Firearms Section

Comparative Analysis Methodology

1. Scope

1.1 Examinations for bullets, cartridge cases, tool marks and physical/fracture matching will be conducted when recovered as physical evidence from a crime scene. This examination can provide information for investigative lead purposes and/or when testimony is required after comparative analysis.

1.2 Comparative analysis may be conducted between test fires, test tool marks, or piece/object of origin (knowns) to evidence (unknown). Evidence (unknowns) may be compared to each other. Comparisons may show marks of value in any combination that are impressed, striated, or physically match.

1.3 Test specimens, when available, are compared to each another prior to being compared with evidence.

1.4 Positioning of specimens on the microscope, lighting and magnification all play important roles in the ability to see what information is present on the specimens.

1.5 This section utilizes *pattern matching* techniques. This process of form perception is where the examiner must use training and experience to locate sufficient matching agreement between questioned and known to form a conclusion.

2. Safety and Quality Assurance

2.1 Ensure that proper PPE is worn when dealing with sharp objects or items that have biological evidence. Equipment and instrumentation will be cleaned after examining evidence contaminated with biologicals.

2.2 The tests from known evidence will be evaluated to determine the type of marks produced by the known and the suitability of those marks for an association with an unknown. If the known tests have sufficient and repeatable marks, they can be used for comparison.

2.3 If tool marks on the known tests are not reproducing consistently and cannot be matched to one another then it cannot be used for comparison with unknowns.

2.4 Unknown samples will be examined to determine if they are suitable before they are compared with knowns.

2.5 The examiner should use caution when examining pieces close together making sure the pieces do not contact each other in a way that could damage, alter or destroy the minute detail.

3. General for all examinations

3.1 The case file will contain all necessary documentation to support the examination process and conclusions via notes, diagrams, photographs, or any combination of these.

3.2 Trace evidence such as blood, hair, tissue, paint, wood, fibers, and other trace will be documented and collected as needed.

3.3 Perform a visual examination of the items. Suitability and class characteristics are noted. Unique characteristics are examined further visually and/or microscopically

3.3 Comparison of known components may be required to compare against unknowns.

4. Projectiles, Bullets, Shot Pellets, and Slugs

4.1 Document the bullet composition, shape, cannelures, and contaminants, when feasible. This may not be feasible if the bullet is too damaged or missing these features.

4.2 The bullet may be cleaned and straightened to reveal the necessary microscopic detail. If necessary, the petals of an expanded bullet may be bent or cut to expose additional areas on the bullet's surface.

4.3 Determine the pellet type such as lead, bismuth, tungsten, steel or other.
Measure the bullet or pellets to determine caliber/size and weight, if feasible.

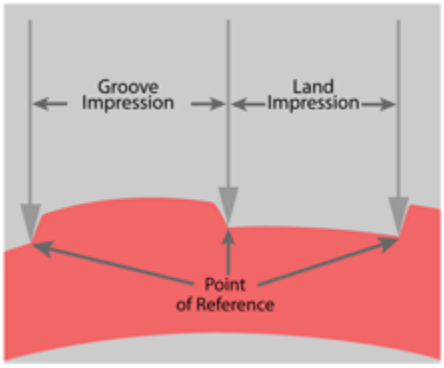
4.4 Count or determine the number of lands and grooves on bullets, if available.

4.5 Measure the diameter and the land and grooves on a bullet to provide a list of possible firearms that could have fired the bullet. The search list will be provided to the case investigator for investigative lead purposes. No database is all inclusive. It is not necessary to conduct a general rifling search when a firearm is submitted, and a direct comparison of the lands and grooves can be conducted.

4.5.1 A caliper or micrometer may be used to measure the bullet diameter.

4.5.2 The lands and grooves may be measured using a micrometer placed on one stage of the microscope or using a mini scale.

4.5.3 The land and grooves should be measured at the base of the land and groove as shown, with the area being measurement in the center and as level as possible.



4.5.4 The measurements may be searched in the Federal Bureau of Investigations General Rifling Characteristic's (GRC) Database or using the Association of Firearm and Toolmark GRC via the website.

4.5.5 The land and groove measurements are measured to the nearest 1000th of an inch and the measurements may be expanded to accommodate for distortion and/or damage.

4.5.6 The database provides a list of manufacturer's that are known to manufacture firearms with certain rifling characteristics. The cartridge case information such as caliber designation or other descriptors may be used in the search as well. The database does not contain every firearm manufacturer.

4.5.7 The list of firearm manufacturers may be given to the case primary for investigative purposes and is not conclusive.

4.6 The bullet may be marked by the examiner, if the marks are placed in a location that will not obscure tool marks left on the bullet from the firearm. If this is not feasible, the evidence container will be marked.

5. <u>Cartridges, Cartridge Cases, Shot shells, and Wads</u>

5.1 Document the head stamp, the case and primer type (nickel, brass, aluminum, or steel) and/or load in shotshell.

5.2 Note any damage, such as flattening, scuff marks, splitting, primer deformation, case bulging, fluting marks, or dents.

