Firearms Section

Serial Number Restoration Methods

1. Scope

This document identifies a standard operating procedure for processing methods to restore serial numbers and / or vehicle identification numbers (VIN) on items of evidence. This procedure applies to any item of evidence, including but not limited to firearms, automobiles, motorcycles, and recreational vehicles, which require serial number restoration. The technique of die stamping serial numbers is common on most weapons and other objects. It produces a compression of the metal in the area immediately surrounding, and a short distance below, the penetration of the die. This allows for the possible restoration of a serial number, even though the characters were obliterated.

2. References

AFTE Members Area, Serial Number Search Database

ATF Firearm Serial Number Structure Guide

ATF Laboratory Serial Number Restoration Course Booklet

Bar Code 39 key table

Handbook of Methods for the Restoration of Obliterated Serial Numbers, Treptow, Richard S., NASA, Jan 1978

3. Safety and Precautions

Appropriate safety equipment will be utilized when making and using chemicals. Eye protection, lab coat, and nitrile gloves will be worn. Reagents will be made and applied in the fume hood or with the use of the fume extractor.

Magnaflux - extremely flammable as an aerosol, store away from heat sources. This solvent is harmful when in contact with skin, therefore nitrile gloves shall be worn. This solvent is harmful if inhaled due to the isobutane vapors, therefore this procedure will be performed in a hood or a ventilated room.

Hazardous chemicals: acetone, ethyl acetate - extremely flammable, extra care should be used near sources of heat.

4. Supplies, Reagents, and Equipment

- Acetone
- Camera
- Cotton Tipped Applicators
- Digital Image Processing Software (Adobe Photoshop or Equivalent)
- Disposable Pipettes
- Distilled Water
- Ethanol
- Ethyl Acetate
- Glass Dish, Tray, and / or Beaker
- Heat Gun
- Horse-Shoe Magnet, various sizes
- Iron with steam capabilities
- Magnaflux (Black Magnaflux #7HF)
- Magnifying Glass
- Pencil Eraser
- Rotary Tool with Emery Wheels (Dremel or equivalent)
- Sandpaper and / or Emery cloth
- Soldering Iron
- Steel Wool
- Stereomicroscope

5. Preliminary Inspection and Preparation

5.1. Record observations on the Serial Number Restoration Worksheet, Case Notes (Blank) Worksheet, or Case Notes (With Lines) Worksheet.

5.2. Inspect the area with the obliterated serial number.

5.2.1. Note any coatings, trace materials, or character remnants.

5.2.2. Determine the method of obliteration, if possible.

5.3. Record the "as received" condition of the obliterated serial number area by notation and / or photographic depiction.

5.4. Using a solvent, such as ethanol or acetone, clean the serial number area of any coatings. Fully determine the method of obliteration, if possible, documenting observations.

5.5. Note any toolmarks of value. If toolmarks are present, casts should be taken to preserve for possible future comparison.

5.6. Reference the AFTE Members Area, Serial Number Search Database and / or ATF Firearms Serial Number Structure Guide to determine the possible alphanumeric structure of the serial number for a particular make / model of firearm, and / or the lab firearms reference collection to identify the serial number location(s), duplicate or partial serial numbers, letter / number style and arrangement.

5.7. Hidden serial numbers:

5.7.1. Some firearms manufacturers place hidden serial numbers on some of their product lines. If the evidence firearm is known to have a hidden serial number, then attempts should be made to locate and read this number prior to any restoration methods.

5.7.2. Some hidden serial numbers are micro-etched with a laser on one or more internal surfaces and may require magnification to read (e.g., some Smith & Wesson pistols).

5.7.3. Some hidden serial numbers are embedded within the polymer frame of the firearm and would require cutting of the frame or melting of the polymer to expose the number for viewing (e.g., some Hi-Point pistols).

5.8. Barcodes:

5.8.1. Some firearms have a barcode which can be read or decrypted to reveal the serial number. Barcodes can be of either linear or 2-D matrix format.

5.8.2. Inspect linear barcode to ensure that at least portions of every bar are present.

5.8.3. Read the barcode utilizing a barcode reader.

5.8.3.1. Open a blank Microsoft Word document (or alternative software.

5.8.3.2. Scan the barcode on firearm with a barcode reader.

5.8.3.3. Record the results.

5.8.4. Alternatively, some linear barcodes can be manually decrypted.

5.8.4.1. For Code 39-type barcodes, begin by delineating the bars into character units. Use of an enlarged photograph or photocopy is recommended.

5.8.4.2. Start at the far-left bar and count five bars over then label this as the first character set. The character set will include the five (5) bars and the four (4) white spaces in between the bars.

