A Simplified Protocol for the Examination of Materials that Possess Gunshot Discharge Products, A Workshop

Hosted by Robert J. Shem, Alaska Department of Public Safety, Anchorage, Alaska, and the Association of Firearm and Tool Mark Examiners at the AFTE annual training seminar, Monday, June 1, 2009 and Tuesday, June 2, 2009, 6:00 – 9:00 PM, Miami, Florida

Purpose

The purpose of this workshop is to offer a simplified alternative protocol to established procedures for the analysis of gunpowder residue patterns. This simplified protocol is desirable for several reasons:

1. **Time Saving** - A reduction in the number of procedural steps saves time and tedium.
2. **Less Wasteful** - The reagent-treated test papers are prepared one at a time immediately prior to use, so there is no waste due to pretreated papers degrading over time in storage.
3. **Less Lead-Time Needed** – The test papers do not need to be dried prior to use.
4. **One Protocol for all Target Materials** - This method is applicable to both porous and nonporous materials, so a consistent methodology is followed, instead of switching between a "reverse" method for nonporous items and a traditional "steam-through" method for porous items.
5. **Fewer Opportunities for Human Error –** The reduction in procedural steps provides fewer opportunities to introduce human error. Plus, the application of a single protocol for all target materials provides a greater familiarity with the procedures due to that fact that one would get more "practice" when employing a single methodology.

The Protocol

1. Visual Examination
2. Stereoscopic Examination
3. Infrared Examination
4. Simplified Griess Test
5. Simplified Sodium Rhodizonate Test
6. Documentation
7. Interpretation of Findings
8. Report Wording

Introduction

The Rationale behind Muzzle-to-Target Distance Determination testing

Prior to the application of the protocol demonstrated in this workshop or any other protocol for the analysis of gunpowder residue patterns the scientist needs to understand how these tests will serve the shooting incident investigation. For example, in one case the shooter may claim that he accidentally shot his wife while he was cleaning his gun. The discovery of a contact shot to the victim's chest would provide valuable information to the trial jury. In another case a shooter may claim that the firearm discharged during a struggle. The lack of any gunpowder residue patterns may indicate that the muzzle was at a distance that the victim could not have been physically interacting with the firearm at the moment of discharge. The scientist can best serve the investigation when the examination is tailored to address the questions developed during the course of a shooting incident investigation. In the first example, simply establishing that the firearm discharged within an arm's reach of the muzzle would belie the shooter's claim. Whereas in the second example the fact that the gun was out of reach of the victim would challenge the notion that the decedent contributed to his own death by "tugging" on the gun. In most cases it is not necessary to establish that the muzzle-to-target separation was 1.5 inches or 23 inches.

This workshop walks the student through each of the eight steps.

Visual Examination

The visual examination is conducted to familiarize the scientist with the evidence. It is during the visual examination that the scientist will locate the areas where potential gunpowder particle patterns might exist. It is at this stage that rips, holes, tears, sooty areas, are noted. Whenever possible review autopsy photos and reports. It is not unheard of that a small caliber bullet may enter near a seam and be very difficult to locate without the assistance of the autopsy findings. In the case where the victim receives medical attention it is not uncommon to find that the paramedics used a bullet hole as a convenient location to place their scissors when cutting the clothing from the victim. Again, autopsy or medical information may help draw attention to the areas of greatest interest.

Stereoscopic Examination

Prior to chemical testing the garment should be examined with magnification. On occasion it has been observed that gunpowder particles, readily apparent during a stereoscopic examination, fail to be detected by chemical examination. It may be helpful to "flag" the gunpowder particles using ¼ inch "color coding label" dots. The use of a contrasting color, for example yellow dots on a blue shirt or blue dots on a yellow shirt will be helpful in visualizing the extent of the distribution of gunpowder particles across a garment. The resulting pattern of dots, when photographed, provides a compelling graphic display of the gunpowder pattern.

Infrared Examination

Infrared Examination can provide the scientist with "another set of eyes" in the form of an enhanced visual examination. In many cases gunpowder particle patterns can not be seen with the naked eye due to a dark or confusing fabric pattern. Infrared examination allows the scientist to "see" reflected infrared radiation. Whereas dark fabric dyes absorb visible light these dyes may actually reflect infrared radiation as readily as a white T-shirt reflects visible light.

