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12.0 Tool Mark Examination Protocol

12.1 Tool mark evidence examinations are one of the more difficult and challenging tasks in the area of comparative analysis. This is because of the variety of tools encountered and the diversity of class and individual characteristics that any one tool may produce in the form of tool marks. The resulting tool marks depend primarily on how the tool was used in a particular case. The major problem is to determine how and under what conditions the tool was used in order that replicate test marks can be produced. Comparative analysis of tool marks requires patience and a systematic approach in order to attain a high rate of success in arriving at comprehensive examination results.[1]

12.2 Examination of a tool:

12.2.1 **Describe the tool.**

- A sketch or photograph of the tool should be made to assist the examiner in describing the tool.
- Note the manufacturer of the tool if determined..
- Note the type of the tool. e.g. pliers, flat blade screw, channel locks, pry bar, etc.
- Note the model of the tool if it can be determined.
- Note any serial number on the tool if found.

[1] California Department of Justice Firearms/Tool mark Identification Training Syllabus, Module -7 - Professionalism , Reprinted in AFTE Journal Volume 3, Number 2, April 1991 on page 716.

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- Note the type, color and condition of the tools finish.

- Note if tool has grips or handles and describe composition, finish and condition.

- Measure the tool.

  - Overall length
  - Length of blade on screwdrivers, knives, etc.
  - Size of bar stock on pry bars, screwdrivers, etc. (optional)
  - Width and thickness of screwdriver, pry bar and other similar tools prying tip(s)/working end(s).
  - Diameter of head of hammer and similar type impact tools.
  - Length of cutting head blades on scissors, wire cutters, bolt cutters and similar type shearing, cutting type tools.
  - Size of the jaw (length and width) on pliers and other gripping type tools.
  - Number of teeth and the distance between teeth on pliers and other gripping type tools.
  - Any other measurement deemed necessary by examiner.

12.2.2 Note any trace evidence on the working end/working parts of the tool and on any other part of the tool.

  - Paint chips, metal fragments (different from tool), rubber/plastic, safe insulation, etc.

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- The presence of trace material may be an indication of which part of the tool was used to make the questioned tool mark(s). e.g.

  - The presence of traces of copper on the blades of wire cutters may indicate the area on the blades which should be examined first.

  - The presence of trace material or paint on a sledge hammer may indicate the particular area on the hammer head which made contact with the marked surface.

- If necessary remove and save the trace evidence or

- contact the Trace Evidence Section for an analyst to remove and take custody of the trace evidence for an analysis and comparison with standards to be taken from the submitted tool marked object.

12.2.3 Note and describe any irregularities in the working end/ working parts of the tool

- Broken/missing tip, blade, or jaw, etc.

- Deep indentations in the blades of bolt cutters, wire cutters, scissors, etc.

- Note any usually bright or shiny areas on the tool where dust or corrosion has been removed or where protective paint on new tools has been removed.

- Blades of bolt cutters or pliers or similar type tools out of alignment.

- Any other observable irregularity

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12.2.5 Note any tool marks on the working end/working parts of the tool.

- If present, these marks may have been made by a hard surface on the object suspected of being marked by the tool

12.2.4 Mark the tool.

- Mark the tool in area away from any surface that may have been used to make tool marks.
- Mark with Item #, Lab Case # and Initials.

12.3 Examination of tool marks:

12.3.1 **Describe the item that has been tool marked**.

- The examiner may sketch or photograph the item that was tool marked to assist the examiner in describing it.
- Give a description of the item. e.g. chrome coated padlock, galvanized chain link wire, white painted door frame, gray safe door etc.
- Note the manufacturer of the item, if it can be determined. e.g. Masterlock, Sentry safe door.
- Note any model number or serial number.
- The examiner may measure this item.
  - Length, width and depth of large items such as doors, safes, window frames, etc.

- The length and diameter of wire, chain link, etc.
- Diameter of a lock shackle, lock hasp, etc.
- Any other measurement deemed necessary by the examiner.

- Note the position of the tool mark(s) on the item.
  - The examiner may use the sketch or photograph of the item to indicate the location of the tool mark(s).
  - The examiner may take measurements and note the position of the tool mark(s) on the object based on those measurements.

12.3.2 **Mark the item that has been tool marked.**

- Mark the item in area away from any tool marks.
- Mark with Item #, Lab Case # and Initials.

12.3.3. **Examine the tool mark(s)**

- Visually and under low magnification (stereo-microscope) examine the tool mark(s).
- Determine the type of tool mark(s).
  - Impression - Surface contour variations on an object caused by applied force without motion, or where motion is approximately perpendicular to the plane being marked.
    - ♦ e.g. Hammer blow, punch mark, etc.

- Striated - Parallel surface contour variations on the surface of an object caused by a combination of force and motion where the motion is approximately parallel to the plane being marked.
  - e.g. Pry bar scrape marks, cut marks on wire or chain link, etc.
- Combination - Tool mark contains both impression and striated characteristics.
  - e.g. Pry bar mark on door jam, glancing hammer blow, etc.

