Presumptive Field Test for Bullet Wipe Determination

**Purpose:** Chemical reactions anticipated for the presence of lead &/or copper.

**Materials:** Required for each team, six members per team (*PBL* Experience).

Outside preparation for lab activity (*see advance preparation notes at end*).

- Target surfaces of different materials (in this example; fiber board, white wall, plywood, Styrofoam, sheet metal vent flashing, and car windshield).
- Three(+) firearms (handguns &/or rifles) of varying caliber (in this example; .357 magnum, 9 mm and .45 caliber).
- Ammunition to ensure a minimum of five bullet strikes of each caliber spread out over the target surface.
- Documentation cameras (still & video); DSLR, high quality cell phone camera.
- Documentation identification stickers (in this example 5mm colored dots, red for .357, blue for 9mm & green for .45 caliber).
- Power drill with various size bits (in this example; 1/4, 3/8 & 1/2 inch) and hole punch & hammer for making "complementary" holes in target surfaces.

Student laboratory activity.

- Safety gloves and eye protection (worn at all times during lab activities).
- Diagram materials (paper, pencil, measurement scales).
- Chain-of-Possession (COP) form (evidence in/out of lockup each classes).
- Identifying stickers.
- CPU access to Team Google Site and Google SketchUp program.
- Chemical test set for presence of lead and copper (see description attached).
- Documentation camera (DSLR or high quality cell phone camera).

**Procedures.**

**Hypothesis...** Will you be able to identify, with accuracy, which holes in the target surface are from gunshots/bullets? A **bullet wipe** is the residue left by a bullet passing through a surface...
First period (50 minutes) or 1st hour of longer/block period.
1. Target surface (evidence) is received from Property & Evidence (P&E) Lockup, COP completed.
2. Critical measurements (length, height, width, identify each side, N,S,E & W) completed with physical description of evidence (surface type, materials, identifying features, colors, wood grain, etc).
3. Initial diagrams identifying various holes (by stickers, removed after each class)
4. Documentation digital images captured.
5. Estimates as to which holes are believed to be bullet strikes, and why.
6. Return evidence to P&E LockUp and complete COP.

Second period (50 minutes) or 2nd hour of longer/block period.
1. Recover evidence from P&E Lockup, COP completed.
2. Re-identify holes with appropriate stickers.
3. Undertake presumptive field tests for all holes, strictly following protocol, documenting results.
4. Appropriately discard all utilized materials in field test.
5. Remove all ID stickers.
6. Return evidence to P&E LockUp and complete COP.

Third period (50 minutes) or 1st hour of second block period
1. As a team, complete digital diagram (SketchUp or scan hand drawn diagram).
2. Indicate which holes were positive for presence of lead &/or copper.
3. Create appropriate table of data related to this evidence analysis (complete with coordinates for each identified hole and test results, +/-).
4. Labels and caption for all captured digital images and any/all scans (pdf.file)
5. Notify Command when your final report (ppt.file) is completed. With title page, team member tasks (contact info.), COP form, formal diagram of evidence, documentation digital images, presumptive test data table and with a "de-briefing" summary. This de-briefing is in the Scientific Method format.

(*advance preparation notes: Consultation with shooting range management for suggestions as to how to place the target surfaces, and secure access to capture digital images following each session of bullet strikes for presumptive test confirmations. Collection of all cartridge shells (and bullets?) will be of value in another Forensic Ballistics lesson plan or crime scene processing activity.)
Sodium Rhodizonate Test for Lead

The Sodium Rhodizonate test provides a color reaction indicative of the presence of lead. It can be employed around the periphery of a hole or defect to determine if it is consistent with the passage of a bullet. Lead may be deposited not only from lead bullets, but from lead residues found on the exterior of most fired copper-jacketed bullets as well. At the scientist's discretion, the test may also be used to evaluate other objects or surfaces for the presence of lead.

The hole (above left) is to be tested with sodium rhodizonate solution. The control test (above right) shows the reagent is giving expected results, a purple color reaction to the area to which lead was applied. The bullet hole is tested by transferring lead to a filter paper with an acidic solution on it (below left) and then applying sodium rhodizonate solution to obtain the color reaction (below right). This reaction is indicative of bullet wipe and shows the hole is consistent with the passage of a bullet.

The procedure can be applied to a number of surfaces, such as victim clothing, drywall, vehicle upholstery, curtains, carpet, etc. It is always performed after the Modified Griess Test and the Dithiooxamide Test to preclude potential chemical interference.
The objective of this test is to confirm the results of the Modified Griess Test. Information from this test may also assist in establishing a muzzle-to-target distance; lead is generally detected at closer distances. A positive result around the suspected bullet hole is consistent with passage of a bullet.