Traditional infrared examination involves the use of 35mm photographic film. Infrared film photography is a difficult science that requires considerable experience to master. This is because the inherent differences between visible light film photography and infrared film photography are great. A camera focused for visible light will be out of focus when using infrared films and filters. Built in light meters are worthless, requiring a lot of "bracketing" to insure a correct exposure. Infrared film needs to be handled in complete darkness and can be accidentally exposed by infrared light leaking through solid darkroom walls.

Digital infrared examination is a godsend for today's scientist. All of the difficulties experienced with traditional infrared film photography are a thing of the past. All the scientist needs is an infrared sensitive digital camera, an infrared lens filter, and an incandescent light source. In fact, the camera demonstrated in this workshop collects infrared light even when there is no apparent source of infrared radiation.

The Camera

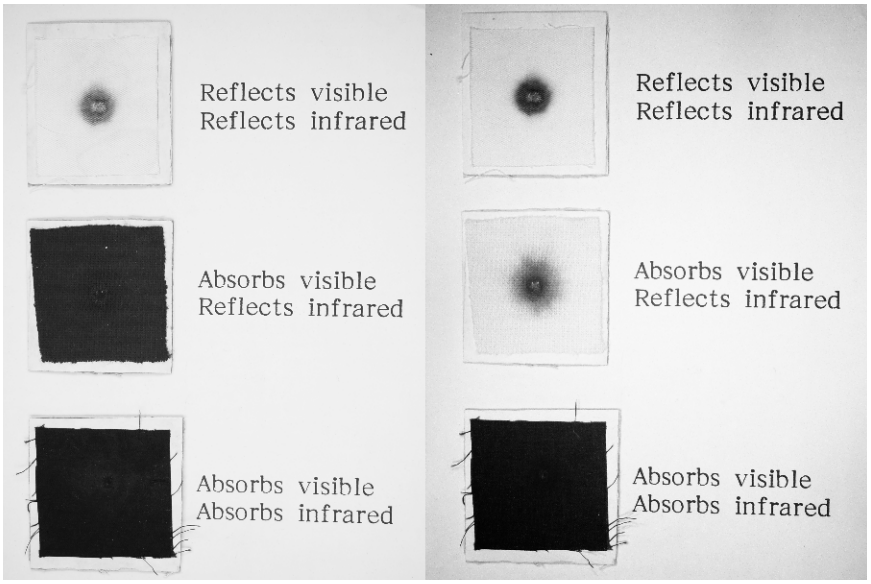
The camera used in this workshop is the Sony DSC-F707. At its top setting it produces digital photographs that are 2560 pixels by 1920 pixels. At 150 pixels per inch this camera is capable of producing high quality 12"x17" color photographs which are indistinguishable from conventional film photographs. The significant distinguishing feature of this camera is the incorporation of Sony's lo-lux infrared circuitry. This camera when equipped with a 58mm Infrared Filter, such as a Hoya R72 , makes a near perfect infrared imaging system. The only drawback to this camera is that the tiny LCD screen on the back is only so-so for screening evidence and you cannot determine if you captured a good photo until you view it on a computer monitor. Images are stored on Sony Memory Sticks. A typical Memory Stick currently available will hold 128 megabytes of images which calculates out to almost 100 high resolution jpeg images. Images are transferred to the computer by use of a USB memory stick reader or directly from the camera by use of a specialized USB cable.

This camera possesses two infrared emitters located on the face of the lens at the one o'clock and eleven o'clock positions. These emitters would be handy in a cave for bat photography, but they create a hot spot in the center of each infrared photo. As a workaround black electrical tape can be placed over the emitters.

Once equipped with a 58mm Infrared filter and switched into the "nightshot" mode this system is ready to go. Incandescent light bulbs - normal everyday light bulbs - are a great source of infrared light. Fluorescent lights, such as those present in most crime labs emit far less infrared light than do incandescent bulbs. Therefore, three or more strategically positioned ceiling fixtures equipped with incandescent flood lights are an excellent way to evenly illuminate your work space with infrared radiation.

