9.0 Serial Number Restoration

9.1 Introduction

Serial numbers are removed and/or obliterated in a variety of ways and may be restored if the removal/obliteration is not taken past the metal compression/deformation zone by using a variety of methods.

9.2 Safety Considerations

Examinations performed in the Firearm and Toolmark Section are inherently hazardous. These procedures involve hazardous chemicals, firearms, ammunition and power tools. All hazardous procedures must be performed in compliance with the Laboratory Quality Manual and the Health and Safety Manual.

9.3 Preparation

All reagents, chemicals, and/or chemical containers received into the laboratory shall be marked with the recipient's initials and the date of receipt. Upon opening, all reagents, chemicals, and/or chemical containers shall be marked with initials and opened date (LOM 2.10.1.4)

NOTE: ALWAYS ADD ACID TO WATER. NEVER ADD WATER TO ACID.

9.3.1 Fry's Reagent

- To 90 grams of Cupric Chloride ($CuCl_2$)
- Add 100 milliliters of distilled water (H_2O)
- Add 120 milliliters of Hydrochloric Acid (HCl)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.2 Turner's Reagent

- To 2.5 grams of Cupric Chloride ($CuCl_2$)
- Add 30 milliliters of distilled water (H_2O)
- Add 40 milliliters of Hydrochloric Acid (HCl)
- Add 25 milliliters of Ethanol (Ethyl Alcohol) (C_2H_6O)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.3 Davis's Reagent

- To 5 grams of Cupric Chloride ($CuCl_2$)
- Add 50 milliliters of distilled water (H_2O)
- Add 50 milliliters of Hydrochloric Acid (HCl)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.4 25% Nitric Acid Solution (Step II)

- To 75 milliliters of distilled water (H_2O)
- Add 25 milliliters of Nitric Acid (HNO_3)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.5 Acidic Ferric Chloride Solution

- To 25 grams of Ferric Chloride ($FeCl_3$)
- Add 100 milliliters of distilled water (H_2O)
- Add 25 milliliters of Hydrochloric Acid (HCl)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.6 Ferric Chloride Solution

- To 25 grams of Ferric Chloride ($FeCl_3$)
- Add 100 milliliters of distilled water (H_2O)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.7 10% Sodium Hydroxide Solution

- To 100 milliliters of distilled water (H_2O)
- Slowly add 10 grams of Sodium Hydroxide (NaOH)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.8 Cupric Chloride in Hydrochloric Acid Solution

- To five (5) grams of Cupric Chloride ($CuCl_2$)
- Add 100 milliliters of distilled water (H_2O)
- Add three (3) milliliters of Hydrochloric Acid (HCl)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.9 Zinc Alloy Etching Solutions

- Solution 1 - To two (2) milliliters of distilled water (H_2O), add 98 milliliters of Phosphoric Acid (H_3PO_4)
- Solution 2 - To 95 milliliters of distilled water (H_2O), add five (5) milliliters of Nitric Acid (HNO_3)
- Store solutions in appropriate, sealed containers that are marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.10 Griffin's Reagent

- To 30 grams of Cupric Chloride ($CuCl_2$)
- Add 30 milliliters of distilled water (H_2O)
- Add 30 milliliters of Hydrochloric Acid (HCl)
- Add 120 milliliters of Methanol (Methyl Alcohol) (CH_3OH)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.11 50% HCl

- Add equal amounts of Hydrochloric Acid (HCl) and distilled water (H_2O) (Always add acid to water. Never add water to acid.)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.12 AL Alloy

- To 100 milliliters of distilled water (H_2O)
- Add 100 milliliters Hydrochloric Acid (HCl)
- Add 55 milliliters Ethanol (Ethyl Alcohol) (C_2H_6O)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.13 Steel Alloy

