks are considered evidence and will be returned to the submitted agency. Any additional test fires/cuts/marks retained by the lab will not contain any agency-specific case information and will only be used for training and research. If additional test fires/cuts/marks are retained, the stakeholder will be notified via the report.

H. If the submitted ammunition is tracer/incendiary or armor-piercing, it will not be used to test fire. Similar case and bullet composition ammunition from the lab stock shall be used.

I. NIBIN Entry Only

1. If a firearm is submitted for NIBIN entry only (i.e., with no fired evidence for comparison), any accompanying unfired ammunition and/or accessories must be inventoried in the BEAST. No documentation form(s) or photos are required.

2. If fired evidence is submitted, but no comparisons are needed/requested (e.g., a revolver with fired cartridge cases recovered from the cylinder, a confirmed suicide, etc.) the fired evidence will be documented (i.e., sub-itemized) in the BEAST and an overall photo will be taken. This photo can be included on the firearm worksheet or its own General Images/Notes page.

J. Officer Involved Shootings

1. Regardless of submission of fired evidence for comparison, all officer involved shooting firearms and unfired ammunition will be documented on their respective documentation worksheets.

2. It is encouraged that ammunition from the officer or agency that mirrors the fired evidence from the officer involved incident be submitted in Officer Involved Shooting cases where the firearm will not be available to the examiner throughout the entire examination and comparison process. If no such ammunition is submitted, lab stock ammunition may be used for functionality and NIBIN suitability. The examiner should use a variety of ammunition with primer/cartridge case metal compositions to try to address the types of ammunition potentially used.

K. Comparisons

1. All marks examined must be documented in the examiner's case notes.

2. The marks used to report an identification must be in the report and case notes.

3. The marks or characteristics used to report an elimination (class or individual) must be in the report and the case notes.

   Note: each group of marks or characteristics may have their own 'conclusion;' however, the final or overall conclusion may likely be a culmination of those marks or characteristics. The examiner is encouraged to add remarks to their case notes explaining this if it is not clear (e.g., three areas are listed as inconclusive III, but the final or overall conclusion is an elimination).

4. A representative photograph of each identification or elimination on individual characteristics must be saved to the case file. At minimum, the title of this file shall include the OSBI lab number and the items depicted in the photograph. This same information (OSBI lab number and items) should be embedded into the photo via the SPOT software. Documenting at which magnification the photograph was taken is encouraged but not required.

L. Administrative Review

1. An administrative review is an evaluation of the report and supporting documentation for consistency with laboratory policies and for editorial correctness.

2. All (100%) cases, excluding no-analysis communications, will be administratively reviewed by a qualified examiner.

3. General Guidelines for Administrative Reviews (See QP 31 – Reviews)
    - Review the report for spelling and grammatical accuracy
    - Review all administrative/examination records to ensure proper labeling as required by policy.
    - Ensure the report has all the necessary information and all required sections are included in the report.
    - Ensure the original RFLE and BEAST information is accurate.
    - Ensure all required documents / photographs are included in the case file.

M. Technical Reviews

1. A technical review is an evaluation of reports, notes, data and other documentation to ensure there is an appropriate and sufficient basis for the conclusions draw.

2. All (100%) cases, excluding no-analysis communications, will be technically reviewed by a second, qualified examiner. (See examiners' ATW memos for authorization.)

3. Technical reviews will be documented with the TR checklist within the BEAST. The technical reviewer will answer each statement as yes, no or N/A, as applicable.

4. General Guidelines for Technical Reviews (See QP 31 – Reviews)
    - Ensure that all appropriate testing was done as dictated by the type of evidence received and any requests by the submitting agency.
    - Ensure that the conclusions are supported by the notes, worksheets and data.
    - All controls were verified and the expected results were obtained, as applicable.
    - The required verifications have been performed and documented.
    - Results of IBIS/NIBIN eligibility and evaluation for entry is documented and reported.

    Note: The technical reviewer is responsible for also conducting an administrative review. However, it is the original examiner's responsibility to conduct an administrative review of their work prior to routing for technical review. The signing of the report in the BEAST signifies the original examiner has conducted an administrative review.

5. The route function of the BEAST will be used to document technical reviews.

    a. When a Class I nonconformance is identified, the technical reviewer is to route the case back to the original examiner for question or comment (route code RQC), explaining the needed or suggested change(s) in the routing comments. The technical reviewer may choose to speak with the original examiner instead. This is allowed, as long as any changes made to the case

file are documented in a case narrative or in a new route for technical review (route code TR).

b. When a Class II, III or IV non-conforming work is identified, it is the technical reviewer's responsibility to route the case back to the original examiner for correction (route code C), describing the nonconformance. If necessary, the original examiner will email or speak with the Technical Manager. The Technical Manager will review the case, speak with the appropriate individuals, and document their decision within the case narrative, as well as the Nonconforming Work Record spreadsheet, as necessary. Once resolved, the original examiner will route the case back to the technical reviewer. The technical reviewer will ensure the issue was resolved, and that the resolution is documented within the case file, then complete the technical review and approve the case.

c. If a possible Class III or Class IV non-conforming work is identified, CSD QP 14.2 or 14.3 will be followed.

d. The technical reviewer is responsible for ensuring the case file contains all requirements found in the appropriate FATM protocols, in addition to those found in CSD QM QP 31 – Reviews.

N. Changes to Case Record Documentation

1. If any changes are made to the technical record after the case has been signed and routed for technical review, the original file must be retained in addition to the corrected file.

2. If changes are made:

a. The original file uploaded to the image vault of the BEAST will be renamed to include "DRAFT" in the title.

b. The corrected file will be uploaded to the image vault of the BEAST with the original title of the file.

## VIII. Comparisons

A. This section provides a standard scale of conclusions and criteria to be used for all microscopic firearm and toolmark examinations and comparisons conducted for the forensic purpose of determining if two or more toolmarks were or could have been created by the same tool. This policy takes into consideration the current state of professional practices and scientific research, which has demonstrated the ability of firearm and toolmark examiners to make reliable and accurate source conclusion

judgements. Throughout this policy, the term “toolmark” is used to refer to both firearm-produced and non-firearm toolmarks.

B. Theory of Identification as it Relates to Toolmarks (from AFTE Glossary, 6th ed.)

1. The theory of identification as it pertains to the comparison of toolmarks 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.

C. Comparative Value

The class and/or individual characteristics of a fired bullet, cartridge case or toolmark could have any of the following comparative values.

1. No value (unsuitable) for classification and/or (macro or micro) comparison
    - Appears to lack the class and individual characteristics necessary for comparison
    - Heavily damaged
    - Examples: Fragments, shot pellets, lead cores

2. No value (unsuitable) for further microscopic comparison
    - Exhibits class characteristics, but lacks the individual characteristics necessary for microscopic comparison due to damage

Examples: bullets that have gone through walls, mangled bullets, cartridge cases that have been run over or are heavily oxidized

- A note should be made in both the case file and the report that certain/specific class characteristics are in agreement between two items, but the individual characteristics needed for further microscopic comparison are absent due to the condition of/damage to the evidence

NOTE: This is not the same as Inconclusive II as defined by the AFTE Range of Conclusions (see below). This classification of comparative value is for items unsuitable for comparison due to damage, not due to a firearm marking poorly.

3. Of value (suitable) for comparison
    - Potentially has sufficient class, subclass and/or individual characteristics for further evaluation, examination, or microscopic comparison

D. Reproducibility

1. Before a microscopic comparison between an evidence item and known tests is made, the examiner should inter-compare the known tests to establish reproducibility of the marks to be used in the microscopic comparison to the evidence item(s).

2. The inter-comparison of known tests can also aid in determining the source of a mark (i.e., proof of cycling versus proof of firing).

E. Caliber Mis-Match

1. If there are physical indicators on the bullet and/or cartridge case of a caliber mis-match, a microscopic comparison is recommended. Physical indicators include incomplete rifling, bullet shearing, bulged or split cartridge case and pierced primer.

2. At the request of the stakeholder, or at the discretion of the examiner, microscopic comparisons may be conducted between items from the same caliber family. Examples include a 380 Auto cartridge case to a 9mm Luger firearm, a 9mm Luger bullet to a 357 SIG firearm, a 40 S&W bullet to a 10mm Auto pistol, etc.

F. Range of Conclusions When Comparing Toolmarks (from AFTE Glossary, 6$^{th}$ ed.)

1. 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.

2. Inconclusive

(I) Agreement of all discernible class characteristics and some agreement of individual characteristics, but insufficient for an identification.

(II) Agreement of all discernible class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility.

(III) Agreement of all discernible class characteristics and disagreement of individual characteristics, but insufficient for an elimination.

3. Elimination

Disagreement of discernible class characteristics and/or significant disagreement of individual characteristics.

G. Qualifications and Limitations

1. It is possible for firearms to be altered or parts replaced, and these alterations may not be apparent. If items are identified or elimination as having been fired by a firearm, it is implied it is in that firearm *as received* by the FATM Unit.

2. An examiner shall not assert that examinations conducted in the forensic firearms and toolmarks disciplines are infallible or have a zero-error rate.

3. An examiner shall not provide a conclusion, whether in a report or testimony, that includes a statistic or numerical degree of probability/certainty inference except when based on relevant and appropriate data.

H. Additional Notes

1. Extreme caution shall be taken when eliminating a toolmark to a non-firearm tool, based on the disagreement of individual characteristics. As non-firearm tools can be used in many ways, they can also leave marks in many ways.

2. The origin of individual characteristics dictates the extent of the conclusions they support (i.e., proof of cycling versus proof of firing marks). It may be

necessary to cycle unfired ammunition through a firearm to ensure the origin of marks. If the examiner cannot attribute marks found on a cartridge case to a certain portion of a firearm, the examiner cannot report that the cartridge case(s) were fired and/or cycled through the firearm.

