# FIREARM & TOOLMARK SECTION
# STANDARD OPERATING PROCEDURES

## Residues & Range Determination Protocol

# VISUAL AND MICROSCOPIC METHODS

**INTRODUCTION**

Muzzle-to-target distance determination is based on gunshot residue examinations and/or shot patterning examinations. When a firearm is fired gunshot residues, including burned gun powder particles, partially burned gun powder particles, unburned gun powder particles, vaporous lead and particulate metals, are discharged from the firearm. These gunshot residues, along with the morphology of the bullet hole or the size of the pellet pattern, can effectively be used in determining the possible muzzle-to-target distance.

Clothing and other items may be evaluated for the presence of gunshot residues or patterns of gunshot residues without a suspect firearm. With exception of contact or near contact shots, valid conclusions in muzzle-to-target distance examinations must be reached through tests which are conducted to reproduce the physical parameters related to the incident. For example, if a series of holes is found in a garment indicating a bullet entrance, exit and re-entrance, test patterns should be produced to simulate this incident and compared with the questioned pattern.

Typically, clothing or items submitted to the laboratory that do not have a suspect bullet hole (such as suspect clothing, a shirt from an individual with a gunshot wound on their neck, chin, head, etc.) are not examined for the presence of gunshot residues. However, there may be circumstances where conducting an examination for the presence of gunshot residues may be deemed necessary.

Range determination evaluations on wounds and from photographs of wounds shall not be reported by firearms examiners. If a distance determination is requested on skin, appropriate test patterns can be fired using the method outlined below and in consultation with appropriate Medical Examiner staff. Test patterns shall be reproduced as described below for the MEO.

With the exception of contact or near contact shots (see below), elements needed to perform valid muzzle-to-target distance determinations include:

- Firearm
- Ammunition involved and component(s) identified back to firearm
- Questioned pattern

Sufficient ammunition recovered from the incident being investigated must be available to check consistency of gunshot residues produced with laboratory stock ammunition of the same brand and load. If sufficient evidence ammunition is not available, a valid muzzle-to-target distance determination is not possible. An item of evidence can still be evaluated for the presence of gunshot residues; however, the presence of a pattern shall be reported as if a firearm/ammunition is not available for testing.

The evidence shall be marked in accordance with the Quality Manual. A systematic approach should be used for range determination using the visual, microscopic, and chemical methods, with recording of findings and observations in case notes, preferably on the Range & Residues Worksheet.

If the ownership of the clothing is unclear or the examination reveals no holes for evaluation, the examiner should further investigate to clarify the circumstances of the shooting and ownership of the clothing prior to continuing an examination.

**SAFETY CONSIDERATIONS**

This procedure may involve hazardous materials including evidence that may be contaminated with a biohazard. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use. Proper caution, including strict adherence to Universal Precautions and Blood Borne Pathogen safety, must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

**PROCEDURE**

# VISUAL EXAMINATION

Sufficient photographs with a 1:1 scale should be taken to document the garment/object overall. Close-up photos of the damaged areas and areas containing gunpowder particles should also be made for documentation before chemical examination. All photos will be stored in PLIMS.

The visual examination of an item for gunshot residue will include the examination and/or consideration of the following:

1. Presence of soot and/or smoke (size of pattern)
2. Presence of particulate metals (shavings of lead, copper, brass, etc.)
3. Presence of partially burnt and/or un-burnt gunpowder (size and density of pattern)
4. Presence of a visible ring around the perimeter of holes (bullet wipe)
5. Location and size of all holes, tears, other damage
6. Presence and location of burning, singeing, or melting
7. Notation of any missing buttons
8. Presence of any possible masking effects
9. Pattern of artifacts surrounding holes
10. Pellet pattern size
11. Presence of an unusually shaped pellet pattern (e.g., spiral, vortex, or donut shaped pellet pattern)

Data regarding these physical effects and visible residues should be included in the examiner's notes.

