

FEU12 – SOP for Comprehensive Gunshot Residue Examinations in Muzzle-to-Target Distance Determinations

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1. Scope

- 1.1. The purpose of this procedure is to provide the firearms examiner with a comprehensive protocol and examination sequence in conducting examinations for the detection of gunshot residues and the physical effects due to gunshots.

2. Background

- 2.1. To establish the practices for documenting the examination of firearm evidence to conform to the requirements of the Department of Forensic Sciences (DFS) Forensic Science Laboratory (FSL) *Quality Assurance Manual*, the accreditation standards under ISO/IEC 17025:2005, and any supplemental standards.

3. Safety

- 3.1. For proper handling of firearm see the *FEU01 - SOP for the Safe Handling of Firearms*.

4. Materials Required

- 4.1. Table for Materials Required

Stereo zoom binocular microscope (magnification range of 10X – 20X, at minimum)	Steel Tape Measure
Cotton twill test cloth	Felt marker
Camera	Lead and copper bullets
Inertia Bullet Puller	Nitrite cotton swabs
Tape	Firing range

4.2. On a muzzle to garment distance examination one must have the firearm in question and like ammunition.

5. Standards and Controls

5.1. A lead bullet is used as a positive control for the Sodium Rhodizonate Test (SoRo). Nitrite cotton swabs are used for the positive control for Modified Griess Test. If a chemical reagent must be prepared before examination, the following information must be recorded on the FEU Chemical Preparation Log: chemical prepared (should include parent chemical), preparer, date prepared (lot number format MM/DD/YY), the initials of the examiner/technician who prepared it and the amount prepared. The chemical lot number for reagents used during examination will be recorded in the examination notes.

6. Calibration

6.1. Not applicable

7. Procedures

7.1. Visual and Microscopic Examination of Evidence

7.1.1. It should be noted that the initial examination is in regard to the microscopically observable physical evidence characteristics and residues which may be present.

7.1.2. Initially, a visual examination should be performed to determine the presence of gunshot residues. A sketch(s) or photograph(s) is taken to document the item being examined and the relative position of the hole(s) or gunshot residue is recorded.

- 7.1.3. Perform microscopic examinations using a stereo zoom binocular microscope with appropriate lighting. The examiner should be looking for various types of relevant physical effects and residues.
- 7.1.4. Indicative of/consistent with the discharge of a firearm:
 - 7.1.4.1. Vaporous lead (smoke).
 - 7.1.4.2. Particulate lead shavings or solidified droplets.
 - 7.1.4.3. Unburned gunpowder.
 - 7.1.4.4. Melted, adhering gunpowder.
- 7.1.5. Indicative of/consistent with the passage of a bullet:
 - 7.1.5.1. A hole(s) in an item.
 - 7.1.5.2. A visible ring around the perimeter of the hole(s) (bullet wipe).
- 7.1.6. Indicative of/consistent with a contact shot or close to contact shot:
 - 7.1.6.1. Ripping, tearing.
 - 7.1.6.2. Burning, singeing.
 - 7.1.6.3. Melted synthetic fibers.
 - 7.1.6.4. Heavy vaporous lead residues (smoke).

7.2. Chemical Residues and Their Processing

- 7.2.1. After completion of the microscopic examinations, certain chemically specific, chromophoric tests are conducted for the various types of gunshot residue. The initial test: the Modified Griess Test for Nitrite Residue, is directed toward the detection of deposits of nitrite compounds from burned or partially burned gunpowder around a suspected bullet hole(s) or patterns of suspected shot pellet holes.
- 7.2.2. The Sodium Rhodizonate Test for Lead Residues procedure is directed towards the detection of any type of lead residue which might be present. This would include vaporous lead (smoke) usually associated with closer ranges, particulate lead and *bullet wipe*, a ring-shaped deposit often found around the perimeter of a bullet hole.
- 7.2.3. The results of these tests will be reflected in the examination notes.