Applying Infrared Imaging to Evidence

Gunpowder residue patterns, in particular close range sooty material, reflects infrared light very poorly. Many dark fabric dyes reflect infrared light quite readily. This difference in reflectivity is what makes infrared imaging a valuable tool in visualizing residue obscured by darkly colored fabrics. To the infrared "eye" the sooty material and gunpowder particles remain dark while the background stands in bright contrast. However, not all dark garments reflect infrared radiation. Some garments that appear to be "dark" to your naked eye are also "dark" to infrared imaging. Care must be taken when interpreting your images. If the garment dye reflects infrared light to the same degree as does gunshot residue, then the image captured appears to depict a garment free of residue, especially when the intensity of the infrared radiation is increased to "lighten up" the background. As the background lightens so does the gunshot residue. Known samples of various dark garments with different infrared reflectivity are handy as “calibrators”. Infrared imaging of garments that absorb infrared radiation is generally worthless at determining whether or not gunpowder residue patterns are present.



Calibration card recorded with conventional imaging (left) and with infrared imaging.

A Simplified Griess and Sodium Rhodizonate Test

Key Words: Alpha-napthol, distance determination, Griess Test, gunshot residue, Marshall's Reagent, Sodium Rhodizonate Test

ABSTRACT

This paper presents a very effective method of gunpowder particle, gun smoke, and bullet wipe detection that is preferable to other methods described in the literature. This method is more economical in terms of consumables and effort. In addition, this method reintroduces the use of Marshall's Reagent, once thought to be a carcinogen.

Introduction

About 20 years ago Marshall's Reagent, an effective component used in the detection of nitrites as part of the Griess Test, was suspected to be carcinogenic. As a result, the search for a replacement compound led to the use of alpha-napthol in the Modified Griess Test for nitrites [1]. When this compound was first put into service, the author believed it to be inferior to Marshall's Reagent in two areas - reaction color and sensitivity. The orange azo dye reaction color produced in the Modified Griess Test using alpha-napthol stood in poor contrast to transferred biological stains, whereas the brownish-red color produced using Marshall's Reagent stood in better contrast. Furthermore, in-house testing conducted by the author and a college intern demonstrated that Marshall's Reagent has superior sensitivity, particularly when used with a filter paper transfer [2].

The procedures outlined in this article reintroduce Marshall's Reagent, no longer believed to be carcinogenic [3], and simplify both the Griess and Sodium Rhodizonate Tests by eliminating unnecessary steps and materials and combining both procedures on the same test paper. Additionally, test papers are prepared one at a time prior to use, so there are no unused test materials to deteriorate in storage.

Materials

Marshall's Reagent, N-(1-Naphthyl)-ethylene-diamine Dihydrochloride
Sulfanilic acid
Glacial acetic acid
One liter Nalgene bottles (three)
Whatman No. 2 filter paper 185mm circles, Cat. No. 1002 185 (or equivalent)
Distilled water
Methanol
Sodium rhodizonate (disodium salt of rhodizonic acid)
5 percent aqueous hydrochloric acid solution
50 mm glass beaker
Preval spray gun (or equivalent)
Plastic photo development tray (10"x12")
Fabric swatches with known gunshot residue
Photo heat press or clothing iron
Camera on a photo stand
Ruler scale

Reagent Preparation

Prepare the Griess Test stock solutions as follows:

5 grams sulfanilic acid dissolved in 1000 ml distilled water
5 grams Marshall's Reagent dissolved in 1000 ml methanol

Store the two stock solutions and a supply of glacial acetic acid in separate one liter Nalgene bottles. In the author's experience, stock solutions stored this way have remained viable with no detectable loss of potency for at least three years. If the stock solutions are mixed and stored, the solution will gradually lose potency. Concurrently, the solution will darken and a precipitate will form on the sides of the storage bottle. This may be due to the fact that Marshall's Reagent is unstable when exposed to either moisture or light [3]. The Marshall's Reagent stock solution should be stored in a tightly sealed opaque bottle to prevent ambient light or atmospheric moisture from degrading the solution.

Prepare the Sodium Rhodizonate Test solution as follows:

An aqueous sodium rhodizonate solution has virtually no shelf life and must be prepared and used the same day. Starting with about 50 ml of distilled water add small amounts sodium rhodizonate (approximately 0.5 gram or less) to the water until the solution is saturated (no more dissolves). Allow several minutes for the suspended particles of undissolved sodium rhodizonate to settle to the bottom. Decant the tea colored solution into the container bottle of a Preval spray gun. Prepare a second spray gun by filling the container bottle with the five percent hydrochloric acid solution.

