Consecutively Manufactured Ruger P-89 Slides

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ABSTRACT

Ten consecutively manufactured Ruger P89 pistol slides and one frame were acquired from the manufacturer for examination and testing. The slides were mounted on the frame and test-fired to obtain cartridge cases for comparison. Breechface marks on the test-fired cartridge cases were compared for class and individual characteristics that resulted from the manufacturing processes. The parallel striations evident on each test-fired cartridge case were a product of filing of the breechface. Granular detail exhibited by some of the test-fired cartridge cases was a result of bead blasting of the slide; tests from two of the slides display marks that correspond to burrs found around the periphery of the firing pin aperture. It was found that the slides can be identified based on these breechface marks.

INTRODUCTION

The purpose of this research is to confirm that breechface marks on cartridge cases fired from consecutively manufactured slides are distinguishable and identifiable based on individual characteristics present on the breechface of each slide. Previous research of tool marked items has established this concept as factual (1, 2). However, due to the differing tools and manufacturing processes in the industry, the research bears repeating. Although sequentially manufactured items have been cut using the same tool, the continuous wear of that tool against the work surface will cause each successive surface to vary in appearance (3). In the context of this research, striations left on the breechface of the ten Ruger slides vary greatly due to hand filing during the manufacturing process. These variations, combined with other imperfections and irregularities that occurred during the manufacturing process, result in unique, individual breechface marks that can be positively identified.

METHODOLOGY

Based upon previous experience, I felt that the Ruger P-Series pistol breechface tends to mark well. I contacted Production Engineer Mike Smisko at Sturm, Ruger, and Co., Inc., in Prescott, Arizona, and informed him of my intentions for the project. After discussing the specifics with him, we determined that the Ruger P-89 semiautomatic pistol, caliber 9 millimeter Luger, would be the best pistol for the project. In discussing the different models of the P-series pistols, I found that the "P" denotes "pistol"; the number designation for each model indicates the year in which design and development of that model began. On February 23, 2001, I received a Ruger P-89, 9 millimeter Luger caliber semiautomatic pistol frame and 10 consecutively manufactured slides (Figure 1). The slides were stamped as raw castings as to the order of production on the inside roof (Figure 2). Also enclosed was a letter from Mike Smisko attesting that the slides were in fact sequentially manufactured and escorted throughout the production facility by a production engineer technician to insure that the slides were processed in order and that no extraneous operations were performed. In addition, a copy of the manufacturing plant operation sheets was provided, establishing the manufacturing methods and tools used in the production of the slides. Prior to test firing, each slide was mounted on the frame and subjected to a full safety inspection. Excess machine oil was removed. The slides were externally labeled for ease of identification during test firing. Alphabetic characters corresponding to the order of manufacture were used to avoid confusion when scribing test cartridges.

Figure 1

To select the most suitable ammunition for use in this research, trials were conducted testing six cartridges produced by major manufacturers. These were obtained from the laboratory standard ammunition file. Of the six chosen, two have brass primers and the remaining four have nickel primers. After firing two cartridges of each type of ammunition using Slide A, the slide and barrel were cleaned. The test-fired cartridge cases were then evaluated to determine

which cartridge exhibited the marks most suitable for microscopic comparison. The examination revealed that the CCI Blazer 9 millimeter Luger, with a 115 grain total metal jacketed bullet, marked the best, and were selected as the ammunition to be used in the research project. It was determined that 5 tests would be discharged utilizing each slide, with additional tests to be fired if necessary. The tests were labeled according to the slide in which they would be fired, and the sequence of firing (A1, A2, B1, B2, etc.).

Figure 2

The pistol was assembled with the respective slide in place and the five tests were fired. Between sets of five tests, the slide and barrel were cleaned. After firing from the ten slides, the tests were compared with others fired from the same slide to verify that the marks created by each of the slides were reproducible (Figures 3—6). The tests were identified to the other tests in the group, and therefore were identified as having been fired from each of the respective slides. The best cartridge case from each group of five was chosen for comparison with tests from the other slides. Comparisons between the slides began at this time.

