

<b>SUBJECT</b>	<b>GUNPOWDER, GUNSHOT RESIDUE AND/OR SHOTGUN PELLET PATTERN EXAMINATION PROTOCOL</b>
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## **15.0 Gunpowder, Gunshot Residue and/or Shotgun Pellet Pattern Examination Protocol**

### **15.1 Gunpowder and Gunshot Residue Examinations**

Handle clothing and other items for gunpowder and gunshot residues carefully

Refer to the SBI Policy and Procedure Manual - Evidence Which May Carry  
Infectious Diseases - Page 37-3

- Read SBI-5 to determine if request for serological examination was made or if summary of incident indicates that such an examination is necessary. If determined that serological examination is necessary, transfer evidence to Molecular Genetics Section prior to examining.
- Wear recommended laboratory gloves when handling evidence.

#### **15.1.1 Microscopic examination for observable physical characteristics of residues which may be present.**

- Perform these microscopic examinations in an uncontaminated area using a variable power stereo microscope with adequate lighting.
- Look for physical effects that are indicative of/consistent with the discharge of a firearm:
  - Vaporous lead (smoke)
  - Particulate lead (shavings, tiny solidified droplets)
  - Unburned gunpowder, partially burned gunpowder and/or burned gunpowder.

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- Look for physical effects that are indicative of/consistent with the passage of a bullet:
  - A hole in the garment/object.
  - A visible ring around the perimeter of a hole, possible “bullet wipe”.
- Look for physical effects that are indicative of/consistent with a contact gunshot:
  - Ripping, tearing of fabric at area of hole. Stellate shaped tear/hole.
  - Burning, singeing.
  - Melted artificial fibers.
  - Heavy soot and vaporous lead residues.

15.1.2 Record the findings of the microscopic examination.

- Notes should include a written description of the garment/object.
- Notes should include a description of the location of any holes in the garment/object.
- Notes should include a sketch/drawing of the garment/object with the holes indicated.

15.2 Chemical processing of evidence.

15.2.1 The Modified Griess Test:

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Note: All chemical tests should be performed in a proper

- Used to detect deposits of nitrite compounds from burned or partially burned gunpowder around a suspected bullet hole or patterns of suspected shot pellet holes in porous items.
- Positive Control - Test the corners of the emulsion-coated side of desensitized and chemically treated photographic paper for sensitivity to nitrite compounds.(See the Section Manual for the Preparation of Chemicals for directions to prepare the chemicals and paper needed to perform the Griess Test)
  - Saturate a nitrite test swab in a small amount of 15% acetic acid solution and dab the corners of the photographic paper.
  - An orange color should appear at each corner, confirming such sensitivity.
  - Test enough photographic paper as needed for the examination of the evidence and one more for a control test.
- Negative Control -Soak a piece of nitrite-free gauze/cheesecloth in 15% acetic acid solution and wring it out. Place this gauze/cheesecloth on the desensitized and chemically treated photographic paper and apply a hot iron to the gauze/cheesecloth. No reaction should take place and no visible nitrite reactions should be found on the photographic paper.

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- If the results of the positive and negative control tests were appropriate, place a check in the box next to “Okay” on the notes sheet.
- Place the evidence garment/object questioned side down on the emulsion-coated side of the photographic paper. Using a pencil or other marking device index suspected bullet/pellet holes.
- Soak a piece of nitrite-free cheesecloth/gauze in a solution of 15% acetic acid solution and wring it out. Place the cheesecloth/gauze on the questioned item as the third layer. Press the cheesecloth/gauze with a hot iron.
- Discard the cloth and separate the questioned item from the photographic paper. Any orange reactions on the photographic paper are the results of chromophoric reaction chemically specific for the presence of nitrite residues.
- Record and describe fully any reactions into the case notes.
- For health and safety reasons, discard the photographic paper used in an appropriated Bio-Hazard container..
- Repeat the above process (only one negative control is needed) for all holes in the questioned item and for any other porous questioned items submitted for gunshot residue examination.

15.2.2 The Reverse Modified Griess Test:

- To be used for non-porous materials through which the acetic acid solution “steam” will not penetrate.

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- Follow the procedures in 15.2.1 for positive and negative controls.
- Wipe the emulsion-coated side of the photographic paper with a piece of cheesecloth/ gauze saturated with the 15% acetic acid solution. Apply this solution to the entire surface, but lightly. Too much acetic acid may cause an indistinct or hazy result due to pigment migration.
- Immediately place the photographic paper emulsion side down the questioned surface. Apply a hot iron to the back of the photographic paper. (Note: Placing filter paper between the iron and the photographic paper can help prevent the photographic paper sticking from to the iron.)
- Separate the photographic paper and the questioned item. Any orange indications on the photographic paper are the result of a chromophoric (color-producing) reaction chemically specific for the presence of nitrite residues.
- Record and describe fully any reactions into the case notes.
- For health and safety reasons, discard the photographic paper used in an appropriate Bio-Hazard container.
- Repeat the above process (only one negative control is needed) for all holes in the questioned item and for any other non-porous questioned items submitted for gunshot residue examination.