Procedures

When ready to process evidence or laboratory test targets, pre-heat a photo press or clothing iron to approximately 225 degrees (F). Mix seven parts of the sulfanilic acid solution and seven parts of the Marshall's solution with one part of glacial acetic acid in a 10"x12" plastic photo tray. A total of 150ml of solution is sufficient to treat approximately five to ten pieces of filter paper. Tip the tray back and forth to assure that the solutions are completely mixed. Run a control test using a pre-labeled Whatman filter paper circle. Label the filter paper in pencil, rather than ink, as the methanol will cause the ink to run. Dip the filter paper into the photo tray completely saturating the paper. Remove the paper from the solution and hold it over the tray, allowing the solution to drain from the bottom edge until the dripping stops. This will insure that the paper contains an even distribution of solution while being neither too dry nor too wet thus yielding the optimum reaction. Place the filter paper face down on top of a swatch of cloth with known gunshot residue. Sandwich the assembly between several pieces of dry filter paper or copy machine paper. Place this entire packet into the photo press or under a clothing iron and apply pressure for 30 seconds. Separate the papers and document the control reaction photographically. Transferred nitrites from partially burned gunpowder will appear as brownish-red azo dye spots. Once it is determined that the reagents are working as expected, repeat the procedure on the test targets and evidence. Preserve the results photographically. Be sure to include a ruled scale in the photographs (Figures 1 –3).

Figure 1: Dip, Drip, and Drop. These three words best describe this Simplified Griess Procedure. Dip the paper in the solution, completely saturating the paper. Lift the paper out of the tray draining excess solution until it stops dripping. Then . . .

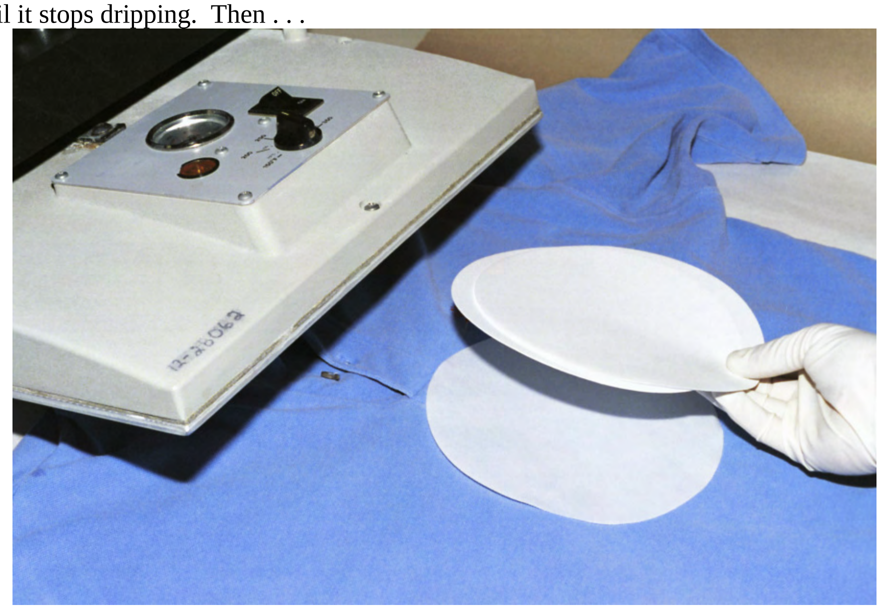


Figure 2: Drop the paper, face down above the suspected gunshot residue. Lay several sheets of dry filter paper on top of the treated paper. Cover the entire garment with parcel wrapping paper. Place the garment in the photo press at 225 degrees (F). Apply pressure for 30 seconds.

