B191 Gunpowder Particle and Vaporous Lead Deposit Patterns on Fabric From Hand Gun Discharges

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After attending this presentation, attendees will have learned about the deposit patterns for gunpowder particles and vaporous lead when selected handguns are fired into clothing fabrics using different ammunition and at different distances.

This presentation will impact the forensic community and/or humanity by demonstrating that the collection/manipulation history of clothing exhibiting gunshot defects seized as evidence during shooting scene investigations is extremely important in determining muzzle to target distances.

Outcome: Clothing items with bullets holes and gunpowder deposits as recovered from shooting homicide victims can be carefully evaluated for their collection/manipulation history, gunpowder particle deposit patterns and vaporous lead deposits and thereby provide a valuable foundation for muzzle to target distance determinations.

Gunpowder particle deposit patterns on clothing fabrics, particularly in the region of a bullet penetration defect, provide interpretive opportunities for forensic scientists interested in establishing an intervening distance measurement between the discharging firearm and the target clothing fabric. The same can be said for vaporous lead deposit patterns. This presentation reports on the results of testing conducted thus far involving one 9mm semi-automatic pistol using twenty one different rounds of 9mm Luger ammunition representing ten manufacturers or brands.

In order to establish baseline information relating to the source of lead in gunpowder particle deposit patterns on clothing the gunpowder, jacketed bullet and cartridge case of one round representing each of the ten manufacturers were tested using X-Ray fluorescence spectrophotometry, (XRF). All gun powders were found to contain lead ranging from 25 ppm to 180 ppm.

Next, one each of the ten representative manufacturer's cartridge cases with the live primer cap in place was fired in the 9mm pistol into white, 100% cotton t-shirt fabric at a muzzle to target distance of four inches. The resulting smoke and particulate deposit on the white cotton fabric was tested for lead using XRF. Lead content was noted in the range of from 7,000 parts per million (ppm) to 19,000 parts per million in the deposit. Copper, antimony, mercury, and zinc were also noted in significant quantities.

Then, one manufacturer's specific cartridge design was used in the 9mm pistol to fire into white 100% cotton t-shirt fabric at muzzle to target distances of 4", 6", 8", 10", 12", 14", 16", 20", 24", 30", 36", 42", 48", and 54". A template of concentric circles drawn at one inch, two inches, three inches, and four inches from the center point was prepared on clear Mylar sheet stock and this was used as an overlay on top of the test fire panels with the center point placed dead center on the bullet defect in the panels. The circles were scribed into quarters and during microscopic examination, counts for gunpowder particle deposits were made in one quarter of the circle.

The counts, for purposes of this presentation, are reported in three ways. One unit used is the number of gunpowder particles counted in a particular quarter circle area. The gunpowder particle count for the area ranging from the circle center point out to the quarter arc at one inch from the circle center is recorded as the "First Order Quarter-Circle Gunpowder Particle Count" and the number for the "Second Order Quarter-Circle Gunpowder Particle Count" is the number of gunpowder particles counted in the quarter of circle area ranging from the circle center point out to the quarter arc at two inches from the circle center, and so on. Another unit used is the calculated density of gunpowder particles in a particular designated quarter of a circle area and that figure is recorded using the appropriate quarter-circle reference as "First Order Quarter-Circle Density," "Second Order Quarter-Circle Density" and so on. The third unit is the gunpowder particle count for a particular "Quarter-Arc Band" in which gunpowder particle deposits were found. For instance, the "First Order Quarter-Arc Band" is the same space as that designated by the "First Order Quarter-Circle" area and the "Second Order Quarter-Arc Band" is the area between the quarter circle perimeter at one inch from the bullet penetration center and the quarter circle perimeter at two inches from the bullet penetration center, and so on. Gunpowder particles were found on the test panels out to a muzzle to target firing distance of 54 inches.

Finally, using the 9mm pistol, one each of the twenty one rounds representing varying cartridge configurations of the ten manufacturers were fired into white, 100% cotton t-shirt fabric from a consistent muzzle to target distance of 10 inches. Gunpowder particle deposit counts were tabulated for the various orders of "Quarter-Circle" and "Quarter-Arc Band" areas. Six test-fire panels were selected from this group and XRF analysis was performed in the "First Order Quart-Arc Band," "Second Order Quart-Arc Band", "Third Order Quart-Arc Band", and "Fourth Order Quart-Arc Band" areas. The range of lead content was from 147 ppm to 732 ppm in the "First Order Quart-Arc Band", from 55 ppm to 333 ppm in the "Second Order Quart-Arc Band", from 62 ppm to 223 ppm in the "Third Order Quart-Arc Band" and from 32 pm to 147 ppm in the "Fourth Order Quart-Arc Band". The same six panels were then subjected to manipulation typical of procedures used for collecting a t-shirt from a person shot in the chest and found deceased at an indoor scene. This was accomplished

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by pinning the fabric panel from the test firing process to the chest of a volunteer wearing a t-shirt, rolling the body of the volunteer on the scene, wrapping the volunteer in a sheet, lifting and carrying the volunteer, opening the transporting sheet, removing the volunteer's t-shirt over her head, hanging the t-shirt on a hanger, removing the t-shirt from a hanger, placing the t-shirt in a brown paper bag and closing it, handling the paper bag, opening the paper bag, removing the t-shirt and spreading the t-shirt out on an examination table. After this process the selected six panels were examined microscopically and gunpowder particle counts were conducted. One panel of the six manipulated panels showed an increase in quarter-circle area gunpowder particle deposit counts while the other five showed an average decrease of; 13% in gunpowder particle deposit count in the first order quarter-circle, 20% in the second order quarter- circle, 20% in the third order quarter-circle and 22% in the fourth order quarter-circle.

Clothing items with bullets holes and gunpowder deposits as recovered from shooting homicide victims can be examined and analyzed for their gunpowder particle deposit patterns and vaporous lead deposits for the purpose of muzzle to target distance determinations, however it is equally important to carefully evaluate their collection/manipulation history before expert opinions are communicated.

Gunpowder Patterns, Vaporous Lead, Primer Smoke

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