## VIII. Comparison Verifications

A. All microscopic comparison conclusions will be verified by a second qualified examiner.

Eliminations based on differences in class characteristics do not need to be verified on a microscope. However, the difference(s) must be documented in the case file. This could be via notes or a photograph, and will be 'verified' during the technical review process.

B. Form FATM-QMA1: Comparison Verification will be used to document all verifications. The verifier's signature documents their agreement with the original examiner's conclusions.

C. Verifications can be performed on the original examiner's microscope, the evidence can be transferred to the verifier, or can be performed via photographs. Whichever method is used, it must be documented on FATM-QMA1.

D. If the original examiner and the verifier cannot concur on their conclusion, the Technical Manager will be consulted. If the Technical Manager is one of the examiners involved in the disagreement, the CSD Quality Manager will be consulted. This consultation may help the original examiner or verifier reach another conclusion. If an agreement cannot be reached, the original examiner will report an inconclusive result.

E. Any changes made to the original examiner's conclusion(s) shall be documented in the case file (case narrative or notes section of FATM-QMA1). Any changes to conclusions during the verification process will also be documented on the Nonconforming Work Record spreadsheet on the QA server to act as a way to identify any trends. (Changes in conclusions are not always immediately considered nonconforming work; they will be documented on the spreadsheet for trend-tracking purposes/to identify any issues over a period of time.)

## IX. Reporting of Results (See also QP 28 – Report Writing)

A. The creation of test fires, test cuts/marks, debris collection, etc. must be sub-itemized in the BEAST and described/addressed in the report, even if to say 'not examined.'

B. If the evidence will be retained by the OSBI CSD, or transferred to another unit, the disposition of items shall be reflected in the report.

C. Evidence descriptions should only contain what is on or about the item. No results from examination shall be included in the evidence description [e.g., One (1) fired bullet, not One (1) fired 9mm Luger bullet].

D. As the results of examinations are commonly the same, recommended standardized verbiage will be stored within the BEAST for use by FATM personnel.

1. This standardized verbiage is maintained within the BEAST by the FATM Supervisor/Technical Manager.

2. This standardized verbiage includes the Notes section of the FATM report template, which includes definitions and parameters for comparisons (qualifications/significance of associations), gunshot residue examination conclusions and the extent of initial NIBIN searches.

3. If case circumstances do not fit any of the standardized verbiage within the BEAST, the examiner should modify the standardized verbiage or consult with the FATM Supervisor/Technical Manager for guidance.

E. There are specific case circumstances in which analysis will stop and/or not all possible comparisons will be conducted and/or reported. Since all possible situations that may arise in the course of analysis and case circumstances cannot be addressed here, examiners are instructed to consult with the FATM Supervisor/Technical Manager whenever required report content is not clear.

F. Any eliminations that can easily be inferred by the stakeholder are not required to be included in the report.

1. Examples:
   - If fired evidence is identified to a firearm, elimination to other firearm(s) do not have to be reported
   - If cartridge cases and/or firearms of different calibers/cartridge designations are submitted, elimination(s) to one another do not have to be reported

## X. Approved Abbreviations and Symbols List

*Typically used abbreviations in reports, case notes, etc.*

| | |
|---|---|
| AFTE | Association of Firearm and Tool Mark Examiners |
| BL | Barrel length |
| BLS | Blood-like substance |
| BF | Breechface marks |
| BPS | Brown paper sack |
| Br | Brass |
| BRM | Bolt rotation marks |

| | |
|---|---|
| CoC | Chain of custody |
| Conv | Conventional rifling |
| CC | Cartridge case/casing |
| Cal | Caliber |
| CHBR | Chamber marks |
| Class | Class characteristics |
| Cu | Copper |
| DA | Double action |
| DAO | Double action only |
| DNMC | Does not meet criteria |
| DTO | Dithiooxamide |
| EE | Evidence envelope |
| EJR | Ejector |
| Elim | Elimination |
| EXT | Extractor |
| FTEX | Failure to extract |
| FTEJ | Failure to eject |
| FMJ | Full metal jacket |
| FP | Firing pin |
| FPD | Firing pin drag |
| FPI | Firing pin impression |
| Ga | Gauge |
| GEA | Groove engraved area |
| GMB | Glock Marksman Barrel |
| Gr | Grain |
| GRC | General rifling characteristics (database) |
| HS | HydraShok |
| HP | Hollow point |
| IBIS | Integrated Ballistics Identification System |
| INC, incon | Inconclusive |
| ID, ID'd, IDed | Identification/identified |
| JHP | Jacketed hollow point |
| JSP | Jacketed soft point |
| L | Left (twist) or Long |
| L/G | Lands and grooves |
| LRN | Lead round nose |
| LEA | Land engraved area |
| LFN | Lead flat nose |
| LR | Long rifle |
| MAG | Magnum or magazine |
| MC | Metal case |
| MIM | Metal injection molding |
| MROS | Minimum Required Operating Standards |
| Ni | Nickel |

| | |
|---|---|
| NIBIN | National Integrated Ballistic Information Network |
| NSFI | Not suitable for IBIS entry |
| OL | Overall length |
| OTM | Open tip match |
| O/U | Over/under |
| PMF | Privately manufactured firearm |
| Poly | Polygonal rifling |
| PRT | Projectile recovery tank |
| R | Right (twist) |
| Ref | Reference |
| RN | Round nose |
| SA | Single action |
| SN, S/N | Serial number |
| Sod Rho, Na Rho | Sodium Rhodizonate |
| SPL | Special |
| St | Steel |
| SWC | Semi-wadcutter |
| SXT | Super Expanding Talon |
| TF | Test fire |
| TF'd, TFed | Test fired |
| TFing | Test firing |
| TMJ | Total metal jacket |
| UOM | Uncertainty of measurement |
| UTL | Unable to locate |
| WC | Wadcutter |
| ⊕ | NATO |
| # | Number |

*Typically used abbreviations in GRC database search results*

| | |
|---|---|
| B | Submachine gun/automatic pistol |
| MA | Machine gun |
| PD | Derringer |
| PG | Air operated pistol |
| PI | Semiautomatic pistol |
| PK | Blank pistol |
| PR | Revolver |
| PS | Single shot pistol |
| PU | Percussion pistol |
| RA | Automatic rifle |
| RB | Bolt action rifle |
| RC | Carbine |
| RG | Air operated rifle |
| RI | Semiautomatic rifle |
| RL | Lever action rifle |

| | |
|---|---|
| RS | Single shot rifle |
| RU | Percussion rifle |
| SB | Bolt action shotgun |
| SE | Double barrel shotgun (side by side) |
| SO | Over and under shotgun |
| SP | Pump action shotgun |
| SS | Single shot shotgun |

## XI. Measurement Uncertainty

A. Scope

1. An estimation of the uncertainty of measurement shall be determined for examinations in which a critical quantitative measurement is reported. In the Firearms and Toolmarks Unit, critical measurements requiring an estimation of the uncertainty of measurement includes:
    - Barrel length and overall length determinations for long guns (e.g., shotguns, rifles, carbine rifles) when required by the stakeholder.
    - Muzzle-to-target range determinations where test panels are being created to determine a range of possible distances.

2. An estimation of the uncertainty of measurement shall not routinely be determined for muzzle-to-target distance determination when the distance is determined to be consistent with contact.

B. Documentation

1. The expression of uncertainty shall be included in the case notes and the report, where and when applicable.

2. The Firearms and Toolmarks Unit Supervisor/Technical Manager, or their designee, shall maintain the records associated with the estimation of uncertainty of measurement in the appropriate unit specific subfolder on the network, found here.

C. Estimating the Uncertainty of Measurement

1. Estimations of the uncertainty of measurement shall be conducted and documented using an uncertainty budget.
    - The uncertainty budget for the procedures of measuring barrel length and overall length of firearms falling within the scope of this document shall include both Type A and Type B evaluations of uncertainty.

    Type A evaluation: method of evaluation of uncertainty by statistical analysis of series of observations.

    Type B evaluation: method of evaluation of uncertainty by means other than statistical analysis of series of observations.

- Uncertainty budgets shall be reviewed on an annual basis by the Firearms and Toolmarks Unit Supervisor/Technical Manager, or their designee.

- The analysis results shall be recalculated when a change occurs for measurement of barrel length, overall length or distance determination test panels, such as the acquisition of a new measuring device, a change in participants, or a change of methods.

2. The uncertainty of a laboratory barrel length (BL) and overall length (OL) measurements shall be estimated with data from a study of repeated measurements of several firearms by all those in the laboratory responsible for measuring and reporting BL-OL. The study will employ firearms similar to those found in casework and which are close to the relevant statutory minimum lengths, such as 16 in., 18 in., and 26 in., required by applicable laws. (Based on federal law, barrel and overall length measurements must be reported in inches. Therefore, SI units are not used in this document.) The same measuring device (i.e., steel rule) shall be used for all measurements for the BL-OL uncertainty study.

3. Measurement traceability shall include the calibration certificate of the measuring device (i.e., steel rule). The uncertainty of a laboratory's test panels at known distances measurements shall be estimated with data from a study of repeated measurements of several distances by all those in the laboratory responsible for the creation of said test panels. The study will employ distances likely to be found in casework. The same measuring device (i.e., steel rule) shall be used for all measurements for the distance determination test panel uncertainty study.

D. Reporting the Estimated Uncertainty of Measurement

1. The calculated expanded uncertainty will be rounded to no more than two significant digits.

2. When measurements are recorded as a fraction, the calculated uncertainty will be reported to the next highest 1/32 inch.