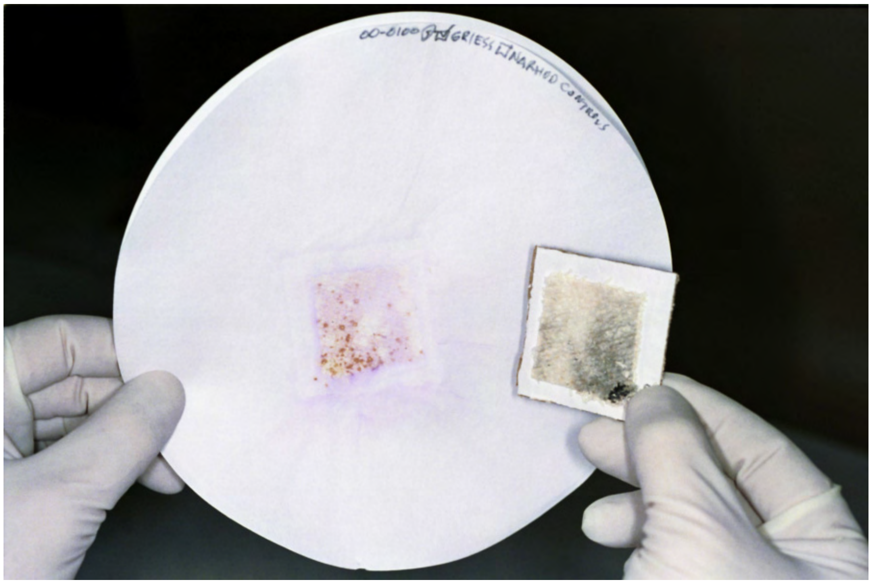


Figure 3: A control test swatch containing a known close range gunshot is processed first, verifying the potency of the chemicals.

The filter papers will dry quickly due to their exposure to the heat. This prepares the filter papers for a follow-up Sodium Rhodizonate Test. Starting with the control test filter paper, spray a fine mist of the sodium rhodizonate solution over the surface of the filter paper until the paper is completely treated but not dripping wet. Then spray the paper with the hydrochloric acid solution until the yellow background color just fades to clear. Transferred lead-rich gunshot residue will appear as a magenta reaction. These two steps should then be repeated directly on the test and evidence targets, provided that they are of light colors that will not mask a chromorphic (color producing) reaction. The lead-rich residues on the targets will produce a purple color. As before, record the results photographically (Figure 4).

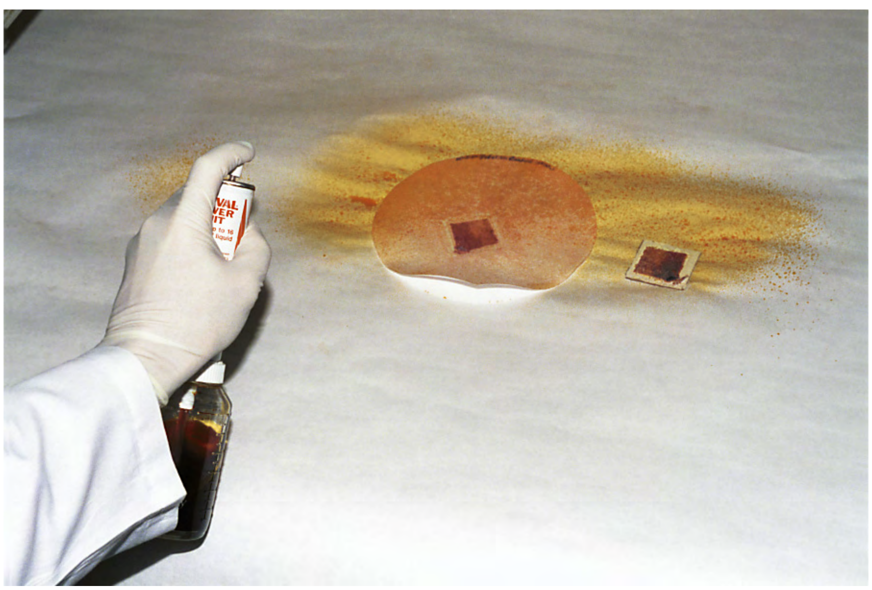


Figure 4: A follow up Sodium Rhodizonate Test can be performed on either the test filter paper or on the garment itself.

As an intermediate step between spraying the evidence and test materials with the sodium rhodizonate solution and the hydrochloric acid solution you may spray them with a tartaric acid buffer (1.9 grams sodium bitartrate and 1.5 grams tartaric acid per 100 ml distilled water). A chromorphic reaction would indicate the presence of one or more chemical compounds or metallic ions. Although this step is included in published procedures, it is unnecessary unless a test to discriminate between barium and lead is warranted [4].

When the examination is completed, the remaining test solutions and treated test papers should be properly disposed.