Figure 3

MACHINING PROCESS

The plant operation sheets were reviewed to ascertain the processes performed on the breechface, as this will affect the marks left on the test-fired cartridge cases. The slides for the P89 pistol begin as raw castings, which are produced at Ruger Investment Casting, located adjacent to the Sturm, Ruger, and Company, Inc., production facility in Prescott, Arizona. The raw casts are then finished utilizing various processes, which include the use of computer numerically controlled (CNC) machinery. In

Figure 4

Figure 5

Figure 6

CNC machining, several pieces are arranged on a turret, then placed inside the machine, which holds a number of different tools. The correct machining operations and tolerances are programmed into the machine, which then performs the needed operations, changing tools between processes. The operations performed on the breechface are of primary interest in this project.

Milling of the breechface is the first operation performed which will potentially affect marks left on the tests. The breechface is end-milled using a dovetail-type cutter which is sent through the muzzle end of the slide to mill the cartridge recess. The toothed cutter used in this type of milling forms concentric circles on the cut surface of the workpiece. According to the operation sheets and information provided by Mike Smisko of Ruger, each piece is visually inspected after milling as to size, shape, and finish. If there are any irregularities, the tool is changed. There is no regular schedule for changing the tool.

The next operation affecting the breechface, which is filing, removes the concentric circles left during the

milling process and leaves parallel striations on the surface. Burrs and rough areas are removed using a barrette file, and is done by hand. A Ruger production engineer explained that the name "barrette" file refers to the shape of the cross-section of the file, which is that of a trapezoid. The narrow top edge fits perfectly into the breechface recess. The filing process is actually called "draw filing", simply meaning that the file is drawn across the work surface in one direction, and leaves nearly perfectly parallel striations on the surface. After filing, all pieces are visually inspected. Then the slides are tumbled at a maximum of 120 parts at once, to remove any rough edges. The tumbling media employed for this model is of a cylindrical shape and is an aluminum oxide and ceramic composite. The cylinders are 5/16 inch in diameter, and 1 1/8 inch long, with ends angled at 60 degrees. The tumbling method is that of a bowl vibrating method; the media and slides are placed into a large open bowl and vibrated for a period of 45 minutes. After tumbling, 10% of the slides are visually inspected, then proceed to the pre-heat treat inspection. The slides are heat treated, then passed to post-heat treat inspection. Bead blasting, using glass beads, is the next operation that may alter the breechface. Bead blasting is similar to sand blasting using smooth, spherical glass beads, rather than rough, asymmetrical grains of sand-like material. The slides are installed on a turret by inserting the slide rails onto rubber tracks that are permanently affixed to the turret. The turret is inserted into a bead-blasting stall, and the slides are mechanically blasted in a predetermined pattern by a stream of air and glass beads. The rubber tracks protect the slide rails from any damage during bead blasting; only a light plastic-like protective coating covers the breechface. According to Ruger employees, however, this coating does not always preserve the breechface. An affected breechface may appear somewhat pitted, which will translate to granular marks on the primer.

Later in the manufacturing process, the breechface is burnished. The slide, burnishing bar, and locator block are inspected to assure that they are clean and chip-free before beginning this operation. The burnishing bar and locator block are lubricated between each slide. After burnishing, all slides are inspected visually for remaining burrs.

The last process that may affect the marks left on a primer is the chamfering of the firing pin aperture to create a beveled edge. According to Mr. Smisko, the aperture is chamfered so that it accommodates primer flow, as well as allowing debris collected in the firing pin channel to discharge with movement of the firing pin. This action also serves to remove burrs around the aperture. All of the pieces are visually inspected after this operation. The slides proceed to completion, with a complete inspection before being assembled with a frame.

