

**TENNESSEE BUREAU OF INVESTIGATION**  
*Forensic Services Division*

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**Firearm/Toolmark Standard Operating Procedures Manual**  
**Serial Number Restoration Procedure**

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**21.0 SERIAL NUMBER RESTORATION PROCEDURE**

**21.1 Scope:** This procedure will detail how a firearm examiner or forensic technician shall perform serial number restorations on firearms and other items of evidence. This procedure includes polishing, magnetic particle inspection, chemical etching, and barcode decryption. These processes may aid the firearm examiner or forensic technician in the recovery of an obliterated or obscured serial number, or other stamped information (firearm make, model, caliber, etc.).

**21.2 Precautions/Limitations:** The firearm examiner or forensic technician shall proceed slowly and pick the appropriate method which will be most effective for the evidence submitted. The firearm examiner or forensic technician should also consult available literature or reference firearms to ascertain where the serial number should be located, whether the submitted evidence has a hidden or secondary serial number, or whether the submitted evidence/firearm was manufactured without a serial number.

**21.3 Related Information:**

**21.3.1** FTIU Chemical and Reagent Manual

**21.3.2** FTIU SOP Manual Section 1 – Quality Assurance Procedures (Sections 3.2 and 3.3)

**21.3.3** FTIU SOP Manual Section 5 – Physical Examination of Firearms Procedure

**21.3.4** FTIU SOP Manual Section 4 – Safe Firearm Handling

**21.3.5** FTIU Appendix 1 – Worksheets

**21.3.6** FTIU Appendix 4 – Range of Conclusions

**21.3.7** FTIU Appendix 5 – Firearms Reference Collection

**21.3.8** FTIU Appendix 8 – Verifications and Casework Review

**21.4 Instruments and Equipment:**

**21.4.1** Stereomicroscope

**21.4.2** Balance

**21.4.3** Strong Magnet or yoke

**21.5 Reagents/Materials:**

**21.5.1** Etching Solution # 1 – Turner's Reagent  
Commonly used on Cast Steel

30 ml deionized/distilled water

40 ml Hydrochloric Acid

25 ml Ethanol

5 grams Cupric Chloride

**21.5.2** Etching Solution #2 – Fry's Reagent  
Commonly used on Cold Rolled Steel

90 grams Cupric Chloride



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120 ml Hydrochloric Acid  
100 ml deionized/distilled water

**21.5.3** Etching Solution # 9 – 25% Nitric Acid  
Commonly used on Pot Metal

50 ml Nitric Acid  
150 ml deionized/distilled water

**21.5.4** Etching Solution # 9 ½ – 50% Nitric Acid  
Commonly used on Aluminum

100 ml Nitric Acid  
100 ml deionized/distilled water

**21.5.5** Acidic Ferric Chloride  
Commonly used on Aluminum

25 g Ferric Chloride  
25 ml concentrated Hydrochloric Acid  
100 ml deionized/distilled water

**21.5.6** 10% Sodium Hydroxide  
Commonly used on Aluminum

90 ml deionized/distilled water  
10 ml concentrated Sodium Hydroxide

**21.5.7** Phosphoric/Nitric Acid  
Commonly used on Zinc/Aluminum

**21.5.8** Magna-Flux or magnetic particle solution  
Used on any metal

**21.6. Hazards/Safety:**

**21.6.1** Proper caution shall be exercised and the use of personal protective equipment shall be considered to avoid exposure to dangerous chemicals. It is recommended that the firearm examiner or forensic technician have a general understanding of the chemical hazards posed by the chemical etching solutions. The firearm examiner or forensic technician should consult the appropriate Material Safety Data Sheet (MSDS) for each chemical prior to use.

**21.6.2** The firearm examiner or forensic technician should use eye protection and gloves, and work within a fume hood, when mixing all chemicals.

**21.6.3** When mixing acid and water the firearm examiner or forensic technician shall add acid to



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water. Never should water be added to acid!

**21.7 Reference Materials/Controls/Calibration Checks:** A positive control for the chemical etching solutions will be conducted prior to the application of the reagent to the serial number area, and the results of this testing recorded in the case notes.