3. The measurement result shall include the measured quantity value, *y*, along with the associated expanded uncertainty, *U*, and this measurement result shall be reported as $y \pm U$ where the units of *U* are consistent with the units of *y.*

4. The expanded uncertainty will be reported at a coverage probability of 99.73% (k=3).

# FIREARMS AND TOOLMARKS POLICY MANUAL

# FATM-01: FIREARM EXAMINATION

**I. Scope**

This policy establishes standard procedures for the examination and testing of a firearm. Following these procedures, an examiner will be able to conduct, document and report the examination and testing of a firearm.

**II. Items Needed for Testing**

- Submitted firearm
- Lab stock or submitted ammunition

**III. Parameters to be Determined**

- A firearm is capable or incapable of discharging a cartridge under laboratory conditions (Firearm Functionality)
- A firearm is capable or incapable of discharging a cartridge without pulling the trigger (Accidental Discharge Testing)

**IV. Equipment and Supplies**

- Various light sources
- Personal protective equipment
- Engraver or scribe
- Stereomicroscope
- Dummy cartridges of various calibers / gauges
- Firearm barrel and overall length measuring device
- Various tools necessary for disassembly of firearms
- Firing range and bullet recovery device
- Digital camera
- Ammunition / primed cartridge cases
- Rubber mallet

**V. References**

- Various firearm manufacturers' armorer / owner's manuals
  - All hard copies are stored in the FATM laboratory
  - Online resources are as-available
- Blue Book of Gun Values (https://www.bluebookofgunvalues.com/#/Login)
- Firearm Reference Collection

**VI. Reference Standards / Materials Required**

- Steel rule

**VII. Description of the Procedure**

A. Safety

1. Gloves shall be worn when handling any evidence item.

2. Ensure the firearm is unloaded prior to examination. If the firearm is found to be loaded, unload the firearm and notify the Supervisor/Technical Manager immediately.

3. Point the muzzle of the firearm in a safe direction at all times.

4. Do not place a finger or other object on the trigger unless it has been confirmed that the firearm is unloaded, or until ready to test fire / dry fire.

5. Firearms will only be loaded with live ammunition in the shooting room. At no time should a firearm be loaded in the general lab space. If ammunition is needed (e.g., to verify the firearm's caliber), use the provided dummy-rounds or go into the shooting room.

B. Documentation

1. Label the firearm and its container(s) according to QP 6.1 – Evidence Handling.

2. Take an overall photograph of the firearm with scale, as well as a close-up photograph of the serial number found on the frame/receiver. If there is no number found on the frame/receiver, but another number is found elsewhere, that number may be reported as the 'likely serial number,' and should be photographed.

3. All evidence photographs and examination documentation shall be documented using Form FATM-QMA2.1: Firearm (if comparisons will be conducted to the firearm's test fires) or Form FATM-QMA2.2: NIBIN Firearm (if no comparisons / NIBIN entry only).

C. Visual Examination

1. Conduct a preliminary, visual examination of the firearm.

2. Document any pertinent observations such as bore obstructions, damage, modifications, improper assembly, missing parts, broken parts or defects (**paying particular attention to anything that may affect the structural integrity of the firearm, and thus the safety of firing the firearm**).

3. Observe and note all applicable attributes listed on the applicable firearm form.

    a. If the caliber is not easily found on the firearm, every effort should be made to determine the caliber prior to removing any parts from the firearm. Efforts could include researching the firearm on the manufacturer's website, looking up the firearm in the Blue Book of Gun Values, the use of dummy cartridges, etc. Any and all efforts made to determine the caliber shall be documented in the case file.

D. Mechanical Functionality

1. Test in all applicable modes of fire by dry-firing (e.g., semi-automatic and automatic, single and double action, etc.).

a. If a magazine is not submitted, use a reference magazine, if available.

b. Ensure the submitted magazine does in fact lock into the firearm / is designed for the firearm. If not, the mis-matched magazine(s) should be sub-itemized in the BEAST. Otherwise, the magazine may be included in the parent item number.

2. Field test semi-automatic firearms to determine if they are capable of fully automatic fire. If a firearm field tests positive for full-auto, load only one cartridge into the firearm at a time when test firing into the Projectile Recovery Tank. Fire at least three cartridges on the long range to confirm capability of fully automatic firing. This same procedure should be used if a firearm is submitted with an accessory designed to allow full-auto, like an after-market auto sear. If a firearm is found to be capable of fully automatic fire, it will be included in the report.

3. Dry firing may damage certain types of firearms; use caution.

4. Inspect the firearm for any conditions which have the potential to cause slam firing (e.g., frozen firing pin, hammer that does not consistently stay cocked).

5. Determine if the firearm is suitable for test firing.

   a. If a firearm is encountered that has apparent components not intended for firearm assembly (e.g., nail, screwdriver, paperclip), and/or is missing components that could compromise the structural integrity of the firearm (e.g., disassembly pin) the Supervisor/Technical Manager must be consulted for the best course of action. If the Supervisor/Technical Manager is the examiner encountering such a firearm, a CLEET-certified firearms instructor, preferably within the CSD, if available, must be consulted. This consultation will be documented in the examiner's notes or as a case narrative in the BEAST.

   b. If there is any doubt as to whether the firearm can be safely fired by hand, consider the use of a remote firing device.

   c. If it is determined that it would be unsafe to fire the firearm as received, the use of an empty, but primed, cartridge case may be used to determine functionality.

   d. A firearm should only be field stripped prior to test firing if inoperable as received and must be partially disassembled to make operational, or unsafe to fire as received and must be partially disassembled to make safe.
      - The examiner's notes and report will explain the condition of the firearm as received, a simple summary of what was done to make it operable, and the results after those efforts.
      - Any disassembly beyond routine field stripping should not be conducted unless the examiner has a current armorer's certificate for the make/model of the firearm, or has been provided guidance / permission by the Supervisor/Technical Manager.

e. Replacement parts from a variety of sources may be utilized in order to render the firearm functional and obtain test fires. Any replacement of parts shall be documented in the case notes and removed after test firing is complete. Note: if the replacement part is one that leaves marks on the fired cartridge case or bullet, marks made by those replacement parts shall not be used in comparisons or imaged into NIBIN.

f. If traditional test fires cannot be collected from the firearm, consider alternate methods for test specimen production. Examples include casting, the use of soft lead media, etc.

E. Barrel and/or Overall Length

1. This measurement will be taken and reported if requested by the stakeholder; however, it may be taken and reported at the examiner's discretion.

2. Ensure the calibration of the steel rule is current. If not current, inform the FATM Supervisor/Technical Manager and do not perform measurements until current.

3. For barrel length, with the bolt closed and the firearm cocked, insert a metal dowel rod into the barrel. With the metal dowel rod touching the breechface, move the metal stop collet to the muzzle end of the firearm and secure in place. (Measurements for altered or uneven barrels should include the longest portion.)

4. Remove the metal dowel rod from the barrel and lay along the measuring apparatus so that it is parallel to the steel rule with the end against the stationary plate.

5. Read and document the measurement, to the nearest 1/32". Include the measurement uncertainty of barrel length of ±2/32" at a coverage probability of 99.73% (k=3).

6. For overall length, lay the locked firearm along the measuring apparatus where the barrel runs parallel to the steel rule and the rearmost portion of the firearm touches the stationary plate. Move the slide plate so that it touches the muzzle end of the firearm.

7. Read and document the measurement, to the nearest 1/32". Include the measurement uncertainty for overall length of ±2/32" at a coverage probability of 99.73% (k=3).

F. Test Firing

1. All safety requirements found in OSBI Policy 121.1 will be observed at all times.

2. Test firing will be conducted using appropriate safety equipment (i.e., inner and outer ear protection, eye protection and proper ventilation).

3. If another individual is not in the Firearms and Toolmarks Unit, inform another individual with access to the Firearms and Toolmarks Unit that test firing will be occurring.

4. Use appropriate ammunition for case circumstances.

5. A minimum of two (2) cartridges/shells will be fired for firearms being evaluated for IBIS/NIBIN entry and/or being used in comparisons. The number and type of ammunition used shall be documented on the appropriate FATM form.

    a. A primed cartridge case or primer can be used for function-only firearms.

    b. There are times where only one (1) test fire is sufficient or necessary. Such instances may be decided at the examiner's discretion, and the reason will be documented in the examiner's case notes or as a case narrative.

6. Test fires should be marked at time of firing so they are traceable to the firearm from which they were fired. This can be accomplished with an engraver/scribe or permanent marker.

7. Handguns and rifles can be fired in the Projectile Recovery Tank, as long as they fall within the capability limits of the tank. Shotguns and firearms falling outside of the capabilities of the tank should be fired on the long range.

8. If a firearm fails to discharge a cartridge after the trigger is pulled, the examiner must keep the muzzle pointed into the Projectile Recovery Tank or down range for a minimum of ten seconds before attempting to determine the cause of the malfunction.

9. Sub-itemize the test fires from the firearm within the BEAST. Repackage the test fires separately in a new container. Popped primers must be sub-itemized from the firearm within the BEAST, but can be repackaged with the firearm.

G. Accidental Discharge Test

1. This testing will only be conducted if requested, and <u>after</u> the firearm has been test fired.

2. Load an empty, but primed cartridge case/shotshell into the firearm.

3. Subject the firearm to forces or conditions that might reasonably be expected to cause discharge or a specific condition reported by the submitting agent, district attorney or investigator.

4. Possible test methods include, but are not limited to:
    - Strike the firearm with a rubber mallet when cocked and uncocked, with safeties on and off.
    - Drop the firearm from various heights in various positions, cocked and uncocked, with safeties on and off.
    - Check for slam fire by closing the bolt or slide.