INTERPRETATION OF RESULTS:

I. Indicative of/ Consistent with the Discharge of a Firearm.
   - A. Vaporous Lead (smoke)
   - B. Particulate Metals (shavings of lead, copper, brass)
   - C. Unburned Gunpowder (morphology)
   - D. Melted Adhering Gunpowder

II. Indicative of/ Consistent with the Passage of a Bullet.
   - A. A hole in the item
   - B. Visible ring around the perimeter of holes

III. Indicative of/ Consistent with a Contact Shot.
   - A. Ripping or Tearing
   - B. Burning or Singing
   - C. Melted Artificial Fibers
   - D. Heavy Vaporous Lead Residues

IV. Possible Masking Effects

   - A. Dark Background Color
   - B. Blood Staining
   - C. Intervening Object

If the above observations support the findings of a "contact or near contact shot" no comparison with known tests is necessary. Without performing test firing, a “contact or near contact” shot is interpreted as the shot having been fired with the muzzle of a firearm within approximately one (1) inch of the target.

If the observations do not support a "contact shot" finding, a working hypothesis will be formed based on the above observations. This hypothesis will be utilized in the comparison procedure.

# MICROSCOPIC EXAMINATION

Microscopic examinations of a questioned item may include documentation of any gunpowder particles observed by producing a clear transparency overlay of the particles present. If the garment/fabric in the area(s) of the holes/gunpowder may have potentially biohazardous residues, then two transparencies should be placed one over the other and the top transparency be used to document the gunpowder. The bottom transparency should be discarded in the biohazardous waste. Overlays produced should be indexed with the bullet holes, buttons, seams and other features so that the overlay can be properly aligned back to the clothing/item being evaluated. Multiple overlays may be necessary to document all pertinent areas of a garment. The overlays produced shall be included as case file documentation.

The microscopic examination of an item for gunshot residue will include the examination and/or consideration of the following:

1. The presence of vaporous lead (smoke)
2. The presence of particulate metals (shavings of lead, copper, brass)
3. The presence of unburned gunpowder
4. The presence of melted adhering gunpowder
5. The presence of burning, singeing or melting
6. The presence of any possible masking effects

Data regarding these physical effects and visible residues should be included in the examiner’s notes.

INTERPRETATION OF RESULTS:

I. Indicative of/ Consistent with the Discharge of a Firearm.
   A. Vaporous Lead (smoke)
   B. Particulate Metals (shavings of lead, copper, brass)
   C. Unburned Gunpowder(morphology)
   D. Melted Adhering Gunpowder

II. Possible Masking Effects
   A. Dark Background Color
   B. Blood Staining

If the above observations support the findings of a "contact shot" no comparison is necessary. If the observations do not support a "contact shot" finding, a working hypothesis will be formed based on the above observations. This hypothesis will be utilized in the comparison procedure.

# CHEMICAL EXAMINATION METHODS

**PREFACE**

NITRITE RESIDUES

At distances greater than contact, patterns of chemically detectable nitrite deposits of varying size and density can be found around a 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) it is possible to find the maximum distance to which such residues are deposited.

VAPOROUS LEAD RESIDUES

Vaporous lead deposits are characteristically deposited at 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 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.

BULLET WIPE AND LEAD PARTICULATE

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.

Patterns produced as a result of chemically processing evidence will be photographed using a scale. The photographs will be saved in PLIMS as an attachment to the item.

**It should be noted that if multiple chemical examinations are going to be performed on an item they must follow a specific order.**

First- Modified Griess
Second- Sodium Rhodizonate

CHEMICAL EXAMINATION PROCEDURES:

Modified Griess Test – Direct Application Technique
Modified Griess - Reversed Application Technique
Sodium Rhodizonate Procedure- Bashinsky Transfer Technique
Sodium Rhodizonate Procedure- Direct Application Technique

# MODIFIED GRIESS TEST

## INTRODUCTION

The Modified Griess Test is used independently and/or in conjunction with other tests in range determinations. The Modified Griess test utilizes a color chemistry reaction to help distinguish obscure or faint gunpowder patterns. This test detects nitrites, a product of the incomplete burning of gunpowder, by reacting with acetic acid to form nitrous acid. This acid combines with alpha-naphthol and produces an orange-red color reaction.

**It should be noted that if multiple chemical examinations are going to be performed on an item they must follow a specific order.** See Preface above.

