Evaluation of Gun Blueing Solutions and Their Ability to Develop Latent Fingerprints on Cartridge Casings

Deborah A. Leben, M.F.S.[1]
Robert S. Ramotowski[2]

The practice of "blueing" or "browning" iron and steel parts of objects dates back to the early days of metalworking. Skilled craftsmen would use these solutions to impart dark blue or brown color to their work. The first known instances of blueing gun metal date back to the early 17th century. The primary reasons for blueing gun metal, aside from improving the weapon's overall appearance, include removing reflections from polished surfaces and preventing rust. Like most forensic techniques used today, the use of gun blue solutions for latent print development was most likely discovered by accident. Anyone who has used this process on their own weapons may have observed the appearance of fingerprints on the metal surface of the weapon after it had been exposed to the blueing solution. In fact, one reference on the process warns clearly that, "from this moment onwards [after cleaning] the degreased parts must not be touched with the naked hand, as the skin is always slightly fatty..." [1] In other words, the presence of fingerprint residues on the metal surface prevents the deposition of the blue/black color. This heretofore undesirable outcome is precisely what forensic scientists would like to exploit for developing latent prints.

Although many gun blueing formulations exist today, they essentially all work in a similar fashion. In short, blueing involves inducing an artificial rusting process [1] using a specially prepared oxidizing solution containing primarily seleneous acid and copper sulfate. These two compounds are responsible for the final blue/black color. While the metal is in contact with the solution, copper and selenium are removed from the solution and deposited together on the surface of the metal, most likely as the alloy copper selenide (CuSe) [2]. The presence of any fingerprint residue on the metal surface inhibits the deposition of the dark colored alloy. The resulting fingerprint detail appears light against a dark colored metallic background.

The ability to develop identifiable ridge detail on fired cartridge casings has always been a challenge to forensic scientists. To date, several techniques have been applied to this problem [3,4,5]. Preliminary results indicate that a partial improvement of latent print detail may be achieved by using gun blueing solutions after superglue treatment. The use of gun blue for developing latent prints was introduced to the U.S. Secret Service early in 1995 by Mr. Ed German, from the U.S. Army Crime Laboratory in Ft. Gillem, Georgia, [6] and Mr. Donald Coffey, from the U.S. Army Crime Laboratory in Frankfurt, Germany [7]. Mr. Coffey had learned of the process from a chemist and gun owner who worked for the Bundeskriminalamt in Wiesbaden, Germany. Ms. Deborah Leben, from the U.S. Secret Service, in cooperation with Dr. George Saunders [8], of BioFor Associates, performed a series of experiments designed to evaluate the use of superglue and gun blue to develop latent prints on both unfired and fired cartridge casings. Numerous unfired and fired shell casings of different metallic content and caliber were evaluated. The gun blue solutions evaluated included: Aluminum Black, Brass Black, Super Blue, Perma Blue Gun Blue Paste, and Perma Blue Liquid Gun Blue for Steel (all from Birchwood-Casey); Brownell's Formula 44/40 Instant Gun Blue; Outers Gun Blue (Blount, Inc./Outers Operations); and Eduard Kettner's Waffen-Brunierung.

The results of the experiments and the final working gun blue dilutions are summarized in Table 1. Although development time varied with each solution, the rate of development can be increased or decreased by adjusting the concentration of the gun blue in the final dilution. However, good judgment must be exercised since adding too much gun blue to speed up the process may lead to overdevelopment.

In summary, preliminary results indicate several conclusions. First, although superglue may develop fingerprint detail on both unfired and fired cartridge casings, the subsequent use of gun blue will, in some cases, improve marginal print detail. Second, caution must be exercised in both processes since overdeveloped superglue prints will lead to complications during the gun blueing stage. According to Dr. Saunders, a slow fuming superglue process appears to work best. Finally, it is important to photograph any evidence prior to each processing step since unanticipated overdevelopment could destroy any previously developed print detail.

Acknowledgments

The authors wish to thank the following individuals for their assistance in performing this research: Messrs. Ed German and Donald Coffey, from the U.S. Army Crime Laboratories in Ft. Gillem, Georgia, and Frankfurt, Germany for introducing the gun blueing process to the U.S. Secret Service and their valuable discussions; Dr. Antonio Cantu, from the U.S. Secret Service, for his insights and technical assistance; and Ms. Sylvia Allen, from Blount, Inc./Outers Operations, for her technical discussions, MSDS information, and for recommending Angier's book.

For further information, please contact either author at:

United States Secret Service
Forensic Services Division
1800 G Street, NW
Washington, DC 20223

See BLUEING, Pg. 10

Table 1: Summary of Recommended Protocols for Treating Cartridge Casings

Cartridge Type	Suggested Treatment after Superglue	Gun Blue (GB) Dilution	Comments
Nickel Plated Brass	Brass Black	1 mL GB in 40 mL distilled water	Other solutions also worked well on these casings
Brass	Formula 44/40 Instant Gun Blue	0.5 mL GB in 40 mL distilled water	Other solutions also worked well on these casings
Lacquered Steel	Super Glue Only		None of the gun blue solutions produced identifiable detail
Aluminum	Aluminum Black	0.5 mL GB in 40 mL distilled water	This is the only solution that worked for this metal

[1] Fingerprint Specialist, U.S. Secret Service
[2] Chemist, U.S. Secret Service

BLUEING, from Pg. 9

References

[1] Angier, R.H. *Firearm Blueing and Browning.* London: Arms & Armour Press, 1936, pp. 2,6.

[2] Personal communication to A. Cantu from Sylvia Allen, Blount, Inc./ Outers Operations, 27 April 1995.

[3] Donche, A.; Musy, C. "Development of Latent Fingerprints on Cartridge Casings," *Fingerprint Whorld*, 20, 75, 1994, pp. 13-19.

[4] Sampson, W.C. "An Inquiry into the Methodology of Preserving and Developing Latent Prints on Expended Cartridge Casings," Journal of Forensic Identification, 43 (1), 1993, pp. 4-12.

[5] Migron, Y.; Mandler, D.; Almog, J. "Is a Fingerprint Left on a Fired Cartridge? The Development of Latent Fingerprints on Metallic Surfaces by Palladium Deposition," presented at the International Symposium on Fingerprint Detection and Identification, Ne'Urim, Israel, June 1995.

[6] Personal communication to A. Cantu from Mr. Ed German, U.S. Army Crime Laboratory, Ft. Gillem, Georgia, 13 January 1995.

[7] Personal communication to A. Cantu from Mr. Donald Coffey, U.S. Army Crime Laboratory, Frankfurt, Germany.

[8] Saunders, G.C. "Evaluation of Several Techniques for Developing Latent Fingerprints on Unfired and Fired Cartridge Cases," presented at the International Symposium on Fingerprint Detection and Identification, Ne'Urim, Israel, June 1995.