The chemistry of the Sodium Rhodizonate Test is comprised of the following process:

1. The questioned area is sprayed directly with a saturated solution of sodium rhodizonate in distilled or deionized water.
2. A buffer solution (pH 2.8) consisting of sodium bitartrate and tartaric acid in distilled or deionized water is then sprayed on the area. Any pink reaction which results may indicate lead or a number of other possible heavy metals. The presence of lead may be confirmed through an additional step.
3. A dilute solution of hydrochloric acid is applied by spraying the area. The color results are dependent on the degree of acidity and the presence of lead. If the pink area changes to a blue-violet color, the presence of lead is confirmed.
4. Safety procedures, gloves and eye protection is required at all times.
Reagents and Test Media

The following reagents and test media are required for the Modified Griess Test:
- Nitrite sensitive emulsion-coated test paper
- Nitrite test swabs (nitrite compound positive control samples)
- Solution of glacial acetic acid (15%) and distilled or deionized water
- Nitrite compound-free cheesecloth

Nitrite Sensitive Emulsion-Coated Test Paper
Desensitized photographic paper or photographic printer paper can be used as a medium for capturing the azo dye pigment patterns generated during the Modified Griess Test.

The test paper preparation procedure is as follows:
1. Prepare a solution of 7.7 grains (.5 grams) of sulfanilic acid in 100 mL of distilled or deionized water.
2. Prepare a solution of 4.3 grains (.28 grams) of alpha-naphthol in 100 mL of methanol.
3. Combine equal volumes of the above solutions.
4. Pour the combined solutions into a nonreactive photo processing tray. Briefly submerge and remove precut sheets of the test paper into the tray.
5. Set the sheets aside to dry on an uncontaminated surface or hang to dry.
6. Store any unused solution in a sealed container labeled according to laboratory protocol.
7. Store dried test paper in a dry place.

Nitrite Test Swabs
1. Prepare a solution of 9.3 grains (0.6 grams) of sodium nitrite in 100 mL of distilled or deionized water.
2. Soak cotton tipped swabs in the nitrite solution.
3. Set the swabs aside to dry.
4. Store swabs in a sealed container labeled according to laboratory protocol.

Glacial Acetic Acid
1. Combine 150 mL of glacial acetic acid with 850 mL of distilled or deionized water.
2. Store the solution in a sealed container labeled according to laboratory protocol.

Cheesecloth
Cut nitrite-free cheesecloth to the size of the processed test paper. (If the cheesecloth contains nitrites, it may produce an orange background color on the processed test paper.)
Test Procedure

The Modified Griess Test is carried out as follows:

1. **Confirm nitrite sensitivity of test paper.**
   Using a nitrite test swab saturated with 15 percent acetic acid solution, dab the corners of the test paper. Each corner should turn orange, confirming the sensitivity of the paper to nitrite compounds. A negative control should also be tested for each sheet of photographic paper to ensure that it is not contaminated.

2. **Mark reference points of evidence on test paper.**
   Place the evidence face down on the emulsion-coated side of the test paper. Using a pencil, index any seams, button holes, buttons, rips, pockets, suspected bullet holes, tears, cuts, etc., for reference. Do not use ink because it may transfer back onto the evidence item.

3. **Create layers of reaction items.**
   Soak an unused piece of cheesecloth in the acetic acid solution. Wring excess solution from the cheesecloth and spread it on top of the evidence (already placed on the photographic paper), completing the three-layer sandwich.

4. **Heat reaction layers.**
   Press the layers with a hot uncontaminated iron. Acetic acid steam is forced through the layers, causing the color-producing reaction.

5. **Examine and interpret the results.**
   Discard the cheesecloth and separate the evidence item from the test paper. Any orange indications on the paper are the result of a chromophoric reaction chemically specific for the presence of nitrite residues.

   Note: It is possible that a spurious source of nitrite residues (not firearms-related) could be present. These are typically visualized as an orange haze; it is unlikely that such residues would alter the interpretation of the point reactions around a suspected bullet hole. Occasionally, background reactions can be observed on clothing items made from blue denim and from garments washed using certain detergents. Some disinfectants, as well as marijuana, can yield positive results.

6. **Label and retain test paper.**
   Mark the previous pencil marks placed on the test paper in ink when the paper is dry. Label with additional data as called for by laboratory protocol.