A. Purpose:

To describe the techniques that can be utilized to recover an obliterated serial number.

B. Responsibility:

Forensic Science Examiners or other employees assigned to the Unit.

C. Safety:

1. The analyst shall use appropriate PPE (eye protection, gloves, lab coat).
2. Serial number restorations shall be conducted in a fume hood.

D. Procedure:

- Operability testing shall be conducted prior to any serial number restoration attempts.
- The condition of the obliterated area(s) and any visible characters shall be documented in the notes by photographs and/or sketches prior to restoration attempts.
- The notes shall demonstrate the progression of the restoration attempt(s).
- During any stage of the restoration, a second analyst must verify the restored characters by initialing the appropriate space on the Serial Number Worksheet (QR FA-8, 8a).

1. Visual Examination

   Make note of the position of the serial number as located on the weapon. If the primary serial number is not on the receiver or frame, note the location and indicate it is a ”secondary” serial number location. Determine the physical property (e.g. magnetic or non-magnetic) of the area of the primary and other serial number if present. If only using the secondary serial, the analyst will indicate in the report that the serial number is a secondary number if it is the only number restored. If the secondary serial number is used to support the partial restoration of the primary serial number it should be noted and indicate the secondary or supported restoration may not reflect the original primary serial number.

   Determine, if possible, the location, size, style (font), hidden numbers and the number of characters typically found in the serial number of the item in question. Record the source(s) of this information if used, such as the Firearms Reference Collection, the Firearms Reference Table (Royal Canadian Mounted Police), or the BATFE Firearm Serial Number Structure Guide.

   On firearms with hidden serial numbers, disassembly of the firearm and/or removal of material may be necessary to reveal this number. Record in the case notes any action taken to reveal a hidden serial number.

2. Items may generally be cleaned with a cotton-tipped swab saturated with the cleaning solution (methanol/acetone).
3. Preparation
    a. Polishing
        i. Can be done with fine grit sand paper, emery cloth, or an electric polishing tool such as a Dremel.
        ii. Depending on the extent of the obliteration, continue polishing until the surface is mirror-like, removing the scratches. If the obliteration is severe, it may not be possible or desirable to remove all of the scratches.
        iii. Any characters that become visible shall be documented.
    b. If the serial number is not visible, or only a portion of the serial number is visible after polishing, chemical and/or magnetic processing may be conducted.
4. Magnetic Particle Inspection

Magnetic particle inspection is generally used on magnetic or ferrous metals, but can also be used on other types of metals. It is considered a non-destructive method of serial number restoration.

a. Spray the Magnaflux oil suspension (red or black) into a small cup or beaker.
b. Place the poles of the magnet on either side of the obliteration. Placement may be adjusted as needed. Press the power button.
c. Using a disposable pipette, drip the oil suspension onto the area of obliteration.
d. Document any characters that become visible.
e. This method may be used alone or in conjunction with chemical reagents.

5. Chemical Processing
    a. Determine the most appropriate reagent for the type of metal.
    b. Using a cotton swab, apply the reagent to the area of obliteration.
    c. Document any characters that become visible.
    d. Polishing may be used in between applications of the reagent.
    e. When complete, flush the area with water to neutralize the chemicals. Then dry the area and apply oil to inhibit oxidation.

For use on magnetic material, such as steel (suggested use going from weakest to strongest):

- 25% Nitric Acid Solution
- Davis Reagent
- Turner's Reagent

- Fry's Reagent

For use on non-magnetic material (suggested use going from weakest to strongest):

- Phosphoric/Nitric Acid
- 10% Sodium Hydroxide Solution
- 25% Nitric Acid Solution
- Acidic Ferric Chloride
- Ferric Chloride
- Chromic Acid (Hubball Reagent)

For use on non-magnetic aluminum media:

- 10 % Sodium hydroxide

May be used as highlighter for above listed chemicals

- 25 % Nitric Acid

Helpful Information:

Magnetic Media	**Non-Magnetic Media**
(rinse with acetone as needed)	(rinse with distilled water as needed)
25% Nitric Acid	Phosphoric/nitric Acid
Davis Reagent	10% Sodium Hydroxide
Turner's Reagent	25% Nitric Acid
Fry's Reagent	Acidic Ferric Chloride
	Ferric Chloride
	Chromic Acid (Hubball Reagent)

- Reagents can be diluted with water to reduce their oxidizing ability.
- Ferric chloride (and/or acidic ferric chloride) used in combination with nitric acid may be beneficial when used on frames/receivers containing zinc.