- To 125 milliliters distilled water (H_2O)
- Add 4.825 grams Ammonium Chloride (NH_4Cl)
- Add 6.5 grams Cupric Chloride ($CuCl_2$)
- Add 125 milliliters Hydrochloric Acid (HCl)
- Store solution in an appropriate, sealed container that is marked with the date and initials of the preparer
- Record in the Firearms Reagent Log

9.3.14 Phosphoric/Nitric Acid (Step I)

- To 98 ml of 85% Phosphoric Acid (H_3PO_4)
- Add 2 ml of concentrated Nitric Acid (HNO_3)

9.4 Instrumentation

- Scale/Balance
- Low voltage DC power source
- Yoke magnets
- AC/DC Yoke electromagnet
- Stereo Microscope
- Comparison Microscope
- The unique identifier assigned to or serial number of the instrumentation used shall be documented on the Discipline page Equipment log

9.5 Minimum Analytical Standards and Controls

All reagents prepared in-house will be QC tested at the time of preparation using pH paper (https://us.vwr.com/store/catalog/product.jsp?catalog_number=60775-881). When the reagent is tested and determined to register as an acid or base (see guidelines below), the reagent bottle shall be marked with the preparer's initials, date, pH result (number) and recorded in the Firearms/Tool Marks Reagent Log (C-35, Appendix C). Reagents may be tested at any time if suspected to be defective or reacting poorly during application/use.

9.5.1 pH Levels (using pH paper with 0 - 12 range)

- Acid = pH of 1 through 6
  - lower numbers = stronger acid
- Neutral = pH of 7
- Base = pH of 8 through 12
  - higher numbers = stronger base

9.6 Procedure or Analysis

The evidence will be marked in accordance with the Laboratory Operations Manual (4.3). Initial inspection of the serial number area should include observations of coating, trace material, character remnants, and the method of obliteration. Initial observations should be recorded in the notes by documenting and/or photographing the serial number area.

9.6.1 Polishing Procedure

The polishing procedure is a desirable method used to remove prior obliteration by polishing, grinding, and filing scratches that obscure the serial number. The polishing procedure can be effective independently, but is more often used in conjunction with other procedures.

9.6.1.1 Application / Process

- Polish the area of the obliteration using either a Dremel-type tool with a sanding/polishing disc or fine grit sandpaper.
- Depending on the extent of the obliteration, continue polishing until the surface is mirror-like, removing all scratches.
- If the obliteration is severe, it may not be possible or desirable to remove all the scratches.
- Observations should be recorded in examiner's notes by documenting and/or photographing the serial number area.

9.6.2 Magnetic or Magnaflux® Procedure

The magnetic procedure or Magnaflux® technique is used by metallurgists to detect surface or subsurface flaws in iron or steel. Magnetic particles, applied to the magnetized specimen, outline the obliterated characters in a successful restoration. This procedure, in conjunction with the polishing procedure, is an effective way to restore an obliterated serial number in magnetic metal. The Magnaflux® technique is nondestructive, and can be applied without affecting other restoration methods.

9.6.2.1 Application / Process

- Determine whether the specimen is suitable for testing with Magnaflux® by placing a magnet on the area of obliteration. The specimen is suitable if it can be magnetized.
- Clean the area of obliteration.

- Apply appropriately prepared 9CM or 7HF Bath to the area of obliteration with a disposable pipette.
- Place a magnet behind the area of obliteration, with the magnetic poles on either side of the area. This placement may be adjusted to reveal more or different areas of the obliteration.
- If 14AM (Fluorescent) prepared bath is being used, observe the characters under a black light.
- Observations should be recorded in examiner's notes by documenting and/or photographing the serial number area.

9.6.3 Chemical Procedure

The chemical restoration procedure is suitable for restoration of serial numbers in metal. This procedure, in conjunction with the polishing procedure, is an effective way to restore an obliterated serial number in metal. Selection of the appropriate chemical reagent, based on initial observations, may include magnetic media or non-magnetic media.