## SAFETY CONSIDERATIONS

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

| NFPA LISTING | | | | |
|---|---|---|---|---|
| CHEMICAL | HEALTH HAZARD | FLAMMABILITY HAZARD | REACTIVITY HAZARD | CONTACT HAZARD |
| Sulfanilic Acid | 1 | 1 | 0 | 1 |
| Alpha Naphthol | 3 | 1 | 1 | |
| Methanol | 1 | 3 | 0 | |
| Sodium Nitrite | 1 | 0 | 0 | |
| Glacial Acetic Acid | 1 | 3 | 0 | |

**WARNING**! Alpha Naphthol is toxic and can pose a **SEVERE HEALTH HAZARD.**

**WARNING!** Methanol is flammable and can pose a **SEVERE FLAMMABILITY HAZARD.**

**WARNING!** Glacial Acetic Acid is flammable and can pose a **SEVERE FLAMMABILITY HAZARD.**

The examiner should wear gloves and use eye protection or work within a fume hood.

## PREPARATIONS

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

Sensitized Blank:

1. Add 0.75 grams of Sulfanilic Acid to 150 milliliters of distilled water and mix.
2. Add 0.42 grams of Alpha Naphthol to 150 milliliters of methanol and mix.
3. Once both the solutions in step 1 & 2 are prepared mix them together in a clean photo tray.
4. Saturate pieces of filter paper or desensitized photo paper in this solution.
5. Once the now sensitized blanks are dry, store in an airtight plastic container.
6. Utilizing these proportions, mix the quantity desired.

Acetic Acid Solution:

Mix a 15% Glacial Acetic Acid solution.

Nitrite Test Strips/swabs:

Dissolve 0.6 grams of Sodium Nitrite in 100 milliliters of distilled water. Saturate pieces of filter paper or cotton swabs in this mixture. Once dry, store in an airtight plastic container. Utilizing these proportions, mix the quantity desired.

**Note- Preparation of these reagents should be properly documented in the appropriate reagent log.**

**CONTROLS**

The **positive control** for the Modified Griess procedure consists of placing a test mark, utilizing a Nitrite test strip/swab that is moistened with 15% Acetic Acid solution, on the edge of each of the sensitized blanks being used. An immediate orange color should appear on the sensitized blank. This color shift indicates that the sensitized blank is sensitive to the presence of nitrites. The **negative control** for the Modified Griess procedure consists of no color appearing on the sensitized blank when a clean test strip or swab that is moistened with 15% Acetic Acid solution is touched to the sensitized blank at the edge of the paper. The use of these controls will be recorded in the case notes.

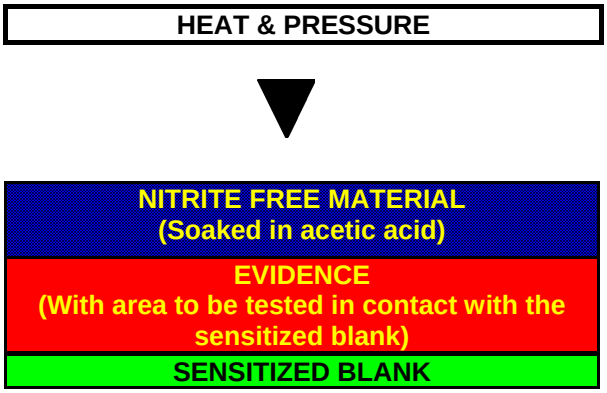
# DIRECT APPLICATION TECHNIQUE

**PROCEDURE**

1. Place the sensitized blank (photo paper - emulsion side up or sensitized filter paper) under the area to be tested.

2. Soak a piece of nitrite free cheese cloth or filter paper with the acetic acid solution, and place this over the reverse side of the evidence.

3. Apply heat and pressure with an iron until the acetic acid solution treated paper is dry.




INTERPRETATION OF RESULTS:

Any orange, orange-red indications on the paper are the results of the chemically specific test for the presence of nitrite residues. Digital images should be taken of positive results. Negative results need only to be noted.

# REVERSED APPLICATION TECHNIQUE

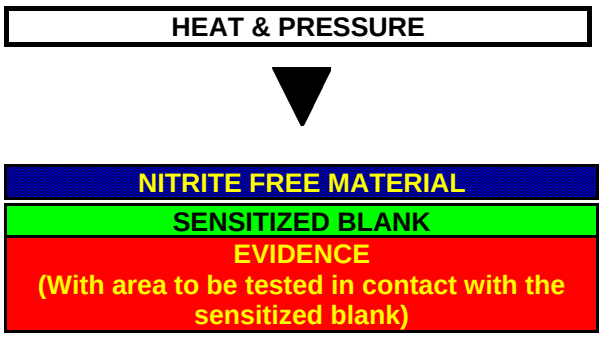
**PROCEDURE**

1. Moisten the side of the sensitized blank that will be in contact with the questioned area with the acetic acid solution.