- Sodium hydroxide used in combination with nitric acid may be beneficial when used on frames/receivers containing aluminum. Note that this combination will produce heat and a strong reaction.
- Phosphoric acid used in combination with nitric acid may be beneficial when used on frames/receivers containing zinc and/or aluminum.

6. Electrolytic Method

   Applying voltage to the chemical reagent process speeds up the reaction between the acid and the metal.

   a. Using an alligator clamp, attach the positive terminal of the low voltage power supply to the frame or receiver of the firearm.
   b. Hold the negative terminal of the low voltage power supply to a cotton swab moistened with the desired reagent.
   c. Turn on the power supply to low.
   d. Swab the obliterated area, taking care to not touch the frame/receiver with the negative terminal on the cotton swab.
   e. Document any characters that become visible.
   f. Polishing may be used in between applications of the reagent.
   g. When complete, flush the area with water to neutralize the chemicals. Then dry the area and apply oil to inhibit oxidation.

7. Reporting Results

   a. Unrestorable characters shall be represented by a "?"
   b. Characters which could be multiple possibilities shall be represented by a "*" with the possibilities listed. e.g. *The "*" represents a character that could be a 3 or an 8.*

The attached are guidance for various scenarios and the reporting:

Serial Number Restored
Submission XXX-XXX was submitted for serial number restoration. Submission XXX was examined and found to have an obliterated serial number. Physical and chemical (or Physical, chemical and magnetic) processing of the submitted pistol restored the serial number to read __.

Serial Number Partially Restored
Submission XXX-XXX was submitted for serial number restoration. Submission XXX was examined and found to have an obliterated serial number. Physical and chemical (or Physical, chemical and magnetic) processing of the submitted pistol partially restored the serial number to read: AB?*2*. The question mark represents an unrestorable character. The first asterisk represents

a character that could be a 1 or a 4. The second asterisk represents a character that could be 3 or an 8.

Serial Number Not Restored
Submission XXX-XXX was submitted for serial number restoration. Submission XXX-XXX was examined and found to have an obliterated serial number. Physical and chemical (or Physical, chemical and magnetic) processing was conducted on submission XXX-XXX. Attempts to restore the serial number were unsuccessful.

Hidden/Secondary
Submission XXX-XXX was submitted for serial number restoration. Submission XXX-XXX was examined and found to have an obliterated serial number. A portion of the frame was removed to reveal a hidden, replicate serial number that reads _____. A hidden serial number placed by the manufacturer on the frame was located and reads _____.

Plate
Submission XXX-XXX was submitted for serial number restoration. Submission XXX-XXX was examined and found to have an obliterated serial number. The metal plate containing the original serial number has been removed and restoration is not possible. A replicate serial number placed by the manufacturer on the slide (and/or barrel) does remain and reads _____. This number represents either a partial or the complete serial number for the firearm as it existed when it left the manufacturer.

When reporting out slide and barrel serial number restoration, they are to be referred to as replicate serial numbers. Please add definition to report if this term is used:

Replicate serial numbers are placed by the manufacturer on the slide and the barrel. These numbers represent either a partial or the complete serial number for the firearm as it existed when it left the manufacturer.