5.8.4.3. Repeat this procedure for the remaining character sets. There will be nine (9) character sets visible.

5.8.4.4. Interpret the barcode element size patterns for every character set.

5.8.4.4.1. Observe each bar and space from left to right.

5.8.4.4.2. Label each as being either “W” for wide or “N” for narrow.

5.8.4.4.3. Each converted character set should now have interpreted pattern (e.g. NNNWWNWNN).

5.8.4.4.4. Complete this for each character set.

5.8.4.4.5. Use a Bar Code 39 key table to correlate each developed pattern sequence from the individual character sets to determine the alpha or numeric character represented by the pattern. Note: Barcodes of types other than Code 39 would require the correct corresponding key for decryption.

5.9. Polishing:

5.9.1. If necessary, the area of obliteration may be polished.

5.9.1.1. Polish the serial number area with an eraser.

5.9.1.2. Inspect the serial number area again for any character remnants and if present, document.

5.9.1.3. If a firearm is corroded, care should be taken while removing the corrosion. The metal is weaker and can flake off easily.

5.9.1.4. Examination with low magnification and oblique lighting may also help visualize characteristics of the serial number.

5.9.2. Polish the serial number area with abrasives or abrading tools.

5.9.3. The surface should be polished to remove cuts and blemishes to the greatest extent possible. Deep cuts may not be completely removed. Polish to a mirror-like finish if possible.

5.9.4. Materials may include various grit sandpaper, emery cloth, or rotary tool with various attachments (e.g., emery wheel, felt wheel).

5.9.5. Inspect the serial number area again for any character remnants and, if present, document.

6. Processing Methods

6.1. Record observations on the Serial Number Restoration Worksheet, Case Notes (Blank) Worksheet, or Case Notes (With Lines) Worksheet.

6.1.1. A positive QC for a reagent would indicate that the examiner observed a reaction. This reaction could be observed as one or more of the following:

6.1.1.1. Bubbling of the reagent on the surface bearing the obliteration

6.1.1.2. Color change of the substrate

6.1.1.3. Color change on the swab

6.1.1.4. Vapors rising from the substrate

6.2. Determine if the serial number substrate medium physical property is ferrous based (magnetic) or non-ferrous (non-magnetic) by touching it with a magnet. When the serial number medium is determined, select the appropriate restoration method and begin processing as indicated below.

6.3. Continually inspect and note any character remnants being recovered and document/photograph accordingly.

6.4. Any characters, or partial characters, recovered during processing should be verified by a second examiner.

6.5. The surface may be moistened with water, glycerin, or oil to better visualize the numbers.

6.6. Once the restoration procedure is completed, a thin coat of oil may be applied to the restored surface to minimize oxidation.

6.7. Non-metal substrates:

6.7.1. Plastic substrates

6.7.1.1. Apply heat to the surface using a heat gun.

6.7.1.2. Apply ethyl acetate to the surface and subsequently apply heat. The surface should appear smoother, allowing the characters to be legible.

6.7.2. Wood substrates

6.7.2.1. Sand the area of distortion and then apply heat and humidity utilizing a steam iron.

6.8. Magnetic Particle Inspection – Magnetic Media

6.8.1. This is a non-destructive method that should be applied first. It can be re-applied throughout the restoration process.

6.8.2. Place the specimen in direct contact with both arms of a horseshoe magnet with the obliterated area positioned directly between the poles.

6.8.3. Spray or pipet the Magnaflux over the obliterated area.

6.8.4. Observe if any of the serial number characters have become visible. Tilting the specimen surface in various directions may aid in viewing any restored characters.

6.8.5. Repositioning the magnet and / or specimen and reapplying Magnaflux may allow for differing development.

6.8.6. Clean the obliterated area with acetone before proceeding to etching.

6.9. Etching - Magnetic Media

6.9.1. Patience and care must be taken to perform the etching very slowly and deliberately for successful results.

6.9.2. For magnetic media, the following etching reagents can be used:

- Fry's Reagent
  - 90 grams Cupric Chloride (CuCl2)
  - 120 ml Hydrochloric Acid (HCl)
  - 100 ml Water (H20)

- Turner's Reagent
  - 2.5 grams Cupric Chloride (CuCl2)
  - 40 ml HCl
  - 25 ml Ethyl Alcohol
  - 30 ml H20

- Davis' Reagent
  - 5 grams Cupric Chloride
  - 50 ml HCl
  - 50 ml H20

- Nitric Acid
  - 25 ml Nitric Acid (HNO3)
  - 75 ml H2O

6.9.3. Apply appropriate reagent with a cotton applicator moistened in the solution.

6.9.4. Slowly draw the swab across the area in one direction only.

6.9.5. Repeat until the swab is dirty or needs more reagent.

6.9.6. Obtain a new swab (NEVER dip a dirty swab into the reagent) and again draw the swab over the area in one direction.