SUMMARY of RESULTS

The manufacturing processes used are the primary factors affecting the type of marks evident on the breechface. The breechface marks in this project are classified as parallel impressed marks; the tests exhibited both fine and gross detail. Throughout the ten slides, only one area of gross detail remained on all of the tests. This, however, was the exception. The breechfaces changed significantly from one to the next. The tests exhibit some areas of random correspondence, but this proved to be coincidental, as the marks do not carry throughout the entire surface of the primer (Figures 7-10).

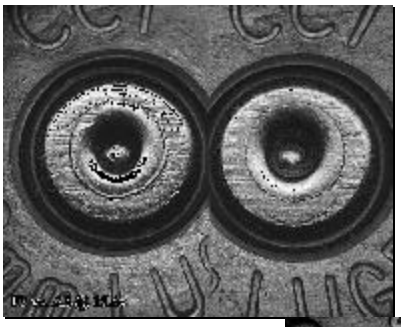

Figure 7

Figure 8

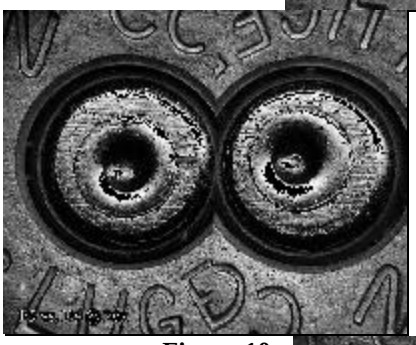

Figure 9

Figure 10

Five of the ten slides have apparent granular detail (Slides A, D, E, G, and H). Such defects are created when the slides are bead blasted, and are not removed during the burnishing process. Due to the random nature of the bead blasting process, these marks are individual in nature, and distinguish that particular slide from all others (Figures 11-12).

Many of the tests exhibit shear around the blowback. This is caused when the primer flows into the firing pin aperture, then is shorn by the edge of the aperture during unlocking. When comparing those tests, there were no similarities between any of the marks, beyond the fact that the marks are parallel striations. On tests from two of the slides there were parallel striations not consistent with shear. After examining slides E and I, it was found that the breechface on these two slides have burrs around the firing pin aperture that were not removed during the manufacturing process. These marks are extremely easy to distinguish from those created by the shearing of the blowback (Figures 13-15).

Figure 11

Figure 12

GENERAL CONCLUSIONS

Based upon the research presented here, I found that although each of the slides exhibited similar class characteristics, tests from each of the slides were easily distinguishable and individually unique. Comparisons resulted in an identification of the cartridge case to each of the respective slides, to the exclusion of all others. The discernable differences from slide to slide were a consequence of the randomness of the file marks produced on the breechface, as well as other imperfections that occurred during the manufacturing and finishing processes.

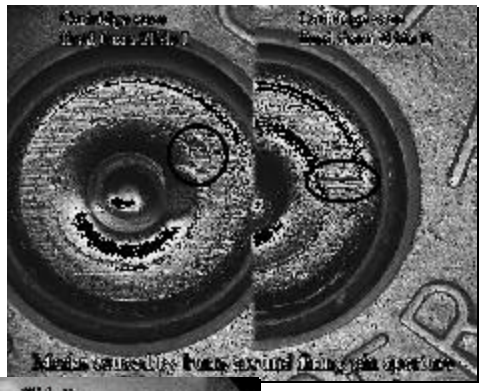

Figure 13

Figure 14

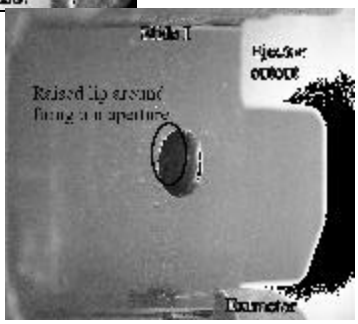

Figure 15

ACKNOWLEDGEMENTS

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