**15.2.3 The Sodium Rhodizonate Test:**

- A chemically specific chromophoric (color-producing) test for lead. Used to corroborate visible physical characteristics and to detect lead residues not visible to the unaided eye.

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**SECTION 15  
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- Always performed after the Griess Test.
- See the Section Manual for the Preparation of Chemicals for preparing the three (3) reagents necessary to perform the Sodium Rhodizonate test and for preparing the control swabs.
- Positive Control/Negative Control - Using the specially prepared lead swabs wipe a clean area on filter paper with one of the swabs.
  - First - spray the control area of the filter paper with a saturated solution of sodium rhodizonate in distilled water.
  - Second - Spray the same area with a buffer solution (ph 2.8) consisting of sodium bitartrate and tartaric acid in distilled water. A pink reaction should be seen in the area wiped with the lead swab and no reaction should be seen in the areas not wiped with the lead swab.
  - Third - spraying a dilute solution (5%) of hydrochloric acid. This spray changes the pink areas to a blue-violet color in the areas wiped with the lead swab and no change should occur in the areas not wiped with the lead swab.
  - If the results of the positive and negative control tests were appropriate, place a check in the box next to "Okay" on the notes sheet.
- Processing Evidence.
  - First - spray the questioned area with a saturated solution of sodium rhodizonate in distilled water.
  - Second - Spray the same area with a buffer solution (ph 2.8)

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consisting of sodium bitartrate and tartaric acid in distilled water. Any pink reaction that results may be lead, but this must be confirmed by

- Third - spraying a dilute solution (5%) of hydrochloric acid. This spray changes the pink areas to a blue-violet color if lead is present, and only if it is present.
- Record and describe fully any reactions into the case notes.

15.2.4 The Bachinsky Transfer Method of Sodium Rhodizonate Testing:

- Used to test dark-colored items which would mask the blue-violet coloration of a positive test result:
- Perform Positive and Negative Controls as outlined in 15.2.3.
- Place a piece of filter paper over the appropriate area of the questioned item. With a pencil note the position of any holes on the filter paper.
- Uniformly dampen the filter paper while on the questioned item by spraying with a 15% solution of acetic acid and distilled water.
- Cover the dampened filter papers with several layers of dry filter paper. Apply a hot iron to the filter paper and iron it until the damp paper is dry.
- Remove the filter paper which was in direct contact with the evidence item and process it as in the direct application method. Note: Any positive reactions are a mirror image of the deposition on the questioned item.

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- Record and describe fully any reaction into the case notes. Positive results would be vaporous lead, particulate lead, “bullet wipe” or a combination of these lead residues.
- Discard any test media used for health and safety reasons.

15.3 Interpreting the results of microscopic and chemical testing.

Note: A prime consideration in the interpretation of any type of gunshot residue is that conclusions must be stated as a result of residues that are found to be present. The absence of residues is not a basis for expressing a categorical and conclusive statement about a particular situation.

15.3.1 The Contact Shot.

- The most basic type of distance determination occurs when a contact shot is found. Based on the presence of the very characteristic ripping and tearing of a garment, the burning and singeing of cloth, the melting of artificial fibers and the heavy vaporous lead (smoke/soot) deposits around the suspected bullet hole, a contact shot is indicated.
- The Modified Griess Test and the Sodium Rhodizonate Test may yield positive results on contact shots, but the physical characteristics in themselves are sufficient to reach the conclusion of a contact shot.
- No suspect firearm testing is necessary to reach this conclusion.

15.3.2 Nitrite Residues.

- At distances greater than contact patterns of chemically detectable nitrite deposits of varying size and density can be found around a



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suspected bullet hole. These patterns can be detected through an application of the Modified Griess Test, and will increase in diameter and decrease in density up to a point where no discernible pattern exists, simply scattered positive results. At some point at still a greater distance, no nitrite residues at all will be deposited.

- When a pattern of nitrite residues is found around a suspected bullet hole it is possible to produce similar patterns using the suspect weapon and ammunition (or ammunition like the suspect ammunition) in combination.
- When only scattered nitrite residues are found around a suspected bullet hole (not a pattern) is possible to find the maximum distance to which such residues are deposited.