- Check for push-off by cocking the hammer and pushing on the hammer.

5. If the accidental discharge testing results in sufficient damage to the firearm, the requesting agency shall be notified. The damage shall be documented in the case file by either narrative or photograph(s), and in the report if it prevents any additional accidental discharge testing. Sufficient damage includes, but is not limited to, any cracking or breaking of parts which may or may not make the firearm inoperable. Minor scuffs and scratches do not constitute sufficient damage.

H. Comparisons

1. If a firearm and/or bullet(s) of the same class characteristics was submitted, conduct microscopic comparisons as outlined in the FATM Quality Manual Section VIII (Comparisons).

2. Use the criteria as described in the FATM Quality Manual Section VIII (Comparisons) to form a conclusion.

3. Comparisons between cartridge cases and firearms of different caliber families will not be performed unless there is a specific request from a stakeholder, obvious distortions to the evidence are observed, or there is another forensic reason to do so.

4. Caliber / cartridge designation mis-match comparisons may be conducted at the discretion of the examiner, or at the request of the stakeholder. (Example: 380 Auto cartridge case compared to a 9mm Luger pistol.)

I. IBIS / NIBIN Suitability

1. If necessary, determine the entry suitability of the test fired cartridge case. See FATM-05: IBIS / NIBIN for further guidance.

## VIII. Interpretation and Reporting of Results

A. A firearm is capable of discharging a cartridge if the pulling of the trigger results in sufficient force of the firing pin/striker to detonate the priming compound in the cartridge case/shell primer.

1. If the firearm chambered, fired, extracted and ejected the test fires as designed, the firearm is within normal operating condition.

2. If the firearm is able to create test fires but encountered an issue during the firing process, the firearm is capable of discharging a cartridge. The issue(s) encountered should be included in examiner's notes, and may be included in the report at the examiner's discretion.

B. A firearm is capable of an accidental discharge if sufficient force of the firing pin/striker to detonate the priming compound in the cartridge case/shell primer is able to be produced by any means other than pulling the trigger.

C. A firearm is non-functional / inoperable if the pulling of the trigger does not result in sufficient force of the firing pin/striker to detonate the priming compound in the cartridge case/shell primer. This is regardless of a visible firing pin impression. This could result from a wide variety of issues with the firearm including, but not limited to:
   - Presence of a magazine disconnect, and no submitted magazine
   - Inability to cock the firearm or pull the trigger due to rust, corrosion, dried blood, etc.
   - Missing integral components/parts
   - There could be an issue with the ammunition (misfire). It may be necessary to attempt test firing with another cartridge(s).

D. For non-functional / inoperable firearms, the report shall reflect that the firearm was non-functional / inoperable as received in the laboratory. A summary of any actions taken to obtain test specimens shall be included in the examiner's notes. If attempts to make the firearm functional were unsuccessful, this shall be reported.

E. The report description of any firearm should include, at minimum and if known, the make/manufacturer, firearm type, model, caliber/gauge and serial number. If any descriptive information is not readily apparent on the firearm, it may be included in the evidence description; however, the source of the information must be documented in the case notes.

F. Standard verbiage for the reporting of firearm functionality shall be determined by the FATM Technical Manger and be maintained in the BEAST.

## IX. Additional Notes

A. Homemade firearms will be evaluated for safety. If deemed safe, a primed cartridge case will be used to determine functionality of the homemade firearm. Only if the homemade firearm is deemed safe to fire, and comparison(s) to know test fires is requested, should live ammunition be fired in a homemade firearm. Use of a remote firing device is strongly recommended.

B. Casting of the bore/barrel and/or chamber is an acceptable practice in applicable circumstances (e.g., comparison to non-functional firearm).

C. Ammunition and firearms within the same parent container shall be sub-itemized. Magazines and shooting accessories (e.g., holster, scope) may be included with the firearm. The appropriate documentation worksheet(s) need only be filled out if comparisons will be conducted in the case. i.e., ammunition and shooting accessories accompanying firearms submitted for NIBIN entry-only do not require a documentation worksheet.

D. After ensuring the firearm is unloaded and before repackaging, reasonable effort shall be made to prevent the action of the firearm from locking (e.g., zip tie through the magazine well). If this is not possible (e.g., the firearm will not fit in the original packaging with the action unlocked), the examiner may label and initial the outer container as unloaded.

# FATM-02: FIRED BULLET EXAMINATION

## I. Scope

This policy establishes standard procedures for the examination and testing of fired bullets (also called projectiles) by firearm and toolmark examiners.

## II. Items Needed for Testing

- Unknown bullet or metallic fragment

## III. Parameters to be Determined

- Caliber
- Possible ammunition manufacturer
- Possible manufacturer of firearm used to fired unknown bullet
- Common origin

## IV. Equipment and Supplies

- Camera
- Stereomicroscope and/or comparison microscope
- Scale / balance
- Calipers / micrometer
- Personal protective equipment
- Various light sources
- 1:10 bleach/water or known tuberculocidal disinfectant

## V. References

- FBI's General Rifling Characteristics (GRC) File (2021 version)
- AFTE's online GRC Search database (www.afte.org/members/databases/grc-search)
- Various ammunition manufacturers' catalogs and websites
    - All hard copies are stored in the FATM laboratory
    - Online resources are as-available
- Ammunition Reference Collection

## VI. Reference Standards / Materials Required

None

## VII. Description of the Procedure

A. Safety

1. Gloves shall be worn when handling any evidence item.

2. If necessary, disinfect any evidence items suspected of biological contamination. Use of a nylon brush on jacketed bullets is permitted. Wire brushes should never be used on evidence items. Document any cleaning/disinfecting performed.

3. If any physical manipulation of the bullet occurs, this should be documented in the case notes.

B. Documentation

1. Label the evidence item and/or its container(s) according to QP 6.1 – Evidence Handling.

2. Take an overall photograph of the evidence item with scale. A photograph of the item, as received, should be taken. An additional photograph(s) after cleaning or manipulating is optional.

3. All evidence photographs and examination documentation shall be documented using Form FATM-QMA6: Fired Bullet(s).

C. Examination

1. Ensure the calibration of the scale, calipers and micrometer are current.

2. Weigh the bullet.

3. Measure the diameter of the bullet.

4. If necessary, measure the land and groove widths.

   a. Land and groove widths are only necessary if a search of the FBI GRC Database will be conducted. This is only required if the submitted firearm(s) is eliminated to the bullet, or if there is no firearm(s) for comparison. All other GRC Database searches may be conducted at the examiner's discretion.

   b. If a GRC Database search is conducted, a copy of the list produced must be saved to the case file.

   c. Ensure the sum of the land and groove widths are consistent with the rifling and caliber. (Use the Land+Groove Impression Widths chart for reference.)

5. Observe and note all applicable attributes listed on Form FATM-QMA6: Fired Bullet(s).

6. Prior to any comparison to a known, ensure the bullet (unknown) is inventoried, examined and documented.

D. Comparisons

1. If a firearm and/or bullet(s) of the same class characteristics was submitted, conduct microscopic comparisons as outlined in FATM Quality Manual Section VIII (Comparisons).

2. Use the criteria as described in the FATM Quality Manual Section VIII (Comparisons) to form a conclusion.

3. Microscopic comparisons between bullets of different caliber families will not be performed unless there is a specific request from a stakeholder, obvious distortions to the evidence are observed, or there is another forensic reason to do so.

4. Caliber / cartridge designation mis-match microscopic comparisons may be conducted at the discretion of the examiner, or at the request of the stakeholder. (Example: 380 Auto bullet compared to a 9mm Luger pistol.)

## VIII. Interpretation and Reporting of Results

A. Based on the size, weight and/or configuration, in conjunction with the examiner's experience, the caliber or caliber-family of a fired bullet may be reported.

B. Based on the criteria outlined in FATM Quality Manual Section VIII (Comparisons), common origin may be reported.

## IX. Additional Notes

None

# FATM-03: FIRED CARTRIDGE CASE EXAMINATION

## I. Scope

This policy establishes standard procedures for the examination and testing of fired cartridge cases or shotshells by firearm and toolmark examiners.

## II. Items Needed for Testing

- Unknown cartridge case or shotshell

## III. Parameters to be Determined

- Possible manufacturer of firearm used to fire unknown cartridge case or shotshell
- Common origin

## IV. Equipment and Supplies

- Camera
- Stereo microscope and/or comparison microscope
- Personal protective equipment
- Various light sources
- 1:10 bleach/water or known tuberculocidal disinfectant

## V. References

- FBI's General Rifling Characteristics (GRC) File (2021 version)
- Various ammunition manufacturers' catalogs and websites
    - All hard copies are stored in the FATM laboratory
    - Online resources are as-available
    - Suggested websites:
        - Municion.org/buscador/
        - Afte.org/resources/headstamp-guide
- Ammunition Reference Collection

## VI. Reference Standards / Materials Required

None

## VII. Description of the Procedures

A. Safety

1. Gloves shall be worn when handling any evidence item.

2. Disinfect any evidence items suspected of biological contamination. Use of a nylon brush is permitted. Wire brushes should never be used on evidence items.

B. Documentation

1. Label the evidence item and/or its container(s) according to QP 6.1 – Evidence Handling.

2. Take an overall photograph of the evidence item with scale.

3. Photograph the cartridge case headstamp.

4. All evidence photographs and examination documentation shall be documented using Form FATM-QMA7: Fired Cartridge Case(s).

C. Examination

1. Observe and note all applicable attributes listed on Form FATM-QMA7: Fired Cartridge Case(s).

2. Prior to any comparison to a known, ensure the cartridge case(s) (unknown) is inventoried, examined and documented.

D. Comparisons

1. If a firearm and/or cartridge case(s) of the same class characteristics was submitted, conduct comparisons as outlined in FATM Quality Manual Section VIII (Comparisons).