- **Determine (if possible) the class characteristics of the tool mark(s).**
  - Note the general shape of the tool mark(s).
  - Measure the width/diameter of the tool mark(s) if applicable.
  - Count the number of teeth marks present and measure the distance between the teeth marks if applicable.
  - For cutting style tool marks, determine if possible, the type of cutting motion employed by the tool that made the mark.
    - Shearing
    - Pinching

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- **If the class characteristics of the tool mark(s) are markedly different than the tool, no further examination is necessary. The examiner can conclude that the tool did not make the tool mark(s).**

- Examiner the tool mark for any marked irregularities.

  - Any striations/area of striations much deeper than surrounding striae.

  - Jagged/rough edge that may indicate missing or fractured tool tip.

  - Presence of irregularities may give examiner an indication of which side of the tool was used or if the tool can be eliminated.

- Examine the tool mark(s) for any trace evidence.

  - Paint, corrosion, metal, etc.

- If necessary remove and save the trace evidence or

- contact the Trace Evidence Section for an analyst to remove and take custody of the trace evidence for an analysis and comparison with standards to be taken from the submitted tool marked object.

12.3.4 **Determine (if possible) the direction of motion and angle of the tool when the tool mark(s) was made**.

- On striated or combination tool marks look for a ridge of metal, paint,

or other material which is pushed ahead of the marking tool.

- By examining the complete object upon which a tool mark is found the examiner may be able to determine the method and therefore the direction that the tool was used. e. g. Striated pry bar mark on inside of a safe door. Examine the surrounding areas of the safe door and safe.

12.3.5 **If necessary remove the tool marks from the item marked to facilitate microscopic examination and comparison.**

- If wire or chain link is cut, the examiner should mark the ends that he made with a dark marker and record the information in their notes.

- When removing tool marks from large object by some cutting/sawing procedure, ensure that the tool marked area is not damaged.

12.3.6 **If it is not possible to remove tool marks from a large object or if removing the tool marks would damage/mar the marks, some type of silicone/rubber cast should be made of the tool marks.**

12.3.7 **Selection of test media.**

- First, use a medium softer and less resistant than the surface of the item marked.

  - Sheet lead, copper, brass, tin and other soft metals.

  - Paraffin, modeling clay, etc.

- If similarities appear or if a tentative identification is made it may be necessary to make test marks in a medium which is similar or identical to the material upon which the questioned mark was found.

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Perhaps a clean area of the item itself.

2.3.8 **Make test tool marks**.

- Use the information gleaned from examinations of tool and tool mark(s) to produce test marks if applicable.
  - ➢ If some determination was made as to the area of the tool that may have contacted the item, primary emphasis should be placed on tests made by this area.
  - ➢ If examination of the tool and tool mark(s) did not indicate which area of the tool may have been used then tests should be made using all possible areas of the tool's working end/working parts.
- When making striated test marks, the examiner should attempt to reproduce the vertical and horizontal angle at which the questioned tool mark(s) were made.
  - ➢ If these angles cannot be determined, then it is generally best to continuously change both the vertical and horizontal angle of the tool in relation to the surface of the medium being marked as the tests are made.
- If silicone/rubber casts were made of the questioned tool mark(s) than silicone/rubber casts must be made of the test tool marks for comparison purposes.

12.3.9 **Comparing test and questioned tool marks.**

- The following is an illustration on one way to perform a comparison microscope examination of test and evidence tool marks. Examiners may develop their own routine for this type of examination although

they should incorporate the general points mentioned here in bold letters.

- **Compare test tool marks first.**

- Place one of the test tool marks on the right stage of a comparison microscope.

  - **Adjust the light source to provide oblique or grazing illumination over the test tool mark**.

  - **Using low magnification (10X - 20X) examine the tool mark, manipulating the x and y movement of the stage, look for a position that best highlights the individual characteristics on the tool mark Higher magnifications should be used to verify the correspondence of finer impressions or striae. When such an area is located, leave the test tool mark in that position.**

- Next. place another test tool mark on the left stage and position it in the same relationship as the tool mark on the right stage.

- **Manipulate the stages to move the left and right test tool marks and attempt to align any impressions/striations that are present The examiner can conclude there is <u>sufficient agreement</u> to match or there is not sufficient agreement to match based on the quality and quantity of the individual characteristics present on these test tool marks.**

12.3.10 **Comparing an evidence broken tool tip/blade to a tool with a broken/missing tip/blade.**

- Attempt to align the fracture marks present on the tip/blade to those on the broken tip/blade of the tool.

- Attempt to align any extrusion marks in the metal of the tip/blade and the tool.

- Attempt to align any other individual marks that may be present on the tip/blade and the tool near the broken tip/blade.

- **The examiner can conclude there is <u>sufficient agreement</u> to match or there is not sufficient agreement to match the broken tip/blade to the tool's missing tip/blade based on the quality and quantity of the individual characteristics present.**

12.3.11 **Comparison of tool marks submitted without a tool should be made following the same basic techniques as outlined above with the exception that there would be no test tool marks.**

- **The examiner can conclude there is <u>sufficient agreement</u> to match or there is not sufficient agreement to match tool marks to each other based on the quality and quantity of the individual characteristics present.**

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