Discussion

The Simplified method has performance and labor saving advantages over both the Griess Test and the Modified Griess Test. The Marshall's Reagent works very well when used in a filter paper transfer. Experimentation by the author has shown that filter paper transfers using alpha-napthol produce very poor results, in contrast to the good results obtained using alpha-napthol with desensitized photo paper [2]. Filter paper has an advantage over photo paper in that it does not need to be "desensitized" first. The filter paper absorbs an even distribution of reagents. Unlike the traditional photo paper method, the filter papers are prepared one at a time immediately prior to use, so there is no waste due to pretreated papers degrading over time in storage. This transfer method can be used with non-porous and porous materials, so a consistent methodology is followed, instead of switching between a "reverse" method for non-porous items and a traditional "steam-through" method for porous items [5]. This standardizes the methodology and eliminates a number of procedural steps involved in the traditional "steam-through" method, thereby helping to minimize human error.

In some instances it has been found that the Simplified Griess reaction may develop over several hours, intensifying the reaction sites, making visualization and photo documentation of the pattern easier. If no pattern of reaction sites is seen during the testing of an evidence target, then allow the papers to sit overnight and reexamine them the following morning, prior to doing a follow-up Sodium Rhodizonate Test.

The completion of the Simplified Griess Test leaves the test and evidence targets, as well as the previously processed filter papers in optimal condition for the Simplified Sodium Rhodizonate Test by solubilizing lead-rich residues in an acid environment.

It is preferable to retain photographs of the test papers rather than the actual test papers themselves. The reactions on the test papers fade over time. Spots and discolorations unrelated to gunpowder patterns eventually appear on both used and unused test papers. This complicates the reexamination of the papers at a later date. In addition, the papers may contain biohazardous blood and body tissue, as well as harmful chemicals such as lead and antimony. Photographs preserve the data used to reach analytical conclusions and they best serve the functions of pretrial review and independent reexamination.

A Warning about Alpha Naphthol

Alpha Naphthol is currently rated as a "3" health hazard (recently upgraded from a "2") on the MSDS sheet [6]. Past and present MSDS sheets warn that Alpha Naphthol targets the eyes, liver, kidneys, and blood. The MSDS sheet rates Marshall's Reagent as a "2". Alpha Naphthol is shipped as a hazardous material with the appropriate extra packaging and required labels. Marshall's Reagent is shipped as a non-hazardous material. This apparent lesser danger of Marshall's Reagent should not be interpreted as license to handle the chemical without employing universal precautions (gloves, lab coats, masks, ventilation, etc.). The hazardous concerns about Alpha Naphthol should be the catalyst for forensic laboratories to consider replacing Alpha Naphthol with Marshall's Reagent. All of the chemicals listed in this document should be handled with prudent care as it is possible that additional hazards will be discovered in the future.

References

[1] Dillon, John H., Jr., The Modified Griess Test: "A Chemically Specific Chromophoric Test for Nitrite Compounds in Gunshot Residues," AFTE Journal, Vol. 22, No. 3, July 1990, pp. 243-50.

[2] Shem, Robert J., and Starck, Marnie L. "Comparison of a Simplified Version of the Griess Test to Established Procedures", an unpublished manuscript.

[3] Material Safety Data Sheet, N9125 N-1-NAPHTHYLETHYLENEDIAMINE DI HCL BULK, Sigma Chemical Co.

[4] Harrison, Harold C., and Gilroy, Robert, "Firearm Discharge Residues," Journal of Forensic Sciences, Vol. 4, No. 2, April 1959, pp. 184-200.

[5] Federal Bureau of Investigation, "The Modified Griess Test," Gunpowder and Primer Residue Course Handbook

[6] Material Safety Data Sheet, N0875 Alpha Naphthol, Sigma-Aldrich Chemical Co.

Documentation

The following page shows documentation typical for this protocol. The attached page is from the instructor's computerized worksheet program, which was a Microsoft Access 97 database (currently part of the laboratory's information management system). The American Society of Crime Laboratory Directors/Laboratory Accreditation Board has been known to ask to see "Critical Reagent Logbooks" prior to granting laboratory accreditation. By including entry fields in the database for the performance of the critical reagents used, a permanent record is maintained and can be "queried out" in a compiled list for review, if necessary. This precludes the need for a separate bound log book.