2. Use the criteria as described in the FATM Quality Manual Section VIII (Comparisons) to form a conclusion.

3. Comparisons between cartridge cases (and firearms, if applicable) of different caliber families will not be performed unless there is a specific request from a stakeholder, obvious distortions to the evidence are observed, or there is another forensic reason to do so.

4. Caliber / cartridge designation mis-match comparisons may be conducted at the discretion of the examiner, or at the request of the stakeholder. (Example: 380 Auto cartridge case compared to a 9mm Luger pistol.)

E. IBIS / NIBIN Suitability

1. If necessary, determine the entry suitability of the cartridge case. See FATM-05: IBIS / NIBIN for further guidance.

## VIII. Interpretation and Reporting of Results

A. Based on the criteria outlined in FATM Quality Manual Section VIII (Comparisons), common origin may be reported.

B. If the markings left by the firing process are indicative of a specific make/model of firearm, that information may be included in the case file, as well as the report.

## IX. Additional Notes

A. This policy is additionally applicable to fired shotshells, with the exception that Form FATM-QMA8: Fired Shotshell(s) will be used for documentation.

# FATM-04: SHOTSHELL COMPONENT EXAMINATION

**I. Scope**

This policy establishes standard procedures for the examination and testing of ammunition and ammunition components by firearm and toolmark examiners or technicians.

**II. Items Needed for Testing**

- Fired shotshell components (i.e., shotshell wad, shot)

**III. Parameters to be Determined**

- Gauge
- Shot size

**IV. Equipment and Supplies**

- Calipers / micrometer
- Camera
- Personal protective equipment
- Scale / balance
- Stereo microscope and/or comparison microscope
- Various light sources
- Various tools necessary for disassembly of ammunition
- 1:10 bleach/water or known tuberculocidal disinfectant

**V. References**

- Various ammunition manufacturers' catalogs and websites
  - All hard copies are stored in the FATM laboratory
  - Online resources are as-available
- Cartridges of the World
- National Rifle Association (NRA) Fact Book
- Ammunition Reference Collection

**VI. Reference Standards / Materials Required**

None

**VII. Description of the Procedures**

A. Safety

1. Gloves shall be worn when handling any evidence item.

2. Disinfect any evidence items suspected of biological contamination. Use of a nylon brush is permitted. Wire brushes should never be used on evidence items.

B. Documentation

1. Label the component and/or its container(s) according to QP 6.1 – Evidence Handling.

2. Take an overall photograph with scale.

3. Each component will be sub-itemized in the BEAST. Shot / pellets of similar size, weight and recovery location can be grouped as one item.

4. All evidence photographs and examination documentation shall be documented using Form FATM-QMA9: Shotshell Component(s).

C. Examination

1. Shot / Pellets

a. Ensure the calibration of the scale / balance and calipers are current.

b. Weigh a sampling of shot. Document the weight of each. Use the average to aid in shot size determination.

c. Measure the diameter of a sampling of shot. Document the diameter of each. Use the average to aid in shot size determination.

d. Selection of shot for sampling should be those pieces of shot that appear most complete and without attached debris (weight) or spherical (diameter).

2. Wad / Shot Column

a. Ensure the calibration of the calipers is current.

b. Measure the diameter of the wad or shot column. Document the diameter.

## VIII. Interpretation and Reporting of Results

A. Shot / pellets: Based on weight and diameter, a likely shot size can be reported.

B. Wad / shot column: Based on diameter, a likely gauge can be reported.

Note: Standard verbiage for such reporting shall be determined by the Firearm / Toolmark Unit Technical Manger and be maintained in the BEAST.

## IX. Additional Notes

None

# FATM-05: IBIS / NIBIN

**I. Scope**

This policy establishes standard procedures for the evaluation and entry of evidence and test fires into NIBIN through use of the Integrated Ballistics Identification System (IBIS).

As an agency with access to the National Integrated Ballistic Information Network (NIBIN), the OSBI Firearm & Toolmark Unit will comply with the minimum required operating standards (MROS) as published by the ATF.

**II. Items Needed for Testing**

- Fired cartridge cases (evidence and test fires)
- Fired bullets (evidence and test fires)

**III. Parameters to be Determined**

- Suitability for entry into IBIS/NIBIN

**IV. Equipment and Supplies**

- Stereo microscope and/or comparison microscope
- BrassTRAX system
- MatchPoint Plus system

**V. Reference Standards / Materials Required**

None

**VI. Description of the Procedures**

A. Evaluate the evidence type for entry.

1. Test fired shells/cartridge cases from pump action shotguns and all firearms that automatically eject cartridge cases (semi-automatic) will be evaluated for BrassTRAX entry. All others will be evaluated at the examiner's discretion (e.g., bolt action rifles, single shot shotguns, etc.).

2. Evidence cartridge cases in calibers likely to have been fired by a firearm as described above will be evaluated for BrassTRAX entry. If the evidence cartridge case is a caliber found in firearms that both meet and do not meet entry criteria, the examiner will error on the side of caution and evaluate the evidence for entry.

B. Evaluate the markings on the cartridge cases or bullets for entry suitability.

1. The overall presence, reproducibility, quantity and quality of the individual characteristics of the fired bullet or cartridge case should be used in making this decision.

2. For test fires, the 'best marked' cartridge case or bullet will be entered.

3. For groups of evidence linked to the same firearm, the 'best marked' cartridge case will be entered (i.e., triage).

4. Situations may arise where more than one cartridge case or bullet from a single firearm should be entered. An example would be test fired cartridge cases that have visible breechface marks on one test fired cartridge case, and firing pin aperture shear marks on another, with no one test fire exhibiting both of these markings.

5. Situations may arise where an evidence item may be the 'best marked,' even in comparison to the test fires. The evidence item may be entered as the representative sample for the firearm. Though the category of an evidence item would be 'crime evidence,' the item will be categorized as 'test fire' so that it is documented in the system that the firearm was recovered.

C. Acquire the suitable ballistic evidence.

1. The User Guides provided by the manufacturer are available when logged into BrassTRAX and MatchPoint, and shall be followed.

2. BrassTRAX ballistic evidence should be acquired within 2 business days of receipt to the Firearms & Toolmark Unit.

D. Disseminate the potential NIBIN Lead, as applicable.

1. Upload the NIBIN Lead Notification document from Huddle into the case file.

2. Email the Target and Candidate agencies to inform them of the potential NIBIN Lead, including the NIBIN Lead Notification document as an attachment. Document the email in the case narrative.
3. The potential BrassTRAX NIBIN Lead will be disseminated to the Target and Candidate agencies within 24 hours of the secondary review, as mentioned above.

E. Confirm the potential NIBIN Lead as a NIBIN Hit, if applicable/requested.

1. If confirmation is requested, it is the agencies' responsibility to coordinate the (re-) submission of the items mentioned in the potential NIBIN Lead report.

2. Once received, create a Firearms assignment under the Target and Candidate lab numbers.

3. Compare the Target and Candidate items. This comparison must be verified and documented as any other within the laboratory. If items were previously examined by the Firearm & Toolmark Unit, only documentation of the comparison is required.

4. Add the date of confirmation to the MatchPoint Plus system.

## VII. Interpretation and Reporting of Results

A. Results of suitability will be documented in the case notes. Entry into applicable systems will be documented in the respective systems, the case notes and report.

B. The extent of the search will be documented in the Notes section of the report.

## VIII. Additional Notes

A. Evidence of compliance to ATF MROS Standards 1 through 4 and 6 can be found within the OSBI Criminalistics Services Division Quality Manual and Quality Procedures.

# FATM-06: SERIAL NUMBER RESTORATION

**I. Scope**

This policy establishes standard procedures for the chemical restoration of obliterated markings, including but not limited to, serial numbers on firearms.

**I. Items Needed for Testing**

- Firearm with obliterated or altered serial number or other markings

**II. Parameters to be Determined**

- Manufacturer's or importer's markings, including serial numbers

**III. Equipment and Supplies**

- Cotton tipped swabs
- Rotary tool (Dremel)
- Sandpaper of varying grits
- Deionized water
- Acetone
- Chemical restoration reagents

**IV. References**

- Serial Number Database
- ATF Serial Number Structure Guide
- Royal Canadian Mounted Police – Firearms Reference Table
- Firearm Reference Collection
- NTC-Comprehensive Tracing Section (ntcgrpii@atf.gov)

**V. Reference Standards / Materials Required**

None

**VI. Description of the Procedures**

A. Safety

1. All chemical etchants used in serial number restoration will only be used in a fume hood.

2. The use of gloves and eye protection are required during serial number restoration.

B. Documentation

1. Complete all other documentation and testing of the firearm before beginning any restoration attempt. [See FATM-01, Firearm Examination]

2. A photograph of the serial number as received and after the restoration attempt are required. Additional photographs during the restoration attempt can be documented using Form FATM-QMA10: General Images/Notes.

3. The attempted restoration process shall be documented using Form FATM-QMA11: Serial Number Restoration.

4. Use available resources to determine the likely serial number structure of the firearm.

C. Surface Preparation

1. Remove dirt, debris, paint or other obscuring substances with water, acetone, nylon brush, etc.

2. Smooth scratches and burrs introduced during obliteration with an appropriate polishing technique, such as sandpaper or rotary tool. Depending on the extent of the obliteration, continue polishing until the surface is smooth, removing as many scratches as possible without destroying the deformation area. If the obliteration is severe, it may not be possible or desirable to remove all the scratches.

3. Restoration may be possible with effective surface preparation. If the markings are restored after surface preparation, skip to step E.