8. QC Check
    a. The firearm has a chemical log book that is used when serial number chemicals are made. The log will include the chemical name, the date prepared, the lot number, the initials of the analyst who prepared it and if the quality check was conducted on the chemical. Once the chemical has been found to be acceptable, a colored dot will be initiated and dated with the date of the test. This dot will be taped to the chemical bottle and will signify the chemical is okay to use. Before any chemical is used, every analyst should check for this sticker.
    b. Prior to using any chemical reagent, a quality control check shall be conducted and documented on the Serial Number Restoration Worksheet.

c. Two (2) pistol slides are located in the fume hood. One is a ferrous material, the other is non-ferrous. These will be used to perform the QC check.

d. Using a cotton swab moistened with the desired reagent, dab a small amount onto the appropriate slide.

e. The appearance of bubbles is a positive control which indicates that the reagents are working properly.

f. If the reagent does not bubble as expected, the reagent has failed the QC check. This should be documented in the Firearms Chemical Reagent Log.

g. The failing reagent should be disposed of properly and remade.

E. Available Reagents

Reagents that are prepared in the laboratory shall be logged in the reagent log book. Refer to GL-2 Safety Manual for proper labeling. All chemicals are made in-house and will have a one-year expiration date unless the certificate of analysis for one of the chemicals indicates a retest date prior to one year. All reagents are tested as described above at the time of preparation and recorded on the reagent preparation log sheet. The results must be acceptable before indicating that the reagent is suitable to use in casework. The QC Check is conducted again on the days of use in casework.

Note: In the preparation or dilution of reagents, always pour the acidic portion into the water to avoid a violent exothermic reaction.

a. Fry's Reagent
   i. 90g cupric chloride ($CuCl_2$)
   ii. 100mL distilled water (dH_2O)
   iii. 120mL hydrochloric acid (HCl)

b. Turner's Reagent
   i. 2.5g cupric chloride ($CuCl_2$)
   ii. 25mL ethanol (C_2H_6O)
   iii. 30mL distilled water (dH_2O)
   iv. 40mL HCl (Hydrochloric acid)

c. Davis Reagent

i. 5g cupric chloride ($CuCl_2$)
ii. 50mL distilled water (dH_2O)
iii. 50mL HCL (Hydrochloric acid)

d. 25% Nitric Acid
i. 75mL distilled water (dH_2O)
ii. 25mL nitric acid (HNO_3)

e. Acidic Ferric Chloride
i. 25g ferric chloride ($FeCl_3$)
ii. 100mL distilled water (dH_2O)
iii. 25mL Hydrochloric acid (HCl)

f. Ferric Chloride
i. 25g ferric chloride ($FeCl_3$)
ii. 100mL distilled water (dH_2O)

g. 10% Sodium Hydroxide
i. 10g sodium hydroxide (NaOH)
ii. 90mL distilled water (dH_2O)

h. Chromic Acid (Hubball Reagent)
i. 10g potassium dichromate ($K_2Cr_2O_7$)
ii. 60mL distilled water (dH_2O)
iii. 50mL C_2H_6O (Ethanol)
iv. 80mL concentrated HCL (Hydrochloric Acid)

Directions: Measure the powder on a balance contained in a hood. Add the powder to a glass bottle and add the dH_2O, mixing well to dissolve the powder. In small amounts, add in the Ethanol stirring slowly. Once this step is completed, begin to slowly add in the Hydrochloric Acid to this mixture. This mixture will have an exothermic reaction and will need to cool overnight.

i. Phosphoric/Nitric Acid (for non-ferrous material)
   i. 98mL 85% phosphoric acid (H_3PO_4)
   ii. 2mL concentrated nitric acid (HNO_3)

   -or-

   iii. 50mL concentrated phosphoric acid (H_3PO_4)
   iv. 3mL concentrated nitric acid (HNO_3)

F. Equipment:

1. PPE
2. Fume hood
3. Polishing tools
4. Chemical reagents
5. Cotton swabs
6. MagnaFlux magnet and supplies
7. Low voltage direct current power supply

G. References:

1. GL 2 Safety Manual
2. FA SOP-02 General Firearms Safety
3. ATF Serial Number Structure Guide
4. Treptow, Richard S., Handbook of Methods for Restoration of Obliterated Serial Numbers, NASA, January 1977.