2. Place the sensitized blank (photo paper - emulsion side down or sensitized filter paper) over the area to be tested.

3. Place a piece of filter paper or nitrite free cheese cloth over the sensitized area.

4. Apply heat and pressure with an iron until the acetic acid solution treated paper is dry.




INTERPRETATION OF RESULTS:

Any orange, orange-red indications on the paper are the results of the chemically specific test for the presence of nitrite residues. Digital images should be taken of positive results. Negative results need only to be noted.

# SODIUM RHODIZONATE TEST

## INTRODUCTION

The Sodium Rhodizonate Test is used independently and/or in conjunction with other tests in range determinations. The Sodium Rhodizonate Test utilizes a color chemistry reaction that is specific for lead and can effectively be used in determining the physical characteristics of bullet holes including the determination of entrance vs. exit holes. Fired bullets passing through clothing and/or other objects often leave traces of lead around the bullet hole. This lead transfer comes from the surfaces of the bullet, the barrel and/or the primer residue. This lead transfer can be in the form of minute particles, a fine coating of powder particles or a fine cloud of vaporized lead. At times this lead transfer is an obvious ring or wipe around the hole but is more often invisible.

**It should be noted that if multiple chemical examinations are going to be performed on an item they must follow a specific order.** See Preface above.

## SAFETY CONSIDERATIONS

This procedure involves hazardous materials. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use. Proper caution must be exercised and the use of personal protective equipment must be considered to avoid exposure to dangerous chemicals. Consult the appropriate MSDS for each chemical prior to use.

| NFPA LISTING | | | | |
|---|---|---|---|---|
| CHEMICAL | HEALTH HAZARD | FLAMMABILITY HAZARD | REACTIVITY HAZARD | CONTACT HAZARD |
| Sodium Rhodizonate | 2 | 0 | 0 | |
| Hydrochloric Acid | 3 | 0 | 0 | |
| Sodium Bitartrate | 1 | 0 | 0 | |
| Tartaric Acid | 0 | 1 | 0 | |
| Glacial Acetic Acid | 2 | 2 | 3 | |

**WARNING!** Hydrochloric Acid is toxic and can pose a **SEVERE HEALTH HAZARD.**

**WARNING!** Glacial Acetic Acid is capable of detonation and can pose a **SEVERE REACTIVITY HAZARD**.

The examiner should wear gloves and use eye protection or work within a fume hood.

## PREPARATIONS

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

Sodium Rhodizonate Solution:
Prepare a saturated Sodium Rhodizonate solution.

Hydrochloric Acid Solution:
Prepare a 5% Hydrochloric Acid solution.

Buffer Solution:
Dissolve 1.9 grams of Sodium Bitartrate and 1.5 grams of Tartaric Acid in 100 milliliters of distilled water. This usually requires both heat and agitation to complete in a reasonable amount of time. Utilizing these proportions, mix the quantity desired.

Acetic Acid Solution:
Prepare a 15% Acetic Acid solution.

**Note- Preparation of these reagents should be properly documented in the appropriate reagent log.**

**CONTROLS**

The **positive control** for the Sodium Rhodizonate test consists of placing a test mark with a piece of known lead on a piece of filter paper or twill jean. By performing the Sodium Rhodizonate procedure on this test mark the examiner can determine if in fact the Sodium Rhodizonate solution is reacting properly. An alternative control for the Sodium Rhodizonate test consists of utilizing cotton swabs dampened with a 5% Hydrochloric acid solution. One of the treated swabs is rubbed against a piece of known lead. This swab is then processed with the Sodium Rhodizonate test to ensure that the test is reacting properly. The areas surrounding the test mark should be subjected to the Sodium Rhodizonate and buffer solutions. This area should not produce any color change and serves as the **negative control**. The use of these controls will be recorded in the case notes.

# BASHINSKY TRANSFER TECHNIQUE

**PROCEDURE**

1. Uniformly dampen a piece of filter paper with the Acetic Acid Solution.

2. Place the treated filter paper over the hole/area to be tested.

3. Place a second piece of filter paper over the first and apply moderate pressure or apply a hot iron for approximately 5 seconds.

4. Remove both pieces of filter paper and spray the Sodium Rhodizonate Solution on to the tested area of the filter paper.