D. Chemical Restoration

1. Determine the magnetic properties of the serial number. Prepare or retrieve the appropriate chemical reagent(s).

    a. Magnetic media
        1. 25% Nitric Acid
        2. Fry's Reagent

    b. Non-magnetic media
        1. 25% Nitric Acid
        2. Acidic Ferric Chloride
        3. Ferric Chloride

2. Apply the chemical solution to the area of obliteration utilizing cotton tipped swabs that have been moistened with the appropriate reagent. The swab should be slowly and lightly wiped across the surface. Pooling of the reagent is permitted, but should not be the first technique utilized.

3. Document whether the expected reaction was or was not observed. If not observed, the reagent should be subjected to troubleshooting and/or replaced with newly-prepared items. Preparation instructions can be found in the ChemInv program.
    - Expected reaction for Fry's Reagent: dark grey/black color change
    - Expected reaction for acidic ferric chloride: bubbling/foaming
    - Expected reaction for 25% nitric acid: lightening of metal color

E. Verification

1. Any character that is restored shall be verified by a second qualified examiner. This is regardless of the extent of the serial number restoration, and regardless of the reported result.

2. Verification of the partially or fully restored serial number will be documented on Form FATM-QMA11: Serial Number Restoration. If verifying a specific character(s) before the restoration attempt is complete, the verifier can initial the specific character(s) during the restoration attempt. This includes characters restored during surface preparation.

3. Only if no characters were visible before, during and after all steps of restoration will a verification not be required.

4. Verifications can be via photograph and/or direct observation by the verifier.

## VII. Interpretation and Reporting of Results

A. Only verified characters will be reported.

B. The full result of the restoration attempt will be reported (e.g., unrestorable, partially restored, fully restored).

## VIII. Additional Notes

A. Though this protocol is written specifically for firearms, the processes are applicable to other items (e.g., Vehicle Identification Number on car). The use of this protocol on non-firearms items is acceptable, after prior approval from the FATM Supervisor/Technical Manager and the FATM Criminalistics Administrator.

B. The above-mentioned reagents will be prepared as documented in the Chemical Inventory system of the BEAST.

C. No reagents within this policy require routine checks beyond reliability testing at the time of preparation and observation of the expected reaction with each use.

# FATM-07: TOOLMARK EXAMINATION

## I. Scope

This policy establishes standard procedures for the examination, documentation and comparison of non-firearm tools and toolmarks. Using this policy, an examiner may determine whether or not a known tool was used to mark/cut an evidence toolmark.

## II. Items Needed for Testing

- Item(s) with toolmark(s)
- Tool(s)

## III. Parameters to be Determined

- Tool type
- Tool action
- Common origin

## IV. Equipment and Supplies

- Caliper
- Camera
- Casting material (e.g., AccuTrans)
- Engraver or scribe
- Personal protective equipment
- Ruler and/or tape measure
- Stereo microscope and/or comparison microscope
- Various light sources
- Test medium (i.e. lead wire, copper wire, lead sheeting, aluminum wire)

## V. References

None

## VI. Reference Standards / Materials Required

None

## VII. Description of the Procedures

A. Safety

1. Gloves shall be worn when handling any evidence item.

B. Documentation

1. Label the tool(s) and item(s) with toolmark(s); label its container(s) according to QP 6.1– Evidence Handling.

2. Take an overall photograph of the tool and the item with the toolmark(s) with scale, as well as a close-up photograph(s) of the toolmark(s). The close-up photograph should document any characteristics not visible in the overall photograph.

3. All evidence photographs and examination documentation shall be documented using Form FATM-QMA12: Tool(s) and Form FATM-QMA13: Unknown Toolmark(s)

C. Examination

1. Conduct a preliminary visual examination of the tool(s) and tool-marked item(s) and document the condition as received.

2. Document any pertinent observations such as damage and foreign or trace material.

D. Mechanical Functionality

1. Determine if the tool is in working order / as designed.

2. Determine if the tool is physically capable of making the toolmark.

a. If it is physically impossible for the tool to have made the toolmark, the result is an elimination based on differences in class characteristics. Documentation within the case file shall be sufficient for the technical reviewer to confirm this elimination (e.g., photographs or portion(s) of the documentation worksheet).

b. If the tool, or a portion of the tool, is capable of making the toolmark, continue to the observation and comparison of individual characteristics.

E. Test Marks / Cuts

1. Properly label each marking surface of the tool, and ensure the test toolmarks are labeled accordingly. [For further guidance, see FATM Training Manual for Toolmarks]

2. Sub-itemize the test toolmarks from the tool within the BEAST. Repackage the test cuts separately in a new container.

F. Comparisons

1. Compare test toolmark(s) to evidence toolmark(s). See FATM Quality Manual Section VIII (Comparisons) for further guidance.

2. Use the criteria as described in the FATM Quality Manual Section VIII (Comparisons) to form a conclusion.

## VIII. Interpretation and Reporting of Results

A. Based on the criteria outlined in FATM Quality Manual Section VIII (Comparisons), common origin may be reported.

## IX. Additional Notes

A. Some tool-marked items may be too large or unwieldy to examine microscopically. In these instances, a cast of the toolmark may be produced for microscopic examination. Casts may also be produced to improve visibility of the toolmark under the microscope, especially with translucent or highly reflective materials. If the toolmark is cast, then the test toolmarks must also be cast or reverse lighting should be used.

B. Inter-comparisons of evidence toolmarks have a higher risk of missed identifications and/or false eliminations due to the wide variety of ways a tool can be used to make a mark. To avoid this risk, comparisons shall only be conducted between evidence toolmarks and known test toolmarks.

C. Extreme caution shall be taken when eliminating a toolmark to a tool, based on the disagreement of individual characteristics. As tools can be used in many ways, they can also leave marks in many ways.

# FATM-08: GUNSHOT RESIDUE / DISTANCE DETERMINATION EXAMINATION

## I. Scope

This policy establishes standard procedures for visual and chemical testing of target material for the purposes of muzzle-to-target distance determination. Following these procedures, an examiner will be able to evaluate evidence for the presence of bullet/pellet defects and utilize visual examinations and chemical processing to determine the approximate distance (qualitative or quantitative) between the muzzle and target at the time of discharge.

The sequence of testing is critical. Testing will be performed in the following order:

1. Visual / microscopic examination
2. Modified Griess Test for nitrites
3. DTO Test for copper, if performed
4. Sodium Rhodizonate Test for lead

## II. Items Needed for Testing

- Target material (i.e., victim's clothing, with a suspect bullet hole)
- Evidence firearm (for quantitative results)
- Appropriate ammunition (preferred; for quantitative results)

## III. Parameters to be Determined

- Identify defects caused by the passage of a bullet, as well as their direction
- Identify the presence or absence of gunshot residue
- Determine an approximate muzzle-to-target distance

## IV. Equipment and Supplies

- Fume Hood
- Stereo microscope
- Personal protective equipment
- Photographic equipment
- Nitrite-free cheesecloth
- Nitrite-free filter paper
- Cotton swabs
- Desensitized photo paper
- Heat source (Iron)
- Scale
- Chemical applicators (droppers, spray bottles)
- Laboratory glassware
- Prepared sodium nitrite solution
- Prepared sulfanilic acid solution
- Prepared α-naphthol solution
- Prepared 15% acetic acid solution
- Purchased ammonium hydroxide solution
- Prepared Dithiooxamide (DTO) solution
- Prepared sodium rhodizonate solution

- Prepared 2.8pH buffer solution
- Purchased hydrochloric acid solution

**V. Reference Standards / Materials Required**

- Sodium nitrite
- Known copper
- Known lead

**VI. Description of the Procedure**

A. Safety

1. All reagents used in gunshot residue examination will only be used in a fume hood.

2. The use of gloves and eye protection are required during gunshot residue examination.

B. Documentation

1. Label the target material and its container(s) according to QP 6.1 – Evidence Handling.

2. Take an overall photograph with scale.

3. Take close-up photograph of hole(s), with scale.
   Note: If more than one hole examined, distinguish between holes by using description of location or unique title (e.g., Item 1, Hole 1; Item 1, Hole 2). Ensure photographs and notes are clear on which hole is which.

4. Examination documentation shall be documented using FATM QMA 14 (Gunshot Reside Examination worksheet) and all photographs will be stored in the case file.

C. Visual and Microscopic Examination

1. Perform a visual examination of the evidence item. Describe the item. Document observable physical characteristics (e.g., powder morphology) and residues on the item.

2. A microscopic examination (stereoscope or other magnifier) should also be performed, unless sufficient identifying characteristics are identified during an un-aided visual examination.

3. The visual or microscopic examination of an evidence item for gunshot residue will include the examination and/or consideration of the following:
   - The presence of vaporous lead (smoke)
   - The presence of particulate metals (shavings or solidified droplets of lead, copper, brass)
   - The presence and shape of partially burned and/or unburned gunpowder (distribution and density)
   - The presence of melted, adhering gunpowder
   - A hole or defect in the item

- The presence of a visible ring or wipe around the margin of the defect
- The location of all holes, tears, missing buttons, etc.
- The presence of burning, singeing, or melting
- The presence of any possible masking effects such as blood staining, rough handling, clothing damage, or intervening objects
- The direction of artifacts surrounding the hole

4. If the visual / microscopic observations support the findings of a contact shot, chemical testing may not be necessary.

    a. Further chemical testing is at the discretion of the examiner.

    b. If certain chemical tests are not performed, the examiner shall make note of why on FATM-QMA14. (Example: ammunition used is lead-only, no need to perform DTO as it is testing for copper.)

5. Some factors that might affect the visibility of residues include a dark background color of the examined item and the presence of blood, dirt, or other material. Prior to any chemical testing, these factors should be addressed, especially if any substance is present that might hinder or interfere with chemical testing results.