7.3. Interpretation of Results

- 7.3.1. Gunshot residue distance determinations are a result of residues detected on an item(s) of evidence. The absence of residues is not a basis for expressing a distance determination. The results of the Sodium Rhodizonate Test should be consistent with the results of the Modified Griess Test at a particular muzzle-to-target distance and with any physical effects present.
- 7.3.2. The Contact Shot or Close to Contact Shot: A contact shot or close to contact shot is based on the presence of very characteristic ripping and tearing of an item, the burning and singeing of cloth, the melting of synthetic fibers, and the heavy vaporous lead (smoke) deposits around the suspected bullet hole(s).
- 7.3.3. Nitrite Residues: With increases in muzzle-to-target distances, patterns of detectable nitrite residues around a suspect bullet hole(s) vary in size and density. When a pattern of nitrite deposits is found, it is possible to reproduce this pattern using the submitted firearm and like ammunition in combination. When only scattered nitrite residues are found, it is possible to find maximum distance to which such residues are deposited, using the submitted firearm and like ammunition in combination.
- 7.3.4. Vaporous Lead/Lead Residues: Vaporous lead deposits are characteristically deposited at close ranges and can be chemically detectable utilizing the Sodium Rhodizonate Test. Such residues are produced only if to a particular distance, which is determined utilizing the suspect firearm and like ammunition in known-distance tests. Lead *bullet wipe* is consistent with the passage of a bullet(s) and cannot determine distance.

7.4. Known Distance Test

- 7.4.1. When reproducing residue patterns detected on evidentiary items, it is essential that the suspect firearm and like ammunition be used in the known-distance test. Patterns of residue will vary with changes in or to ammunition, barrel length, caliber, and powder charge.
- 7.4.2. For most situations, white cotton twill cloth is suitable as a test target media. However, there may be instances where the characteristics of the evidence item are unusual enough to preclude meaningful test patterns with the cotton twill cloth. In such cases, it may be necessary to duplicate the evidence of material, or to utilize a portion of the evidence item for firing known-distance tests. (See the Comments section for additional information).
- 7.4.3. When certain types of residues are found, it is necessary to find maximum distance to which these residues are projected from a firearm. A procedure in these instances is to gather data that can be used to

establish the distance at which the particular residue is always found, and the distance at which it is not found in known-distance tests. This forms a bracket for the maximum distance situation for a particular type of residue.

8. Sampling

8.1. Not applicable

9. Calculations

9.1. Not applicable

10. Uncertainty of Measurement

10.1. When quantitative results are obtained, and the significance of the value may impact the report, the uncertainty of measurement must be determined. The method used to determine the estimation of uncertainty can be found in the *FSL Quality Assurance Manual – Estimation of Uncertainty of Measurement (Section 5.4.6)* and in the **FEU Appendix A, Uncertainty of Measurement Guidelines**.

11. Limitations

11.1. The Modified Griess Test and Sodium Rhodizonate yield reactions to nitrite and lead residues, respectively, regardless of whether or not these residues are in fact the result of the discharge of a firearm. Distance determinations reached as a result of gunshot residue examinations must be based on residues found to be present, not on the absence of residues.

11.2. Without the firearm and like ammunition present the distance examination determination cannot be performed.

11.3. Authorization is required by the United States Attorney's Office to utilize any portion of the evidence item(s) for firing known-distance tests to include but not limited to ammunition and garments. If no attorney is assigned, the Executive Director will have the authority.

12. Documentation

12.1. GSR Worksheets

12.2. FEU Report of Results

13. References

13.1. Federal Bureau of Investigation Gunpowder and Gunshot Residue Manual (Current Version)

13.2. Cyber National, Inc., Bullet Recovery System & Remote Firing Platform Operating Guide (2004)

13.3. Forensic Buddy, Savage Arms Operating Guide, (2008)

13.4. DFS Health and Safety Manual (Current Version)

13.5. *Forensic Science Laboratory Quality Assurance Manual* (Current Version)

13.6. *FSL Departmental Operations Manuals* (Current Versions)

13.7. *FSL Laboratory Operations Manuals* (Current Versions)

13.8. *FEU01 - SOP for Safe Handling of Firearms* (Current Version)

13.9. FEU10 - SOP Sodium Rhodizonate (Current Version)

13.10. FEU11 - SOP Modified Griess Test (Current Version)