#### **21.8 Procedures/Instructions:**

##### **21.8.1 Documentation and Initial Examination**

- Document and photograph the submitted evidence or firearm in its original condition. The Firearm Worksheet should be completed prior to serial number restorations on firearms.
- For serial number restoration on firearms, test fires should be obtained prior to serial number restoration. In some instances, the firearm may need to be disassembled prior to the application of chemical etching solutions, and test firing should be conducted prior to disassembly.
- Determine where the serial number should be located using the Firearms Reference Collection or by conducting a literature search.
- Photograph the area where the serial number should be, in its original condition, and document the method of obliteration.
- Note and record any visible characters prior to processing. Any characters present will be verified by a second qualified firearm examiner. This verification must be documented.
- Begin the serial number recovery process with the least destructive procedure. Magnetic Particle Inspection should be attempted prior to sanding, and prior to the application of chemical etching solutions.
- A verification of the serial number restoration process shall occur following each step that results in the recovery of new characters. This verification must be documented.
- A Serial Number Worksheet may be helpful for documentation of the serial number restoration process. An example of this worksheet can be found in Appendix 1 – Worksheets in the document control software (ensur) and stored on the Firearms network drive.

##### **21.8.2 Magnetic Particle Inspection Procedure**

- Make sure the surface where the serial number is stamped is magnetic or that the magnetic field will reach the obliterated area.
- Choose and apply magnet, centering the serial number between the two poles of the magnet.
- Spray Magna-Flux, or other magnetic particle solution, into a beaker and apply it to the serial number surface area with a dropper.
- Photograph and record results. Have the serial number, or recovered characters, verified by a qualified firearm examiner. This verification must be documented.

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#### 21.8.3 Polishing Procedure

- Polish the area of the obliteration using either a dremel type tool with a sanding or polishing disc, fine grit sandpaper, or steel wool.
- 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.
- If characters are present, photograph and record results. Have the recovered serial number, or recovered characters, verified by a qualified firearm examiner. This verification must be documented.
- If the serial number has not appeared, reapply Magna-Flux or magnetic particle solution and examine for characters. If any characters are present, photograph and record results.
- If the serial number still has not appeared, proceed to the chemical etching procedure.

#### 21.8.4 Chemical Etching Procedure

- Utilize the appropriate chemical etching solution(s) according to the evidence submitted. The firearm examiner or forensic technician should start with the weakest reagent first. It is acceptable to switch between reagents and/or to dilute reagents as needed.
- Prior to the application of the chemical etching solution to the serial number area, test the reagent in an area on the firearm away from where the serial number should be located. This test will serve as a positive control. If a bubbling reaction or color change reaction occurs, the reagent is working properly. This will be documented in the case notes or on the Serial Number Worksheet.
- Apply the chemical etching solution to the area of obliteration utilizing cotton tip applicators or swabs that have been moistened with the chemical etching solution.
  - It is generally best to work the reagents in one direction-either right to left or left to right dependent upon the evidence or preference of the firearm examiner or forensic technician.
- If the serial number has not appeared, it may not be restorable or the firearm examiner or forensic technician may proceed to a stronger chemical etching solution.
- Photograph and record results obtained during this process.
- All recovered serial numbers or partial serial numbers must be verified by a qualified firearm examiner. This verification must be documented.
- The Magnetic Particle Inspection Procedure may again be attempted if the serial number has not be fully recovered.

#### 21.8.5 Recovery of Hidden Serial Numbers

Some firearms are manufactured with a hidden or secondary serial number. When a



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hidden or secondary serial number is used in the recovery process, this serial number must be documented and photographed. The hidden or secondary serial number must be verified by a qualified firearm examiner. This verification must be documented.

