

## Firearms/Toolmarks Discipline Standard Operating Procedure for Bullet Examinations

### 1 Scope

This procedure is designed for the evaluation and examination and comparison of bullet(s) bearing toolmarks. Bullet examinations include the evaluation of submitted items (e.g. bullets, bullet jackets, bullet cores, bullet fragments; referred to as bullets and/or item in the remaining document) to determine the value of any toolmarks that may be present, and the physical and microscopic examination of a bullet to determine a source conclusion.

This procedure applies to Firearms/Toolmarks Discipline (FTD) personnel conducting forensic examinations in the following category of testing:

- Firearms

Additionally, the following terms will be used throughout this procedure:

- **Toolmark:** Impressed and/or striated feature(s) created when a tool (harder object) makes forceful contact with an item (softer object) transferring physical and/or microscopic features.
- **Physical Characteristics:** Observable features of a specimen which indicate a restricted group source and are determined prior to manufacture (e.g., shape, color, design).
- **Class Characteristics:** Measurable or discernible features of a specimen which indicate a restricted group source. They result from design features and are determined prior to manufacture.
- **Subclass Characteristics:** Features that may be produced during manufacture that are consistent among items fabricated by the same tool in the same approximate state of wear. These features are not determined prior to manufacture and are more restrictive than class characteristics.
- **Individual Characteristics:** Marks produced by the random imperfections or irregularities of tool surfaces. These random imperfections or irregularities are produced incidental to manufacture and/or caused by use, corrosion, or damage.
- **Unsuitable:** An item bearing no class or individual characteristics for comparison.
- **Suitable:** An item bearing class and/or individual characteristics for comparison.
- **Microscopic Marks of Value (MOV):** An item that may or may not bear class characteristics and contains individual characteristics having quality and/or quantity for a source conclusion comparison.
- **Limited Microscopic Marks of Value (LMOV):** Individual characteristics that are limited in quality and/or quantity for a source conclusion comparison.
- **No Microscopic Marks of Value (NMOV):** Absent of individual characteristics for a source conclusion comparison.

- **Comparison:** The evaluation of two or more items bearing class and/or individual characteristics of value during an examination.
- **Light Comparison Microscopy (LCM):** The use of connected optical microscopes to compare and evaluate microscopic features between two toolmarks.
- **Virtual Comparison Microscopy (VCM):** The use of software to compare and evaluate the digital reproduction of microscopic features between two toolmarks.
- **3D Toolmark Topographical Instrument (3D instrument):** A device that can measure and record the x, y and z positions of microscopic features contained within a toolmark and produce a digital reproduction of the toolmark.
- **Source Conclusion:** An Examiner's conclusion regarding the origin of a toolmark or fracture.

## 2 Equipment/Materials/Reagents

- Known exemplars
- Measurement equipment
- Microscope (stereozoom/comparison)
- Personal protective equipment (PPE)

## 3 Standards and Controls

Known exemplars produced from evidentiary items during examination serve as controls. Exemplars may include bullets (test fires) produced by a known firearm. Exemplars produced from the known item will be treated as secondary evidence in accordance with the *FTD SOP Documentation and Preparation of Evidentiary Items* and marked in accordance with the *FTD QAM Marking and Examination of Evidence*.

## 4 Performance Checks

**4.1** Performance checks of the measurement equipment will be performed and recorded as outlined in the *FTD SOP Measurement, Calibration, Performance Check and Maintenance of Equipment*.

## 5 Sampling

**5.1** Statistical sampling is not applicable in the FTD.

**5.2** Non-Statistical sampling is employed in the FTD. It is based on the training, experience and competence of the examiner. No assumptions are made regarding items/portions that were not selected for examination and Results of Examination in *Laboratory Reports* are specific to the items/portions that were examined.

## 6 Procedures

### 6.1 Evaluation of a Bullet Bearing Toolmarks

**6.1.1** Review all previous observations of the item that were recorded in accordance with the *FTD SOP Documentation and Preparation of Evidentiary Items*.

**6.1.2** Ensure that the item and/or container has been properly labeled with the appropriate identifier.

**6.1.3** Ensure that the item has been reviewed for any trace evidence that could be of probative value. It is at the discretion of the examiner to ensure coordination of the removal and preservation of trace evidence with the appropriate discipline examiner.

**6.1.4** If no trace evidence is observed or has no probative value, the item can be cleaned in preparation for examination in accordance with the *FTD SOP Documentation and Preparation of Evidentiary Items*.

### 6.2 Level 1 Analysis – Evaluation and Classification of a Bullet Bearing Toolmarks

#### 6.2.1 Physical Characteristics

**6.2.1.1** If possible, attempt to determine the physical characteristics of the bullet:

- Base type
- Composition
- Cannelure
- Type of bullet
- Weight

#### 6.2.2 Class Characteristics

**6.2.2.1** If possible, attempt to determine the class characteristics of the bullet:

- Caliber
- Diameter
- Groove Impression width
- Land impression width
- Rifling Number
- Rifling Direction

**6.2.2.2** Refer to the *FTD SOP Measurement, Calibration, Performance Check and Maintenance of Equipment* for guidance on recording general rifling characteristics (GRCs).