5. Spray the tested area of the filter paper with the Buffer Solution.

6. Spray the tested area of the filter paper with the Hydrochloric Acid Solution.

7. Repeat this process on all holes/areas to be tested. Both sides of a hole should be tested if there is a question of entrance vs. exit.

INTERPRETATION OF RESULTS:

A violet or purple colored ring, corresponding to the margin of the hole, or a violet or purple colored stain, corresponding to the area tested constitutes a positive reaction for lead. Digital images should be taken of positive results. Negative results need only to be noted.

# DIRECT APPLICATION TECHNIQUE

**PROCEDURE**

1. Spray the Sodium Rhodizonate Solution on to the questioned area.

2. Spray the tested area with the Buffer Solution.

3. Spray the tested area with the Hydrochloric Acid Solution.

4. Repeat this process on all holes/areas to be tested. Both sides of a hole should be tested if there is a question of direction.

INTERPRETATION OF RESULTS:

A violet or purple colored ring, corresponding to the margin of the hole, or a violet or purple colored stain, corresponding to the area tested constitutes a positive reaction for lead. Digital images should be taken of positive results. Negative results need only to be noted.

# TABLE OF RANGE & RESIDUES TEST CHEMICALS

| | | | NFPA HAZARD RATING | | | |
|---|---|---|---|---|---|---|
| **TEST** | **CHEMICAL** | **AMOUNT** | **HEALTH HAZARD** | **FLAMMABILITY HAZARD** | **REACTIVITY HAZARD** | **CONTACT HAZARD** |
| **Modified Griess Reagent** | | | | | | |
| Mod. Griess | Sulfanilic Acid | 0.5 gm | 1 | 1 | 0 | 1 |
| Mod. Griess | Water | 100 ml | 0 | 0 | 0 | |
| Mod. Griess | Alpha Naphthol | 0.28 gm | 3 | 1 | 1 | |
| Mod. Griess | Methanol | 100 ml | 1 | 3 | 0 | |
| **15% Acetic Acid Solution** | | | | | | |
| Mod. Griess | Glacial Acetic Acid | 150 ml | 3 | 2 | 0 | |
| Mod. Griess | Water | 850 ml | 0 | 0 | 0 | |
| **Nitrite Test Paper** | | | | | | |
| Mod. Griess | Sodium Nitrite | 0.6 gm | 2 | 0 | 1 | oxy |
| Mod. Griess | Water | 100 ml | 0 | 0 | 0 | |
| **Sodium Rhodizonate** | | | | | | |
| Sodium Rhodizonate | Sodium Rhodizonate | Saturate soln. | 1 | 0 | 0 | |
| Sodium Rhodizonate | Water | 100 ml | 0 | 0 | 0 | |
| **5% Hydrochloric Acid** | | | | | | |
| Sodium Rhodizonate | Hydrochloric Acid | 5 ml | 3 | 0 | 0 | |
| Sodium Rhodizonate | Water | 95 ml | 0 | 0 | 0 | |
| **Buffer Solution** | | | | | | |
| Sodium Rhodizonate | Sodium Bitartrate | 1.9 gm | 1 | 0 | 0 | |
| Sodium Rhodizonate | Tartaric Acid | 1.5 gm | 0 | 1 | 0 | |
| Sodium Rhodizonate | Water | 100 ml | 0 | 0 | 0 | |
| **Acetic Acid Solution** | | | | | | |
| Sodium Rhodizonate-Bash. Transfer | Glacial Acetic Acid | 15 ml | 3 | 2 | 0 | |
| Sodium Rhodizonate-Bash. Transfer | Water | 85 ml | 0 | 0 | 0 | |

**Note- Preparation of these reagents should be properly documented in the appropriate reagent log.**

# TEST PATTERN METHODS

## NON-SHOT PELLET TEST PATTERN PRODUCTION

**INTRODUCTION**

By utilizing the suspect firearm and appropriate evidence and laboratory stock ammunition it may be possible to obtain a reproduction of gunshot residue pattern(s) and or shot pellet pattern present on a questioned item. Chemically uncontaminated material and one or more sections of the questioned evidence material can be used while producing test patterns at known distances with the submitted firearm and appropriate ammunition. The known test patterns are then processed using the same methods that were applied to the material containing the questioned pattern. Comparing the test patterns to the questioned pattern(s), a determination may be possible as to the approximate bracketed distance a particular firearm's muzzle was from the questioned item at the time of firing.