D. Chemical Testing – Modified Griess

1. As needed, prepare sensitized blanks, typically photographic paper.

    a. Combine equal parts of sulfanilic acid and α-naphthol solutions.

    b. Dip the paper in the solution.

    c. Allow to dry completely.

2. Positive control

    a. Dip a clean cotton-tipped swab in the prepared sodium nitrite solution. Dab the four corners of each of the sensitized blank(s) being used. Dip clean cotton- tipped swabs in 15% acetic acid. Using a new swab for each corner, dab the same spot in each corner of the photographic paper. If sensitive to nitrites, an orange color will appear.

        1. If the sensitized blank does not respond to the sodium nitrite solution, the blanks and the prepared sodium nitrite solution should be subjected to troubleshooting and/or replaced with newly-prepared items after consultation with the Supervisor/Technical Manager.

        2. Troubleshooting of the sensitized blanks should include the creation of new sensitized blanks using sulfanilic acid and α-naphthol solutions.

        3. Do not use sensitized blanks that do not produce a positive result with the positive control in casework.

b. Make note of the control result in the case file on FATM-QMA14.

3. Negative control

    a. Continued processing of the nitrite positive control blank should not show the characteristic orange color shift in areas exposed only to the reagents.

    b. If the blank begins to show a shift in color in areas exposed only to the reagents, the blanks should be subjected to troubleshooting and/or replaced with newly-prepared items after consultation with the Supervisor/Technical Manager.

    c. Make note of the control result in the case file.

4. Modified Griess test

    a. Direct Application Technique (porous target material)

        1. Place the sensitized blank over the questioned area and index seams, buttons, or other reference points using a pencil.

        2. Soak a piece of nitrite-free cheesecloth or filter paper with the 15% acetic acid solution, and place this over the reverse side of the evidence.

        3. Apply heat and pressure with an iron on the cotton setting until the cheesecloth or filter paper is dry. Separate the sensitized blank and the questioned item.

        4. Photograph or scan the photo paper after labeling, regardless of a positive or negative result. Store the photograph or scan in the case file.

        5. Once digitally stored and fully dry, discard the photo paper

    b. Reverse Application Technique (thick or non-porous target material)

        1. Wipe the side of the sensitized blank that will be in contact with the questioned area with the acetic acid solution.

        2. Place the sensitized blank over the questioned area and index seams, buttons, or other reference points using a pencil.

        3. Place a piece of nitrite-free cheesecloth or filter paper over either the sensitized blank or evidence depending on what is being used for a blank.

        4. Apply heat and pressure with an iron until the cheesecloth or filter paper is dry. Separate the sensitized blank and the questioned item.

5. Photograph or scan the photo paper after labeling, regardless of a positive or negative result. Store the photograph or scan in the case file.

6. Once digitally stored and fully dry, discard the photo paper.

E. Chemical Testing – Dithiooxamide (DTO)

1. Positive control

a. Before using in each case, moisten a clean cotton-tipped swab with the ammonia solution using a disposable plastic dropper. Rub the swab against the copper known. Drop the dithiooxamide solution on the swab. The test is reacting properly if a dark greenish-gray color appears immediately.

1. If the swab does not respond to the DTO solution immediately, the DTO solution and ammonia solution should be subjected to troubleshooting and/or replaced with newly-prepared items after consultation with the Supervisor/Technical Manager.

2. Do not use any DTO solution that does not produce a positive result with the positive control in casework.

b. Make note of the control result in the case file on FATM-QMA14 and discard the swab.

2. Negative control

a. Moisten a clean cotton-tipped swab with the ammonia solution using a disposable plastic dropper. Rub the swab against the evidence item, well away from any holes to be examined. Drop the dithiooxamide solution on the swab. If there is no color change, the evidence item being tested will not produce a false positive or other background interference.

b. If there is a color change, the DTO solution and ammonia solution should be subjected to troubleshooting and/or replaced with newly-prepared items after consultation with the Supervisor/Technical Manager.

c. Make note of the control result in the case file.

3. DTO Test

a. Moisten a piece of filter paper with the ammonia solution using a disposable plastic dropper.

b. Place the ammonia-treated filter paper over the area to be tested.

c. Place a second piece of filter paper over the first and apply moderate pressure for approximately 5 seconds.

d. Remove both pieces of filter paper and moisten the tested area of the filter paper with the DTO solution.

e. Evaluate test medium for any reaction.

f. Repeat this process on all areas or holes to be tested. Both sides of a hole should be tested if there is a question of entrance versus exit (direction).

4. Photograph the filter paper after labeling, regardless of a positive or negative result. Digitally store the photograph in the case file.

5. Once digitally stored and fully dry, discard the filter paper.

F. Chemical Testing – Sodium Rhodizonate

1. Positive control

a. Before using in each case, moisten a clean cotton-tipped swab with a 5% hydrochloric acid solution. Rub the damp cotton-tipped swab against a piece of known lead. Process the swab with the Sodium Rhodizonate test. Alternatively, the known lead can be rubbed onto a piece of filter paper and processed. The test is reacting properly if a visible pink/magenta color appears.

1. If the swab does not respond to the Sodium Rhodizonate test, the prepared sodium rhodizonate, hydrochloric acid solution and/or buffer solution should be subjected to troubleshooting and/or replaced with newly-prepared items after consultation with the Supervisor/Technical Manager.

2. Do not use any of the Sodium Rhodizonate reagents that do not produce a positive result with the positive control in casework.

b. Make note of the control result in the case file on FATM-QMA14 and discard the swab.

2. Negative control

a. Continued processing of the questioned target material should not show the characteristic purple color shift in areas exposed only to the reagents.

b. If the questioned target material begins to show the characteristic purple color shift in areas exposed only to the reagents, the prepared sodium rhodizonate, hydrochloric acid solution and/or buffer solution should be subjected to troubleshooting and/or replaced with newly-prepared items after consultation with the Supervisor/Technical Manager.

c. Make note of the control result in the case file on FATM-QMA14.

3. Sodium Rhodizonate Test

    a. Direct Application Technique (light-colored target material)

        1. Spray the sodium rhodizonate solution onto the questioned area.

        2. Spray the tested area with the buffer solution.

        3. Spray the tested area with the hydrochloric acid solution.

        4. Evaluate test medium for any reaction.

        5. Repeat this process on all holes/areas to be tested. Both sides of a hole should be tested if there is a question of entrance vs. exit.

        6. Photograph the evidence item, regardless of a positive or negative result. Store the photograph in the case file.

        7. Allow the questioned target material to dry completely before re-packaging.

    b. Transfer Technique (dark or stained target material)

        1. Uniformly dampen a piece of filter paper with the acetic acid solution.

        2. Place the treated filter paper over the area to be tested. (If additional support is needed, place a second piece of filter paper over the first.)

        3. Apply moderate pressure or apply a hot iron. Pressure should be applied for at least 5 seconds. The hot iron should be applied, with pressure, until the dampened filter paper appears dry.

        4. Remove filter paper and spray the sodium rhodizonate solution on to the tested area of the filter paper.

        5. Spray the tested area of the filter paper with the buffer solution.

        6. Spray the tested area of the filter paper with the hydrochloric acid solution.

        7. Evaluate test medium for any reaction.

        8. Repeat this process on all holes/areas to be tested. Both sides of a hole should be tested if there is a question of entrance vs. exit (direction).

        9. Photograph the filter paper after labeling, regardless of a positive or negative result. Store the photograph in the case file.

        10. Once digitally stored and fully dry, discard the filter paper.

11. Photographs should be taken quickly, as the positive reaction may fade.

G. Test Panel Production

1. Attach a piece of appropriate target material onto a nitrite-free cardboard backing board. Each test panel shall be labeled with the OSBI lab number, the known distance (excluding uncertainty), initials and date.

2. Mount the evidence firearm into the remote firing device. Move the remote firing device table to a known distance, using the 4-foot level and calibrated steel rule. Once the table is at the appropriate distance, lock the casters.

3. Using ammunition similar to that used in the shooting (as provided by the submitting agency via the RFLE or direct communication), fire one shot into the target material.

4. Repeat steps 1 – 3 with a new piece of target material at increasing or decreasing range increments until a range of distance is established that reproduces the gunshot residue on the evidence item.

5. Chemically process the test panels as per the appropriate Modified Griess, DTO and Sodium Rhodizonate procedures to develop a gunshot residue pattern for comparison to the evidence item(s).

Note: based on visual and/or microscopic examination, it may be determined that not all test panels need chemical processing. This is left to the discretion of the examiner; however, documentation of what panels were created and which were processed is required. If not all three chemical tests are performed and/or if all created test panels are not chemically processed, the examiner should include documentation to explain why those omissions were made in the case file.

NOTE: As the maximum distance of the calibrated steel rule is 36”, maximum distance testing cannot be performed, and test panels cannot be made at a distance greater than 36”.

## VII. Interpretation and Reporting of Results

A. Quantitative Results - By utilizing the evidence firearm and appropriate ammunition, it is possible to obtain a reproduction of a gunshot residue pattern present on an evidence item. Therefore, the approximate bracketed distance range that particular firearm’s muzzle was from the evidence item when it was shot can be determined.

1. The measurement uncertainty related to the test panel production can be found as Attachment 2 to this document.

2. Test panel creation and rounded expanded uncertainty values shall be expressed and reported to the nearest 1/32” of an inch, ±5/32” at a coverage probability of 99.73% (k=3).

3. The muzzle-to-target distance should be reported in a bracketed range, typically at least 12 inches in width, so as to account for possible differences in the ammunition actually used by the suspect and that used in the laboratory test firings.