9.6.3.1 Suggested magnetic media reagent choices:

- Fry's Reagent
- Turner's Reagent
- Davis's Reagent
- 25% Nitric Acid Solution
- Phosphoric/Nitric Acid

9.6.3.2 Suggested non-magnetic media reagent choices:

- Ferric Chloride Solution
- Acidic Ferric Chloride Solution
- 25% Nitric Acid Solution
- 10% Sodium Hydroxide Solution
- 50% HCl

9.6.3.3 Application / Process

- It is strongly recommended to first apply the chemical solution <u>to an area adjacent to or near the area of obliteration</u> utilizing cotton tip applicators or swabs that have been moistened with the appropriate solution.
- Observe and take note of the chemical reaction (bubbling, discoloration, reaction rate, etc.) to ensure the proper chemical reagent or solution has been chosen for application. When comfortable with the recaction, apply the solution to the area of obliteration and note any numbers or characters that become visible. Observations should be recorded in examiner's notes by documenting and/or photographing the serial number area.

9.6.4 Electrochemical Procedure

The electrochemical procedure is a form of chemical restoration that is enhanced by the application of voltage that speeds the oxidation process of metal. This technique, in conjunction with the polishing procedure, is an effective way to restore an obliterated serial number in metal. Selection of the appropriate chemical reagent, based on initial observations, may include magnetic media or non-magnetic media.

9.6.4.1 Suggested magnetic media reagent choices:

- Fry's Reagent
- Turner's Reagent
- Davis's Reagent
- 25% Nitric Acid Solution
- Phosphoric/Nitric Acid

9.6.4.2 Suggested non-magnetic media reagent choices:

- Ferric Chloride Solution
- Acidic Ferric Chloride Solution
- 25% Nitric Acid Solution
- 10% Sodium Hydroxide Solution
- 50% HCl

9.6.4.3 Application / Process:

- The electrochemical technique requires the attachment of the item to the positive terminal of a power supply via the use of metal alligator clips.
- Thoroughly soak the cotton tip of an applicator with the appropriate etching chemical solution and attached the moistened cotton tip to the negative terminal of the power supply via another metal alligator clip, being certain to do so on a moistened area at the base of the cotton tip.
- Turn on the power supply and increase the voltage gradually until the reaction appears.
- Wipe the area of obliteration with the moistened cotton tip, being careful to not touch the surface of the item with the metal alligator clips and note any numbers or characters that become visible.
- Observations should be recorded in the notes by documenting and/or photographing the serial number area.

9.7 Interpretation of Results

Interpretation of results would include full restoration, partial restoration, or unsuccessful restoration. Utilization of the Bureau of Alcohol, Tobacco, Firearms and Explosives Firearm Serial Number Structure Guide may aid in determining the number and type of characters in the serial number that are specific to the manufacturer and/or model of the firearm. A full restoration would be a total recognition of all obliterated characters. A partial restoration would be recognition of some of the obliterated characters. An unsuccessful restoration would be no recognition of any obliterated characters. Notes should include if the restoration procedure was full, partial, or unsuccessful.

9.8 Verifications

All partially or fully restored serial numbers must be verified by a second examiner or technician. This may be accomplished during the technical review of the case. A photo or photos that clearly depict the characters that were developed should be added to the Object Repository in Forensic Advantage. If the restored characters cannot be clearly photographed the verification must be in person with the name of verifier being added to the worksheet.

Note: For restorations that are being verified using photos during the technical review, character overlay should not be used. The restored characters must be clearly visible with no interpretation necessary.

9.9 Appendices

Appendix A - Calibration Standards
Appendix C - Worksheets

9.10 References

Bureau of Alcohol, Tobacco and Firearms Laboratory, Serial Number Restoration Handbook, 1999.

Bureau of Alcohol, Tobacco, Firearms and Explosives, Firearm Serial Number Structure Guide, January, 2013

Polk, Donald E., and Giessen, Bill C. "Metallurgical Aspects of Serial Number Recovery" AFTE Journal Vol. 21, No. 2, p. 174

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