6.9.7. If two types of reagents are required, alternate between swipes.

6.9.8. Observe at various time intervals under a microscope or with the aid of a magnifying glass to determine if the serial number has become visible.

6.10. Etching - Non-magnetic Media

6.10.1. Patience and care must be taken to perform the etching very slowly and deliberately for successful results.

6.10.2. For non-magnetic media, the following reagents can be used:

- Acidic Ferric Chloride
  - 5 grams Ferric Chloride (FeCl3)
  - 25 ml HCl
  - 100 ml H2O

- Ferric Chloride
  - 25 Ferric Chloride (FeCl3)
  - 100 ml H2O

- 10% Sodium Hydroxide
  - 10 grams Sodium Hydroxide
  - 90 ml H2O

- Phosphoric / Nitric Acid
  - 98 ml 85% Phosphoric Acid
  - 2 ml concentrated Nitric Acid

    or
  - 50 ml Phosphoric Acid

- 3 ml Nitric Acid (concentrated)

6.10.3. Use the same procedure as for magnetic media, with the appropriate reagents.

6.11. Alternative Methods

6.11.1. Indirect heating

6.11.1.1. Applying heat with a propane torch to the back side of the item which bears the obliterated characters may assist in visualization of the characters.

6.11.2. Direct heating

6.11.2.1. Applying heat with a propane torch directly on the area bearing the obliterated characters may assist in visualization of the characters.

6.11.2.2. Applying heat with an acetylene torch directly on the area bearing the obliterated characters may assist in visualization of the characters.

6.11.2.2.1. This is a last resort process as it will melt the metal bearing the characters. Just prior to reaching the melting point of the metal, the characters may become visible.

6.11.2.2.2. Photographic equipment must be readily accessible to record the characters.

7. Recording Results and Conclusions

7.1. Record all recovered characters and / or character fragments by notation and, if possible, by photography.

7.1.1. Images should be transferred to the lab shared drive for storage.

7.1.2. Digital images may be processed in Photoshop, or similar software, to aid in visualizing the characters (i.e. adjusting contrast and levels).

7.2. With restored character fragments, render any conclusions as to possible character types or combinations.

7.3. In the case of partially restored numbers, research serial number composition to possibly exclude certain characters based on their position within the serial number or by the shapes of the font.

7.3.1. This is accomplished through various resources, such as:

7.3.1.1. the manufacturer

7.3.1.2. the ATF Tracing Center

7.3.1.3. the AFTE Members Area, Serial Number Search Database

7.3.1.4. the ATF Firearm Serial Number Structure Guide

7.3.1.5. the laboratory's firearms reference collection

7.4. Through research and all appropriate processing methods, render the final conclusions.

7.5. Any recovered characters and / or character fragments must be verified by another examiner and recorded in the case record.

7.6. All chemicals will be logged into the Chemical log. They do not have an expiration date.

8. Reporting

8.1. A minimum of one verification is required to report either verbally or in writing on restorations (full or partial).

8.2. Unaided, macroscopic and / or microscopic examinations or comparisons are dependent upon the quality of the characters in the mark / defect.

8.3. The absence of an identifiable marking on any surface does not indicate lack of a previous identifiable marking nor does it infer that an obliteration was a deliberate destruction of markings.

8.4. Wording of Laboratory Reports:

8.4.1. The following outlines report wording. The wording provided is to be used whenever possible in all cases.

8.4.2. As not every scenario can be accounted for, any deviations from this wording must be approved by a technical manager in the Firearms section.

- *Item ___ was examined and found to have an obliterated serial number.*
- *Item ___ was processed with Magnaflux and acid etching chemicals for restoration of the obliterated serial number.*
- *Plastic on the frame of the firearm, Item ___, was melted away to reveal a duplicate serial number.*
- *Examination of the firearm, Item ___, determined the serial number to be:*
- *Restoration procedures on the firearm, Item ___, revealed the serial number to read:*
- *Restoration procedures on the firearm, Item ___, partially restored the obliterated serial number to read:*
- *Restoration procedures on the firearm, Item ___, failed to reveal any characters of the serial number.*
- *The asterisks represent characters that could not be restored.*
- *The asterisk represents either a "__" or "__".*
- *The second asterisk is consistent with an "__" but could alternatively be a "__".*
- *Item ___ was examined and found to have an obliterated serial number. A hidden serial number placed by the manufacturer within the frame was located and determined to read: _____.*
- *Using the duplicate serial number and the visible characters restored on the serial number plate, the serial number was determined to read: _____.*

- *No areas of damage that would indicate an obliterated serial number were observed. Research indicates that this firearm pre-dates the Gun Control Act of 1968, which would require it to have a serial number.*