**6.2.2.3** Class differences may result from intentional design decisions made by the manufacturer or from minor variations in tool dimensions or finishing methods that are within acceptable manufacturing tolerances for a particular tool.

### 6.2.3 Subclass Characteristics

6.2.3.1 Evaluate for any subclass characteristics in the toolmarks.

6.2.3.2 If possible, attempt to determine the impact on the comparison examination.

## 6.3 Level 2 Analysis (Microscopic) – Evaluation, Classification and Comparison of a Bullet Bearing Toolmarks

6.3.1 During the microscopic evaluation, observations may provide further information regarding the class and/or sub characteristics of the toolmarks.

### 6.3.2 Individual Characteristics

6.3.2.1 Evaluate the individual characteristics of any observed toolmarks to determine if the microscopic marks are of value for comparison purposes. Value refers to the significant quality and quantity of the individual characteristics present on an item. This evaluation can result in any of the following classifications:

<b>NMOV</b>	Microscopic marks are of <i>no value</i>	No microscopic comparison
<b>LMOV</b>	Microscopic marks are of <i>limited value</i>	Suitable for microscopic comparison
<b>MOV</b>	Microscopic marks are of <i>value</i>	Suitable for microscopic comparison

6.3.3 For test fired bullets, evaluate the working surfaces of the known barrel to determine if any manufacturing characteristics may assist in restricting and/or eliminating the influence of subclass characteristics.

6.3.4 All observations of a bullet bearing toolmarks, to include evaluations of physical, class, subclass and individual characteristics, will be recorded on the appropriate *FTD Worksheet* located in Appendix B of *FTD QAM Case Assignment, Records, Results and Verifications*.

6.3.6.1 For items with no observed class characteristics and NMOV, no further examinations will be performed.

6.3.8.1 For bullets with observed class characteristics and NMOV, additional information may be reported using other Standard Operating Procedures within the FTD (e.g., class characteristic database search, reference materials).

## 6.4 Level 2 Analysis (Microscopic)– Comparison and Pattern Matching

6.4.1 A comparison of bullets bearing toolmarks will be performed in accordance with the *FTD SOP Comparison and Pattern Matching*.

**6.4.2** When an inconclusive or elimination conclusion is reached between bullets, a search of the FBI Laboratory's GRCs database may be performed in accordance with the *FTD SOP Class Characteristic Database Entries and Searches* to produce a list of firearms that could have fired the bullet(s).

## 7 Calculations

Using the following equation, the diameter of a mutilated bullet can be determined using the land and groove measurements (sum of land and groove measurements equals the circumference):

$$\text{Circumference} = \pi \times \text{diameter}$$

## 8 Measurement Uncertainty

Not Applicable.

## 9 Limitations

Identifiable microscopic marks may not be reproducible from shot to shot due to changing of the barrel, corrosion, leading, etc. Under such circumstances it may be impossible to identify the known test bullets with each other. Further, mutilated, corroded, and deformed bullets may be of no value for comparison purposes.

## 10 Safety

Take standard precautions for handling of all evidentiary items and measurement equipment. PPE should also be utilized.

## 11 References

Mathews, J.H., Firearms Identification, Vols. I-III, Charles C. Thomas, Springfield, IL (1977).

FBI Laboratory Quality Assurance Manual

FBI Laboratory Operations Manual

“FTU Safety Protocols for Handling of Firearms and Ammunition”, Appendix A, *FTD SOP Firearm Examinations*

Glossary of the Association of Firearm and Tool Mark Examiners, AFTE Training and Standardization Committee, 6<sup>th</sup> Edition, Version 6.030317.1.

Gunther, J.D., and Gunther, C.O., The Identification of Firearms, John Wiley, New York (1935).

Hatcher, J.S., Jury, F.J., and Weller, J., Firearms Investigation, Identification and Evidence, The Stackpole Co., Harrisburg, PA (1957).

Harris, Daniel C., Quantitative Chemical Analysis, 3<sup>rd</sup> ed., W. H. Freeman and Company, New York (1991).

“SWGGUN Admissibility Resource Kit (ARK).” Resources, The Association of Firearm and Tool Mark Examiners. Web. Accessed 5 February 2020.

Rev. #	Issue Date	History
4	03/07/12	Updated section 8 for consistency with Revision 5, QAM. In sections 6.2.4 and 6.3.3, added reference to GRC SOP.
5	03/02/20	Updated Title of SOP, Reformatted Scope and added terminology to Section 1. Equipment listing updated in Section 3. Titles for referenced SOPs were updated in Section 3. Referenced new SOP in Section 4. Clarified sampling options in Section 5. Procedures were updated throughout Section 6. Referenced new SOPs in Section 6.41 and 6.4.2. Updated Section 8 title. Updated references in Section 11.

**Approval**

Redacted - Signatures on File

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Date: 02/28/2020

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