5.3 When there is no known firearm submitted the firing pin shape, extractor and ejector may be utilized on cartridge cases and shotshells to provide a possible firearm type. This information is useful for investigative purposes only.

5.3 Measure the base of the wad to determine gauge. Measure, if needed, pellet indents to determine shot size loaded in the wad.

5.4 The wad design can sometimes aid in determining the manufacturer.

6. Tool marks

6.1 ***The variety of tools and the way they are used can vary; therefore, examiner discretion is important when selecting examination methods.***

6.2 Document the type of tool, defects, and manufacturing marks on the working edges.

6.3 The examiner will mark the tool with his/her identifying marks in a non-critical area or the container in which the item was packaged.

6.4 Label areas near the working edges of the tools with numbers or letters so that the area can be identified. Mark the area on the test with the corresponding number or letter to identify the area that made the marks.

6.5 Marks or labels will be done using a Sharpie or other marker that will not obscure manufacturing or wear marks needed in making microscopic examinations.

6.6 Tests can be made in a variety of media such as: lead, wax, wood, drywall, metal or other. Each case is different, and the media needed will vary depending on the case and the reproducibility of the tool marks needed.

6.7 Microscopic examination can be conducted directly on the evidence (unknown) to the test marks from the tool (known) or casts of the evidence (unknown) can be compared to cast tool marks from the tool (known).

6.8 If a tool mark is determined to be an elimination based on class characteristics, the examiner should evaluate the markings on the scope to ensure there is no anomaly that is overlooked.

6.9 When tool marks are located on an individual such as skin, photographs or tracings may be used for comparison. Photoshop or another imaging software may be utilized in the examination.

6.10 Tool marks may be found on a variety of surfaces which include, but is not limited to the following: metal, wood, plastic, rubber, wax, skin, bone or other.

7. **Fracture Match/Physical Fit**

7.1 Examination of the known is conducted and the same characteristics are examined in the same or similar manner as the unknown.

7.2 If the overall characteristics of the items submitted for comparison are grossly different it can be determined that the items did not originate from a common source and WERE NOT once one piece.

7.3 Comparisons between unknown and known may be done side by side visually, and/or microscopically. In some instances, the examiner may find pieces with complementary edges. The examiner should rely on the sense of touch as well as the sense of sight when performing this type of examination.

7.4 If the items "fit" together, the separation line is examined for continuity of surface markings. Surface markings include, but are not limited to color, condition, patterns, striations, extrusion marks or any irregularities or defects that may run across the surfaces Lighting is instrumental and may involve back lighting, oblique light or reverse lighting.

7.5 The microscope may be utilized to examine the surface topography on fractured pieces.

7.6 If no physical match is determined to exist between the two items, but they exhibit similar overall characteristics, it is possible that:

- They did not originate from a common source
- They originated from a common source, but connecting pieces of material are missing
- They originated from a common source but lack sufficient unique characteristics to form a stronger conclusion.

8. **Range of Conclusions**

8.1 **Identification**, when there is sufficient agreement of a combination of individual characteristics and all discernable class characteristics.

- The agreement must exceed individual characteristics or random agreement that can occur when two items are not from the same source.
- Agreement must be consistent with the agreement demonstrated by items known to have been produced by the same tool or agreement found beyond a few random matching characteristics.
- Sufficient agreement is significant duplication of random/unique defects and/or tool marks that correspond.

- The corresponding tool marks may consist of repeating patterns that are comprised of individual peaks, ridges and furrows that have relative height, depth, width, curvature, and spatial relationship.

8.1.1 Terminology used in notes and/or report to reflect a positive identification may state but is not limited to: was fired from, was fired in, was made from, was at one time joined, connected or one piece.

8.2 Inconclusive Conclusions, when all class characteristics of the test and evidence items are the same, however:

8.2.1 Some agreement of individual characteristics and all discernable class characteristics, but insufficient for identification.

8.2.2 Agreement of all discernable class characteristics with absence of individual characteristics and/or lack of reproducibility.

8.2.3 Agreement of all discernable class characteristics and disagreement of individual characteristics, but insufficient for an elimination.

8.2.4 Terminology used in notes and/or report to reflect this conclusion may state but is not limited to: could have been fired in, could have been fired from, could have been made by, consistent with or could have been connected or joined.

8.3 Elimination Conclusion - Significant disagreement of discernable class characteristics and/or individual characteristics

8.3.1 Terminology used in notes and/or report to reflect this conclusion may state but is not limited to: was not fired in, was not fired from, was not made by, were not joined, connected or one piece

8.4 Unsuitable Conclusion – Unsuitable for microscopic examination

8.4.1 Usually referring to an item or projectile that has fragmented and the pieces (lead, copper jacket or other) are too small or too damaged for further examination. No usable tool marks remain on the item to be used for identification purposes.

9. Technical Review and Verification

9.1 All examinations are technically reviewed, and microscopic conclusions are verified.