Optimized Development Of Latent Fingerprints On Unfired And Fired Brass Cartridge Casings

Katie Sullivan BS[1], Kimberly Gerhardt MSFS[2], Catherine Rushton MSFS[1], Pamela Staton PhD[1]

Marshall University Forensic Science Center[1] Huntington, WV 25701

Rapid City Police Department[2] Rapid City, South Dakota 57701

Abstract

Cartridge casings found at crime scenes may contain fingerprint evidence to introduce or help convict a suspect; however, there are few articles on the subject of the best method to develop fingerprints on cartridge casings. The purpose of this research was to compare the best development methods for unfired casings found in previous research along with other commonly used development methods. After the most effective method was determined, that method was then applied to fired brass cartridge casings. Five different methods and five hundred unfired .40 caliber brass cartridge casings with one fingerprint on each were used. The technique that produced the highest average of fingerprints of comparison value was cyanoacrylate followed by gun blue followed by BY40; this method was applied to fired cartridge casings.

Introduction

There are few articles on the subject of the best method to develop cartridge casings due to the factors a casing sustains during the firing process. One factor affecting the likelihood of developing a fingerprint from a casing is the friction between the casing and the gun through the firing process. Friction occurs between the magazine and casing as the casing is loaded into the magazine, when the casing enters the chamber, and when the casing is ejected. The casing is exposed to high temperatures and combustion gases during the firing process that can affect the oils and sweat from a fingerprint on a casing that would be used in development (Champod et al. 2005).

Although cyanoacrylate fuming followed by palladium deposition was found to be a useful method, many forensic laboratories do not have the capability to use metal deposition to develop latent fingerprints because of its monetary demands (Dominck and Laing 2010). It is important to discover successful fingerprint development techniques that any forensic laboratory can use.

The purpose of this research was to take the best methods for unfired casings found in previous research and compare them to each other and to other commonly used fingerprint development methods. Once the most reliable method was discovered, that method was tested to determine the likelihood of developing fingerprints of comparison value on fired casings.

Materials and Methods

Phase I

Five hundred fired .40 caliber brass cartridge casings were used to test the five different fingerprint development methods. The casings were cleaned using methanol. The nose, chin, and eyebrow regions of the face were rubbed with a finger used to make a fingerprint, and the finger was rolled onto the casing to produce a latent print. The casings were placed on a test tube support rack and set in a cyanoacrylate fuming chamber. Sixteen drops of cyanoacrylate were placed in a small aluminum bowl and placed inside the chamber. The casings were fumed in the superglue chamber for thirteen minutes. The powder used in this research was magnetic latent print powder in midnight black. The basic yellow 40 dye stain (BY40) was composed of two grams basic yellow powder and one liter of methanol. The dye staining process consisted of rinsing the casing with BY40 followed by a water rinse. Each casing was allowed to dry and observed under an alternate light source at 450 nm with orange goggles. The gun blue solution was composed of 30 mL water and 30 mL gun blue. The gun blue process consisted of submerging the casings in the gun blue solution for 30 seconds and then submerging the casings in a water bath. The acidified hydrogen peroxide (AHP) solution was composed of 325.5 mL of 5% vinegar with 500 mL of 3% peroxide. The process was to submerge the casings in the AHP solution for 30 seconds and then submerge the casings in a water bath for 2 minutes (CBDIAI).

Method	Process
Method 1	Cyanoacrylate fuming, BY40
Method 2	Cyanoacrylate fuming, gun blue, BY40
Method 3	Cyanoacrylate fuming, powder
Method 4	Cyanoacrylate fuming, powder, acidified hydrogen peroxide, BY40
Method 5	Cyanoacrylate fuming, BY40, acidified hydrogen peroxide

Table 1: Summary of fingerprint development methods used in Phase I

Phase II

Fifty .40 caliber bullets with brass cartridge casings were cleaned, and a fingerprint was placed on each casing. The bullets were fired from a Glock .40 caliber handgun. The method used on the fired casings was sequential development with cyanoacrylate fuming, gun blue, and BY40 (method 2).

Phase I Results

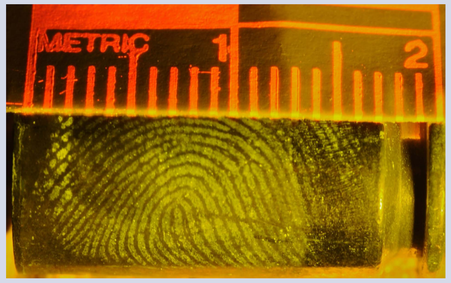

Figure 1: Latent fingerprint developed with cyanoacrylate fuming followed by BY40 given a number 3 rating