State of Alaska, Department of Public Safety, Scientific Crime Detection Laboratory
Target Worksheet

One nylon jacket

Source: ***Brian Dittman on 11/22/2004*** Memo:

Packaging as Received:

One tape sealed paper fold with a taped on tag containing a dark nylon jacket on a wire coat hanger

Repackaging: ***original***

Markings as Received: ***Tag marked ' . . . 03-XXXXX . . . '***

Lab marks: ***03-XXXXS5 on the collar tag***

Stereomicroscopic: ***The area around the tear in the lumbar was examined and found to possess a dull, black, sooty material centered on the center of the cruciate tear.***

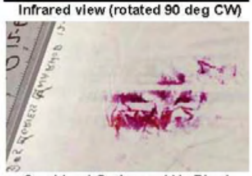
Infrared: ***A dark, infrared absorptive sooty material was noted in a tight, roughly circular pattern around the center of the cruciate tear.***

DTO Test: ***Not performed.***

Griess Test: ***No patterns of gunpowder particles developed around the area containing the cruciate hole.***

Na Rhodizonate Test: ***The Griess paper was processed. A strong reaction developed in the area of the paper which contacted the sooty material which is centered on the center of the cruciate tear. The garment did not lay perfectly flat due to the elastic cuff at the bottom of the jacket so the reaction on the paper was not as circular as the observed soot. The garment is too dark for a direct application of Sodium Rhodizonate.***

Infrared view (rotated 90 deg CW)



Combined Greiss and Na Rhod (flipped to match IR view)

03209705.TIF

Critical Reagent Quality Test Results

DTO Test Control Sample:
None

DTO Control Reaction:
N/A

DTO Control Conclusion:
N/A

Griess Test Control Sample:
Cloth swatch with a close range gunshot

Griess Control Reaction:
Brownish-red and purple spots developed on the filter paper corresponding to gunpowder

Griess Control Conclusion:
Controls - OK

Sodium Rhodizonate Control Sample:
Cloth swatch with a close range gunshot

Sodium Rhodizonate Control Reaction:
Magenta fog developed corresponding to lead-rich soot

Sodium Rhodizonate Control Conclusion:
Controls - OK

Remarks (accessories, obvious modifications, etc):

Gall's Gear brand.

Criteria for the Conclusions:

The large cruciate tear coupled with a tight circular pattern of lead-rich soot centered on the center of the cruciate tear and lack of an embedded gunpowder particle pattern in the vicinity of the hole indicates a contact or near contact gunshot.

Conclusions:

A contact/near contact range gunshot defect is present in the middle of the lower back.

Interpretation of Findings

The case examples in this workshop represent the "best" of what a scientist might encounter in the field. None of the garments in this workshop have been degraded by environmental factors. "Real world" evidence is subjected to any number of degrading factors. Some of these factors are:

1. Bleeding
2. Loss of loose gunpowder due to activities of the shooting victim, of paramedics, and of medical examination.
3. Exposure to rain, wind, and sun.

The scientist should recognize that in some situations gunpowder particle patterns will be very persistent in spite of exposure to extreme degrading factors. A classic example that the instructor experienced was the discovery of gunpowder particles on a personal floatation device (PFD) worn by a shooting victim. The victim had spent several hours bobbing up and down in the ocean and washing up against the beach. When his companions discovered his body they dragged him over the side of their boat and took his body to town in rainy, rough conditions. Gunpowder particles remained on the PFD and were useful in determining muzzle to target proximity. In this case the range of fire was close enough to *embed* the gunpowder between the tightly woven nylon shell material of the PFD. The tightness of the weave of the stout flat nylon threads mechanically *trapped* the large disk gunpowder particles. Had the gunpowder been fired into a different garment material its adherence to the garment would have been controlled by the adhesive nature of the hot gunpowder when it hit the fibers. It is unlikely that any gunpowder would have remained to be examined due to its exposure to this severe degrading environment.

Conversely, expect loosely adhering gunpowder to be lost even with careful handling. This is particularly true of gunpowder projected onto clothing from ranges approaching maximum. After 18 inches or so of travel to the target, the gunpowder loses the kinetic energy necessary to mechanically embed itself. Additionally, the gunpowder cools, decreasing its "stickiness". It is believed that gunpowder softens and acquires a certain degree of stickiness when heated, much like a stick of hot glue. This stickiness would be greatest at the closest ranges of fire. Gunpowder reaches distant targets with a diminished stickiness. Gunpowder deposited at distances beyond 18 inches to two feet can usually be brushed away with little effort. Keep this in mind when you are examining a garment that lacks gunpowder. Your lab test fires may show gunpowder out to three, four, five, or more feet. Before you render an opinion as to how close a gun could have been and *not* left powder, be sure to consider how well the powder adheres to the target and whether it may be lost due to degrading factors.