In order to perform a muzzle-to-target range determination examination properly, it is usually necessary to attempt to reproduce the gunshot residue patterns present on the suspect item. This reproduction is accomplished by shooting tests at varying distances until the gunshot residue pattern present on the suspect item is reproduced.

**It is an <u>essential</u> prerequisite that the suspected firearm and ammunition consistent with the suspect ammunition be utilized.** Tests shall be produced from submitted evidence ammunition. If no evidence ammunition is available, a muzzle-to-target distance determination shall not be conducted. If appropriate evidence ammunition is available, it should be used eventually in the testing protocol for comparison with laboratory stock ammunition of the same brand and load. For comparison of ammunition, one (1) muzzle-to-target distance should be selected for test firing with both laboratory stock and evidence ammunition. Preferably, a distance that produces an approximate pattern size and density of the pattern developed on the evidence should be selected. Duplicate test firing of either laboratory stock ammunition or evidence ammunition, as available, should also be incorporated into the testing protocol.

A carefully planned test can be conducted with one evidence cartridge. Similar laboratory stock ammunition would be used to produce a series of tests at various distances, with some duplicates, against white twill jean cloth (or other laboratory target material). An appropriately sized portion of the evidence cloth or similar material would be cut and mounted on white blotter paper for test firing with another of the laboratory stock cartridges at the same approximate distance as one of the previous duplicate test fires. The patterns would be processed and compared. If the patterns produced with laboratory stock ammunition on the white twill jean material and the evidence cloth are consistent in pattern size and density, then the evidence cartridge can be used to test fire another target prepared from the evidence cloth at the same approximate distance. If the patterns are again consistent in size and density, the laboratory stock patterns on white twill can be used to interpret a bracket. If the patterns produced at the same approximate distance with laboratory stock ammunition on white twill jean cloth and evidence material are dissimilar, then a search for a test material more similar to the evidence material may be appropriate. If the patterns produced at the same approximate distance with laboratory stock ammunition and evidence ammunition on evidence material are dissimilar, then a search for another box of similar test ammunition may be appropriate. If no further testing is possible, then a muzzle-to-target distance cannot be reported.

A systematic approach should be used in conjunction with a working hypothesis formed from observations based on previous testing (visual, microscopic, and chemical tests) to produce test patterns with the appropriate firearm and ammunition for the purpose of developing a range determination.

Muzzle-to-target test patterns produced for range determination interpretations shall be considered evidence, designated as a child item of the firearm from which they are created in PLIMS and be submitted to the Property Bureau after analysis is complete. The test patterns will be described in PLIMS as "Test patterns produced with Item __ [Item # or firearm]." See packaging information in procedures below.

Muzzle-to-target test patterns produced for comparison with autopsy findings shall be considered evidence and entered into PLIMS as a new item (not a child item). The new item should be described as "Test patterns produced with [Item # or firearm] for the MEO." See packaging information in procedures below.

Ammunition components derived from producing test patterns with submitted evidence ammunition shall be designated with unique identifiers, but shall not be created as a child item in PLIMS.

Sections of submitted evidence materials used for test pattern production shall not be created as a child item of the evidence item from which it was derived. The report shall indicate the number of tests produced from sections of the evidence item.

**SAFETY CONSIDERATIONS**

This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use. Proper caution to include strict adherence to any and all Firing Range rules must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential biohazards or dangerous chemicals.

**PREPARATIONS**

Test Target Media

Attach appropriate size pieces of cotton twill material or an unaffected piece of the evidence material located far away from the gunshot-damaged area to a nitrite free cardboard backing board.

**CONTROLS**

Before shooting patterns, a blank test cloth shall be subjected to the chemical process being used for the analysis to determine if any contaminants or interferences are present. The result shall be marked as a “blank”, documented and treated as all other test patterns (as listed above).