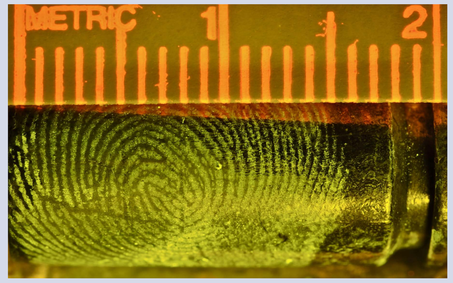

Figure 2: Latent fingerprint developed sequentially with cyanoacrylate fuming, gun blue, BY40 given a number 3 rating

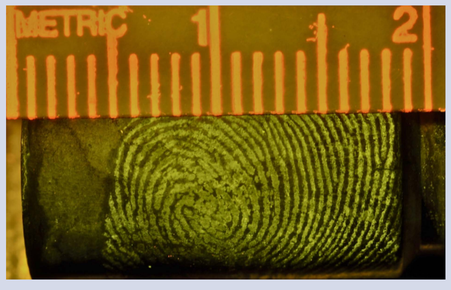

Figure 3: Latent fingerprint developed sequentially with cyanoacrylate fuming, powder, AHP, and BY40 given a number 3 rating

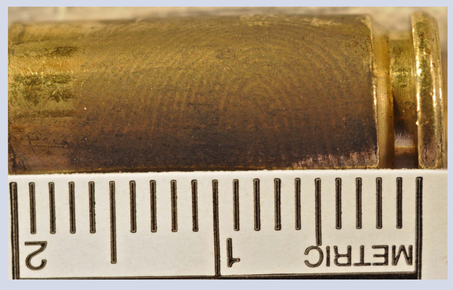

Figure 4: Latent fingerprint developed with cyanoacrylate fuming followed by magnetic black powder given a number 3 rating

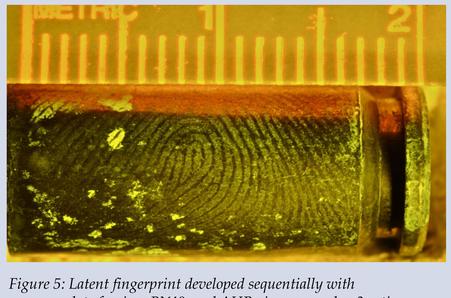

Figure 5: Latent fingerprint developed sequentially with cyanoacrylate fuming, BY40, and AHP given a number 3 rating

Phase II Results

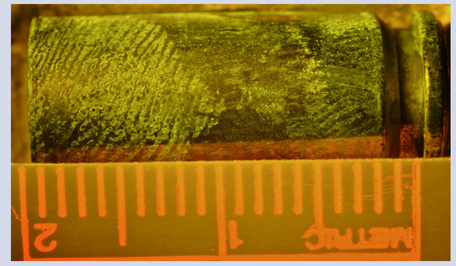

Figure 6: Latent fingerprint developed sequentially with cyanoacrylate fuming, gun blue, and BY40 on fired casing given a number 1 rating

Rating	Description
0	No visible ridges; smudge
1	Poor quality; few ridges present
2	Partial print present; first level detail
3	First and second level detail present; comparison quality

Table 2: Description of rating system

Rating	Method 1	Method 2	Method 3	Method 4	Method 5
0	4	0	40	15	19
1	45	27	46	21	37
2	26	34	12	27	23
3	25	39	2	37	21

Table 3: Total of each rating for various fingerprint methods on cartridge casings

Conclusion

Although little research examining different development methods for cartridge casings exists, there is no research comparing the most reliable methods found in each individual study. This research selected those most reliable development methods found in various experiments and compared them to each other.

Cyanoacrylate fuming followed by gun blue followed by BY40 produced the highest quality prints on unfired casings. Using method 2 for development, 39 out of 100 fingerprints were given a rating of 3, indicating the prints could be used for comparison and identification purposes. No fingerprints were given a rating of 0, indicating that all fingerprints developed with method 2 had ridges present. This method was tested on fired casings, but no prints of comparison value were developed, due to effects of the firing process on a fired casing.

Future research includes testing metal deposition and method 5 on fired casings. The effect of gun blue and AHP on DNA destruction and tool marks should also be considered.

References

CBDIAI. Acidified Hydrogen Peroxide – Latent Print Processing Chemical. http://www.cbdiai.org/Reagents/h2o2.html

Champod C, Lennard C, Margot P, Stoilovic M. Fingerprints and Other Ridge Skin Impressions. Florida: CRC Press LLC; 2004.

Dominick A, Laing K. 2010. A Comparison of Six Fingerprint Enhancement Techniques for the Recovery of Latent Fingerprints from Unfired Cartridge Cases. Journal of Forensic Identification 61(2): 155-165.

MARSHALL™

FORENSIC SCIENCE

Acknowledgments

Kimberly Gerhardt, MSFS, internship supervisor from Rapid City Police Department
Catherine Rushton, MSFS, technical advisor from Marshall University
Pamela Staton, PhD, topic advisor from Marshall University
Investigator Ryan Cook from Pennington County Sheriff's Office for providing fired casings

POLICE
RAPID CITY, SD