

Firearms/ Toolmarks Discipline Standard Operating Procedure for Comparison and Fracture Matching

1 Scope

This procedure is designed for the comparison of fractured items of evidence (referred to as fracture in the remaining document). In addition, this procedure outlines the methods for comparison microscopy. Fracture matching includes the evaluation of submitted items to determine the value of any fracture that may be present, and the physical and microscopic examination of surface contours of two objects to determine if they were once joined.

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

- Toolmarks

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

- **Fracture**: three-dimensional surface contour variations that were produced due to the separation of an object under the action of stress.
- **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 factors and are determined prior to manufacture.
- **Suitable**: An item bearing class and/or individual characteristics for comparison.
- **Microscopic Marks of Value (MOV)**: 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.
- **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 surface contour variations between two fractured items.
- **Source Conclusion**: An Examiner's conclusion regarding the origin of a toolmark or fracture.

2 Equipment/Materials/Reagents

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

3 Standards and Controls

Known exemplars produced from evidentiary items during examination serve as controls. 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

Not Applicable.

5 Sampling

Not Applicable.

6 Procedures

When a comparison is performed between two surface contours, like material should be used. When casts are produced from surface contours of one item, any subsequent surface contours must also be cast.

6.1 Level 1 Analysis – Comparison of Fractured Surfaces

6.1.1 Review the class characteristic(s) and determine the following:

- Disagreement in Class Characteristics – **Exclusion** opinion can be rendered.
- Agreement in Class Characteristic(s) or could not determine – Fracture Matching continues in Level 2

6.1.1.1 An exclusion result will be verified in accordance with the *FTD QAM Case Assignment, Records, Results and Verifications*.

6.2 Level 2 Analysis – Comparison of Individual Characteristics

6.2.1 Using comparative microscopy and/or physical fit, compare the individual characteristics in the random surface contours and render one of the following decisions:

- **Fracture Match**; two or more fracture items were once joined.
- **Inconclusive**; due to a lack of sufficient corresponding microscopic marks of value, no conclusion could be reached as to whether two or more fractured items were once joined.

6.2.1.1 A fracture match result will be verified in accordance with the *FTD QAM Case Assignment, Records, Results and Verifications*.

6.2.1.2 For an inconclusive fracture examination result, additional information may be reported using other Standard Operating Procedures within the FTD.

6.3 Level 1 and Level 2 – Conclusions Rendered

6.3.1 The following opinion workflow will aid in reviewing the details pertaining to the opinion(s) rendered:

Level 1 Conclusions	Level 2 Conclusions
<ul style="list-style-type: none"> • Comparison of Physical and Class Characteristics: <ul style="list-style-type: none"> - Disagreement - Agreement • Conclusion: <ul style="list-style-type: none"> - <i>Elimination</i> <ul style="list-style-type: none"> ○ Difference in physical/class characteristics 	<ul style="list-style-type: none"> • Comparison of Individual Characteristics: <ul style="list-style-type: none"> - Suitable <ul style="list-style-type: none"> ○ LMOV ○ MOV • Conclusions: <ul style="list-style-type: none"> - <i>Fracture Match</i> <ul style="list-style-type: none"> ○ Sufficient agreement in individual characteristics - <i>Inconclusive</i> <ul style="list-style-type: none"> ○ Sufficient agreement not observed in individual characteristics • Verifications: <ul style="list-style-type: none"> - <i>Identification – Fracture Match</i>

7 Calculations

Not Applicable.

8 Measurement Uncertainty

Not Applicable.

9 Limitations

Fracture Matching is an empirical science that relies on objective measurements and a subjective comparison of individual characteristics.

Due to variation in substrate, changes in tool working surfaces from wear, corrosion, and abuse, or the employment of unusual tool/work piece orientations, toolmarks created by the same tool are not always identifiable.

10 Safety

Take standard precautions for the handling of all evidentiary items. PPE should be also be utilized.

11 References

Davis, J.E., Tool Marks, Firearms and the Striagraph, Charles C. Thomas, Springfield, IL (1958).

FBI Laboratory Quality Assurance Manual

FBI Laboratory Operations Manual

“Forensic Optical Topography, Landscape Study, December 2016”, Forensic Technology Center of Excellence, NIJ Award Number 2011-DN-BX-K564.

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

Miller, Jerry, “An Introduction to the Forensic Examination of Toolmarks”, AFTE Journal, 2001; 33 (2): 233 through 247.

Orench, Jose A., “A Validation Study of Fracture Matching Metal Specimens Failed in Tension”, AFTE Journal, 2005; 37(2):142 through 149.

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

“Theory of Identification, Range of Striae Comparison Reports, and Modified Glossary Definitions – An AFTE Criteria for Identification Committee Report”, AFTE Journal, 1992; 24 (3), 340.

“Theory of Identification as it Relates to Toolmarks: Revised By: Committee for the Advancement of the Science of Firearm & Toolmark Identification”, AFTE Journal, 2011; 43 (4), 287.

United States. Department of Justice. Office of Legal Policy. Forensic Science. (2019, January) *Department of Justice Uniform Language for Testimony and Reports for the Forensic*

Firearms/Toolmarks Discipline – Fracture Match Examination. Retrieved from the Department of Justice Web site: <https://www.justice.gov/olp/page/file/1083666/download>

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Approval

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Firearms/Toolmarks
Unit Chief

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Scientific & Biometric
Analysis Unit Chief

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Firearms/Toolmarks
Technical Leader

Date: 02/28/2020