**PROCEDURE**

**It is essential that the suspected firearm and appropriate ammunition are utilized for these tests.**

1. Test firing should be conducted based on the suspected event that occurred during the shooting
2. The suspect firearm and evidence ammunition having cartridge/shotshell case and projectile components like those recovered from the target/victim should be utilized for these tests; these tests can be compared with tests produced in a similar manner with laboratory stock ammunition of the same brand and load to ensure consistency of ammunition; if test patterns produced are consistent, the laboratory stock ammunition can be used to complete the testing.
3. Usually, one test should be fired for each piece of target media.
4. 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.
5. Tests should be fired in increasing or decreasing range increments until a distance is established, that reproduces the gunshot residue patterns on the suspect item.
6. Process target material with same chemicals as were used on questioned item.
7. If possible, at least one test fire should be made with a portion of the questioned evidence material or a material similar in fiber type and construction for comparison with test target material; a suitable area (minimal or no obvious blood/body fluids) of the questioned evidence material should be cut from the item and used for test firing purposes; if no suitable material is available, resort to similar material.
8. Test patterns should be preserved to ensure no loss of powder or contamination between test patterns; e.g., after chemical processing, cloth tests should be separated using clean pieces of white blotter paper or similar material and carefully wrapped.
9. Document test patterns via photography with a scale, if desired, and on the Range & Residues Worksheet.
10. Compare test patterns with questioned item and document results of analysis on the Range and Residues Worksheet

INTERPRETATION OF RESULTS:

By utilizing the suspect firearm and appropriate ammunition it is possible to obtain a reproduction of a gunshot residue pattern present on a suspect item. Therefore one can ascertain the approximate distance that that particular firearm's muzzle was from the suspect item when it was shot.

# SHOT PELLET TEST PATTERN PRODUCTION

**INTRODUCTION**

In order to perform a muzzle-to-target range determination examination involving a shotgun properly, it is usually necessary to attempt to reproduce the shot patterns present on the suspect item. This reproduction is accomplished by shooting tests at varying distances until the shot pattern present on the suspect item is reproduced. It is an **essential** prerequisite that the suspect firearm and ammunition consistent with the suspect ammunition be utilized.

**SAFETY CONSIDERATIONS**

This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use. Proper caution to include strict adherence to any and all Firing Range rules must be exercised and the use of personal protective equipment must be considered to avoid exposure to any potential hazards.

**PREPARATIONS**

Test Target Media

The test media for shot pellet test patterns is an appropriate sized piece of poster board or heavy paper.

**PROCEDURE**

1. Tests should be shot one per piece of target media.

2. Tests should be shot in increasing or decreasing range increments until a distance is established, both shorter and longer than, that which reproduces the shot patterns on the suspect item.

3. **It is essential that the suspect firearm and appropriate ammunition are utilized for these tests.**

INTERPRETATION OF RESULTS:

By utilizing the suspect firearm and appropriate ammunition it is possible to obtain a reproduction of a shot pattern present on a suspect item. Therefore one can ascertain the approximate distance that particular firearm's muzzle was from the suspect item when it was shot.

# REFERENCES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# POSSIBLE RESULTS FOR RANGE DETERMINATIONS

There are many possible results relating to the determining of muzzle -to- target distance and the reporting of residues. This section is included as a guide for the most frequently reported results. It should not be construed to be all-inclusive or limiting to the examiner in reporting examination results.

- Item XXX was examined and found to exhibit holes consistent with the passage of projectiles in the XXX (area of target).
- Item XXX was examined and found to exhibit no damage that was consistent with having been produced by the passage of a projectile.
- Visual and chemical examination of the holes and the areas surrounding the holes revealed a gunshot residue pattern.
- Visual and chemical examination of the holes and the areas surrounding the holes failed to reveal a gunshot residue pattern.
- Portions of Item XXX were used in distance determination testing.
- Based on tests using the firearm submitted item XXX and the ammunition submitted item XXX, it was determined that the gunshot residue pattern found on Item XXX is consistent with a muzzle -to- target distance of greater than XXX but less than XXX.
- The absence of a gunshot residue pattern on Item XXX precludes the determination of a muzzle -to- target distance.
- The damage found in Item XXX is consistent with a contact gunshot.

| Issue Date | History |
|---|---|
| 03/31/00 | Original Issue |
| 03/19/01 | Removed DTO section (never used), fixed format errors. |
| 01/30/04 | Added new Firearms Examiner Gene Rivera, updated process map. |
| 03/08/11 | Changed (corrected) grains to grams in nitrite test strips preparation |
| 06/17/11 | Updated footer for ISO 17025. |
| 11/02/11 | Expanded and updated for evidence retention requirements. |
| 4/4/14 | Updated for PLIMS. |

## Approval

Director _____ Date:
Matthew C. Mathis

## Issuance

Chief Criminalist _____ Date:
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Criminalist _____ Date:
Gene C. Rivera

Criminalist _____ Date:
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