#### 15.3.3 Vaporous Lead Residues.

- Vaporous lead deposits are characteristically deposited a closer ranges when a weapon discharges. These are chemically detectable by application of the Sodium Rhodizonate Test, and positive results are very useful.
- This type of residue is projected from the muzzle in a cloud -like array, and a such is not adapted to a distance determination based on a pattern of residues.
- These vaporous lead residues are projected only to a particular maximum distance which can be found by experimentation using the suspect weapon and ammunition (or ammunition like the suspect ammunition) in combination and firing distance tests.

#### 15.3.4 Bullet Wipe and Lead Particulate:

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- A hole with a visible dark ring around its perimeter that is chemically detectable as lead is consistent with the passage of a bullet. No distance determination can be made based on bullet wipe alone.
- Particulate lead found around a bullet hole can be visible and chemically detectable as lead. Since lead particulate is not a reliably reproducible phenomenon, they are not useful for distance determination. They are however consistent with the discharge of a firearm.

15.3.5 Notes on interpretations.

- The interpretation of all microscopic examination and chemical testing of gunshot residues should be included in the examiners case notes.

15.4 Producing Similar Positive Results

15.4.1 Nitrite Residue Patterns:

- Use white twill cloth squares approximately 9" X 9" for test firing medium.
- Use the suspect firearm and suspect ammunition or ammunition like suspect ammunition.
- Fire into the test media at various distances until a pattern consistently smaller than the pattern found on the questioned item is produced a certain distance and a pattern consistently larger than the pattern found on the questioned item is produced at a farther distance.
- The examiners notes should include the methodology use to produce test patterns and the results (bracketed) of the testing.

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15.4.2 Scattered Nitrite Reactions and/or Vaporous Lead

- Use white twill cloth squares approximately 9" x 9" for test firing medium.
- Use the suspect firearm and suspect ammunition or ammunition like suspect ammunition.
- Fire into the test media at various distances until a distance is found where residues always occur and until a farther distance is found where no residue is ever found.
- The examiners notes should include the methodology use to produce test patterns for maximum distance and the results (bracketed) of the testing.

15.5 Examination and analysis of shot patterns.

15.5.1 Shot patterns in garments and other objects are **always** microscopically examined and chemically tested for nitrites and lead just like the examination for possible bullet holes.

- There is the possibility of a shot pattern concealing a bullet hole and other residues within.
- Attention should be played to the possibility of “pellet wipe” and lead randomly deposited by the impact of wadding materials.
  - These deposits are normally not useful in distance determinations but can be corroborative.
- The examiner should look for finely divided plastic particulate during the microscopic examination.

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- Filler material that may assist in identifying/corroborating the type of ammunition involved and is in itself indicative of a discharge of a shotgun.

15.5.2 The main basis for distance determination is simply the size of the shot pattern and the production of similar size patterns with the suspect firearm and ammunition or ammunition like the suspect ammunition.

- The examiner should avoid being tied to a particular dimensional description of the size of the pattern such as diameter.
- The pattern should be compared side-by-side with known distance test patterns.
  - Examiner can visually eliminate “flyers” or holes which deviate from a normal roughly circular pattern.
- Some pellet patterns will be elongated in shape due to the fact that at the instance of firing there was an angle of some sort involved.
  - The narrower dimension of the elongated shot pattern is the significant dimension and the basis of comparison with the diameter of test pellet patterns.
- Remember that a shot pattern is not necessarily the product of a shotgun having been fired. There are numerous hand gun loads by various manufacturers that fire shot pellets, especially in the smaller shot sizes.

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15.5.3 Producing similar patterns during test firings

- The examiner must use the suspect firearm and suspect ammunition or ammunition like suspect ammunition (Brand, gauge, size, type, shot and powder load).
  - Indicated by live ammunition taken from gun.
  - Indicated by fired ammunition components taken from crime scene.
- Patterns are shot into test media (normally cardboard and/or white cloth squares).
- Patterns are fired at various distances until a pattern consistently smaller than the questioned pattern is produced at a certain distance and pattern consistently larger is produced at some farther distance.
- The examiners notes should include the methodology use to produce test patterns and the results (bracketed) of the testing.

15.6 Sample GRC Note Page.

- A sample note page is shown on following page.

15.7 No formatted spaces on any case work sheets are to be left blank. It is permissible to use N/A (not applicable) or a single line through unused spaces. If a work sheet contains multiple formatted sections, those not utilized must be crossed through or deleted.

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<b>Evidence Examination Worksheet</b>	Παγε 2 οφ 16	
	Laboratory #:	
	Examiner's Initials:	

Report #:	Date:
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Gunshot Residue Analysis

Item #:	Description:
Container(s):	
Package entered through:	
Observations:	
Griess Test	QCC+/- Okay <input type="checkbox"/>
NaRho Test	QCC+/- Okay <input type="checkbox"/>

<b>Evidence Examination Worksheet</b>
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Παγε 3 οφ 16	
Laboratory #:	
Examiner's Initials:	

Report #:

Date:

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