For any particular range of fire there may be a slight change in the appearance of the deposited gunpowder residue pattern. This is due to a number of variables, some known and some unknown. The shot to shot variation in the appearance of the gunpowder particle patterns will be minimized when the variables are held as constant as possible during testing. However, with evidence there may have been other factors at work that are unknown to the scientist. A "bracketed opinion", rather than a precise statement of the range of fire, builds in sufficient leeway to accommodate most unknown factors. An opinion that the range of fire was "between six and twelve inches" is more likely to be absolutely correct, albeit less precise, than an opinion that the range of fire was "7.8 inches".

Report Wording

Whenever possible the report should address any pertinent questions that arise during the investigation of the shooting event. Establishing the precise distance of fire may not be as important determining whether or not the gun was within reach of the shooting victim.

Here are several examples.

Three probable bullet holes are present in the seat area of these pants. A hole in the right lower hip/buttock area has the appearance of an entrance bullet hole. A hole in the left hip slightly to the rear is basically a tear and has the appearance of an exit bullet hole. The remaining hole is rectangular in appearance and it is not clear as to whether this hole is an entrance or exit hole. A chemical test for nitrites revealed reaction sites consistent with partially burned gunpowder in proximity to all three holes. There was no centrally dense pattern of reaction sites necessary to establish a muzzle-to-target distance.

There is one apparent near contact bullet passage with a distinctive soot pattern present in this garment. The shot originates in the upper, left, rear shoulder and exits down and slightly to the right in the upper, left, middle back. A muzzle-to-target distance determination test was conducted using both laboratory and submitted ammunition into both Tee-shirt fabric and a swatch of fabric removed from this evidence shirt. Tests were fired at contact, one inch, three inches, six inches, and nine inches. A similar pattern of residue and damage can be produced at distances greater than contact and less than three inches.

There is an apparent bullet entrance hole in the upper central anterior chest area. An apparent exit hole is located to the right of the center of the back. The area around the entrance hole and both forearms were examined visually, microscopically, with infrared imaging, and by chemical means. No gunpowder particle patterns, soot, gas tearing, or tearing caused by high velocity gunpowder particle impacts were found on which to base a muzzle to target distance determination.

There is a contact/near contact gunshot to the inside of the right front pocket.

There are two apparent contact/near contact bullet passages with distinctive soot patterns in the center of the upper anterior chest. Some disc gunpowder consistent with the gunpowder in the cartridges in Item #27 was observed in the vicinity of these two passages. A possible exit hole for one of these passages is present in the lateral triceps area of the right sleeve. A third hole is present in the upper left biceps area. This third hole is consistent with a contact/near contact gunshot from the inside of the sleeve. Ball gunpowder, similar to that present in the 22 Magnum ammunition submitted as part of Item #632, was observed in association with this hole.

No gunpowder particle patterns, soot, gas tearing, or tearing caused by high velocity gunpowder particle impacts were found on which to base a muzzle to target distance determination.

There is a hole which approximates a typical large caliber handgun bullet hole in size located in the anterior chest just left of the centerline. This hole is apparently the result of wear and tear, rather than a bullet perforation. No bullet wipe, gun smoke, or gunpowder particle patterns were noted on either side of the fabric near the hole.

Two apparent bullet holes are present. One hole is present in the anterior lower left abdominal area. This hole is surrounded by gunshot residues. The residues have the appearance of a contact or near contact gunshot. A muzzle-to-garment distance determination test was conducted using Item #7 and laboratory ammunition into two types of coarse woven cotton fabric. Test shots were fired at contact, two inches, and four inches. A similar pattern of residues can be produced at distances less than two inches. The second hole is present in the lower right back area. This hole has the appearance of a bullet exit hole.

Acquiring a heat activated photo mounting press

The photo press used in this workshop is a modified Seal brand Dry Mount Press. It has a heated working surface that measures 18 by 15 inches. These presses are very expensive when purchased new. Plus, they seem to be an outdated item and are difficult to locate at retail establishments. Fortunately, many crime labs have at least one or two of these presses collecting dust somewhere in the back of their darkrooms. You may be able to find one stashed away at your lab. The press used in this workshop was headed out the back door on the way to State Surplus Property when it was redirected to the Firearm Section.

If you wish to purchase a used press you may find what you need on-line. The image below is from the E-bay auction web site on Wednesday, May 20, 2009.