#### 21.8.6 Barcode Decryption

- Inspect bar code to ensure that at least portions of the full barcode are available.
- Determine if all bars are present.
- Delineate the bars into character units.
  - Use of an enlarged photograph or photocopy is recommended.
  - Start at the far left bar and count five bars over then label this as the first character set.
  - Repeat this procedure for the remaining bars to identify all character sets.
- Interpret and document the barcode element size patterns.
  - Each bar and space from left to right is to be labeled “W” for wide or “N” for narrow.
  - Complete this for each character set.
  - Using the Bar Code 39 key table below, begin correlating each developed pattern sequence from the individual character sets to determine the character represented by the pattern.
  - Record results.
- Have the decryption process and decoded serial number verified by a qualified firearm examiner.

| <b>Bar Code 39 Table</b> |                |                  |                |                  |                |
|--------------------------|----------------|------------------|----------------|------------------|----------------|
| <b>Character</b>         | <b>Pattern</b> | <b>Character</b> | <b>Pattern</b> | <b>Character</b> | <b>Pattern</b> |
| 0                        | NNNWWNWN       | F                | NNWNWWNN       | U                | WWNNNNNNW      |
| 1                        | WNNWNNNNW      | G                | NNNNWNNW       | V                | NWWNNNNNW      |
| 2                        | NNWNNNNW       | H                | WNNNNWNN       | W                | WWWNNNNNN      |
| 3                        | WNWWNNNN       | I                | NNWNWWNN       | X                | NWNNWNNNW      |
| 4                        | NNNWWNNNW      | J                | NNNNWNNW       | Y                | WWNNWNNNN      |
| 5                        | WNNWNNNN       | K                | WNNNNNNWW      | Z                | NWWNWNNNN      |
| 6                        | NNWNNNN        | L                | NNWNNNNWW      | Space            | NWWNNWNW       |
| 7                        | NNNWNWNNW      | M                | WNWNNNNWN      | *                | NWNNWNNWN      |
| 8                        | WNNWNNWNN      | N                | NNNNWNNWW      | \$               | NWNNWNNNN      |
| 9                        | NNWNNWNN       | O                | WNNWNNWN       | /                | NWNNWNNWN      |
| A                        | WNNNNWNNW      | P                | NNWNWNNWN      | +                | NWNNWNNWN      |
| B                        | NNWNNWNNW      | Q                | NNNNNNWWW      | %                | NNNNWNNWN      |
| C                        | WNWNNWNN       | R                | WNNNNWNN       | -                | NWNNNNWNNW     |



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|   |           |   |           |                 |           |
|---|-----------|---|-----------|-----------------|-----------|
| D | NNNNWWNNW | S | NNWNNNWWN | .               | WWNNNNWNN |
| E | WNNNWWNNN | T | NNNNWNWWN | This cell blank |           |

**21.9 Records:** The firearm examiner or forensic technician shall document their findings in the form of handwritten notes, computer generated notes, photography, or by utilizing a Serial Number Worksheet. The firearm examiner or forensic technician shall photograph the submitted evidence before, during, and after the restoration process. The firearm examiner or forensic technician shall strictly adhere to all note taking procedures as prescribed by laboratory policy.

#### 21.10 Interpretations of Results:

- If any characters become visible, note these characters. The firearm examiner or forensic technician shall be absolutely certain as to the characters which are restored.
- The firearm examiner may report partial numbers which are restored.
  - The examiner may use an asterisk (\*) to indicate an inconclusive character (e.g. 5 6 \* 7 8, asterisk indicating that the number may be a 6 or a 0).
  - The examiner may use a question mark to indicate an unrestored character (e.g.: 5 6 ? 7 8 ? 9 0, the third and fifth character could not be restored).
- A trace of the recovered serial number should be conducted using NCIC (National Crime Information Center). If the trace reveals the firearm was stolen, that information should be included in the Official Firearms Report.

**21.11 Report Writing:** Most serial number report writing can be found in Appendix 4 – Range of Conclusions.

#### 21.12 References:

Association of Firearms and Toolmark Examiners Glossary, 5<sup>th</sup> Edition, 2007.

Association of Firearms and Toolmark Examiners Training Manual, March 3, 2001.

Association of Firearms and Toolmark Examiners Procedures Manual, July 9, 2001.

Brown, Erik, "Serial Number Restoration on Ruger P Series Aluminum Alloy Frames", AFTE Journal, Winter 2001, Vol. 33, No. 1, pgs 57-58.

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