B. Qualitative Results – By examining the target material (i.e., victim's garment), it is possible to use the observed residues to approximate the muzzle-to-target distance.

1. Contact / near contact: The muzzle of the firearm was in contact with or very near the target at the time of discharge with possible sooting, ripping, tearing and/or singeing of the target material. [Labeled as Contact in Figure 1]

a. Visual / Microscopic Examination

1. Ripping or tearing (particularly cruciform or stellate)

2. Burning or singeing

3. Melted synthetic fibers

4. Heavy vaporous lead residues

b. Modified Griess

1. Any orange or orange-red indications on the sensitized blank are the results of the chemically-specific test for the presence of nitrite residue.

2. These nitrite residues support the conclusion of a hole consistent with the discharge of a firearm.

3. In contact shots, these nitrite residues will likely be within the wound track; therefore, they may or may not be present in a contact / near contact shot.

4. Nitrite residues that come from a source other than a firearm typically appear as a haze, whereas reactions from residues that have come from a firearm typically appear as pinpoint reactions.

c. Dithiooxamide (DTO)

1. A dark greenish-gray color reaction constitutes a positive reaction for copper.

2. This positive reaction supports the conclusion of a hole consistent with the passage of a bullet (bullet wipe).

d. Sodium Rhodizonate

1. A visible pink / magenta color after the application of the sodium rhodizonate solution, corresponding to the margin of the hole or the area tested, constitutes a positive reaction for lead.

2. This positive reaction in a 'cloud' around the tested hole supports the conclusion of a hole consistent with the discharge of a firearm.

3. Barium or strontium may give a reaction of a slightly different color with the rhodizonate/tartrate reagents, but they will decolorize with the application of the hydrochloric acid solution.

4. Additional confirmation of the lead reaction is supported by observing a violet or purple color after the application of the hydrochloric acid solution.

5. In contact shots, these lead residues will likely be within the wound track; therefore, they may or may not be present in a contact / near contact shot.

2. <u>Close / intermediate range</u>

a. The range at which a firearm and ammunition combination will deposit visible or detectible gunshot residues on a target. [Labeled as Zones I, II and III in Figure1.

b. Visual / Microscopic Examination

1. Vaporous lead (smoke)

2. Particulate metals (lead, copper, brass)

3. Unburned gunpowder (morphology)

4. Melted, adhering gunpowder

c. Modified Griess

1. Any orange or orange-red indications on the sensitized blank are the results of the chemically-specific test for the presence of nitrite residue.

2. These nitrite residues support the conclusion of a hole consistent with the discharge of a firearm.

3. Nitrite residues that come from a source other than a firearm typically appear as a haze, whereas reactions from residues that have come from a firearm typically appear as pinpoint reactions.

d. Dithiooxamide (DTO)

1. A dark greenish-gray color reaction constitutes a positive reaction for copper.

2. This positive reaction supports the conclusion of a hole consistent with the passage of a bullet (bullet wipe).

e. Sodium Rhodizonate

1. A visible pink / magenta color corresponding to the margin of the hole or the area tested, constitutes a positive reaction for lead.

2. This positive reaction in a 'cloud' around the tested hole supports the conclusion of a hole consistent with the discharge of a firearm.

3. Barium or strontium may give a reaction of a slightly different color with the rhodizonate / tartrate reagents, but they will decolorize with the application of the hydrochloric acid solution.

3. Distant / undetermined: Only the bullet reaches the target [determined by chemical testing (bullet wipe), defect characteristics, or autopsy information]. No tearing of the target material observed and no gunpowder particles or soot are observed or chemically detected. [Labeled as Zone IV in Figure 1.]

a. Visual / Microscopic Examination

1. A hole in an item

2. Visible ring around the perimeter of hole, possible "bullet wipe"

3. Relative location of hole or tear to a recovered bullet

b. Modified Griess

1. Negative for nitrite residues

c. Dithiooxamide (DTO)

1. A dark greenish-gray color reaction constitutes a positive reaction for copper.

2. This positive reaction supports the conclusion of a hole consistent with the passage of a bullet.

d. Sodium Rhodizonate

1. A visible pink / magenta color corresponding to the margin of a hole, constitutes a positive reaction for lead.

2. This positive reaction supports the conclusion of a hole consistent with the passage of a bullet.

3. Negative for lead residues outside of bullet wipe, as described above.

4. Negative for gunshot residues

a. No physical characteristics or gunshot residues that indicate the discharge of a firearm can be observed or chemically developed.

b. If only a hole is present (i.e., no gunshot residues) and, after testing, the examiner is unable to determine if that hole was caused by the passage of a bullet, the examiner shall report a conclusion of negative for gunshot residues.

c. 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.

1. Less-than-optimal case situations or other limitations may occur, such as:
   - Elongated patterns caused by angled discharges
   - Disturbed or incomplete patterns caused by intervening objects
   - Partially disturbed patterns caused by other clothing articles (e.g., folds in clothing, rolled up sleeves)
   - Partial patterns caused by the relationship of pattern to target (e.g., half pattern caused by an over the shoulder discharge)
   - Insufficient evidence information (e.g., specific type of ammunition)
   - Interference due to biological contamination
   - Poor evidence handling by medical staff and/or crime scene collection

2. Other reasons for a lack of residue could be that the defect was made by the exiting of the bullet from the target, or that the defect was not made by a bullet.

C. If requested examinations were not performed due to the item being a secondary target (e.g., underwear when the victim was wearing pants), or not near the gunshot (e.g., shoes in a case where the victim was shot in the chest), a statement shall be added to the report regarding the items not being examined.

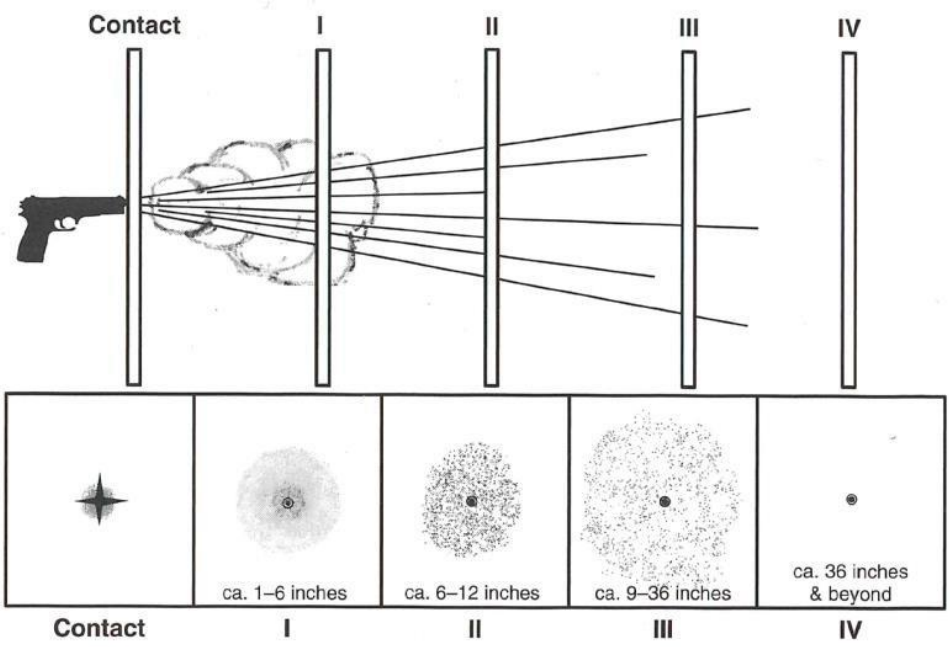



*Figure 1 The General Characteristics and Behavior of Gunshot Residues with Range from L.C. Haag's Shooting Incident Reconstruction, 1st Edition, 2006.*

## VIII. Additional Notes

A. Each distance determination examination is likely meant to answer a specific investigative question, and that question may not need a qualitative or quantitative answer. It is possible that the presence or absence of gunshot residues and their location(s) is sufficient to answer that investigative question. Communication between the stakeholders and examiner is key to best serve the evidence and the investigation. Any and all communications shall be documented in the case file.

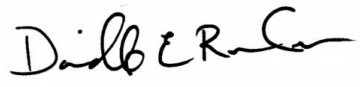
B. Due to the infrequency in which this type of examination is requested, and subsequently sent to trial, it is recommended that when an examiner will be testifying to gunshot residue examinations, this policy and Module 12 of the FATM Training Manual be reviewed prior to the date of the subpoena.

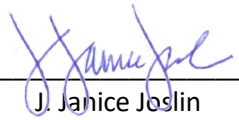
C. The above-mentioned reagents will be prepared as documented in the Chemical Inventory system of the BEAST.

D. No reagents within this policy require routine checks beyond reliability testing at the time of preparation and before each use, through each of the positive control procedures.

# APPROVAL

FATM Technical Manager  Date 08/09/2024
Katelyn J Millar

CSD Quality Manager  Date 08/09/24
Danielle Ross-Carr

CSD Division Director  Date 08/09/2024
J. Janice Joslin

# HISTORY

| Rev # | Effective Date | History |
|---|---|---|
| 00 | 04-19-2022 | Reformatted entire Manual (including forms) in order to align with ISO/IEC 17025:2017 Standards and AR 3125. Additionally, reformatted to include a table of contents and consistent font type/size formatting. |
| 01 | 07-18-2022 | Incorporated deviations and internal audit findings/suggestions [see Track Changes document] |
| 02 | 12-26-2022 | Incorporated deviations and other suggestions [see Track Changes document] |
| 03 | 08-21-2023 | Incorporated deviations and other suggestions [see Track Changes document] |
| 04 | 08-12-2024 | Incorporated deviations and other suggestions [see Track Changes document] |