Subclass Carryover in Smith & Wesson M&P 15-22 Rifle Firing Pins

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ABSTRACT

The firing pin of a Smith & Wesson M&P 15-22 rifle was determined to exhibit possible subclass characteristics during examination of evidence submitted to the Michigan State Police Grand Rapids Forensic Laboratory. Additional testing of multiple Smith & Wesson M&P 15-22 rifles confirmed the presence of subclass characteristics. These subclass characteristics appear to be the result of the current manufacturing process used by the vendor of Smith & Wesson's firing pins.

Introduction

In 2014, a single, .22 Long/Long Rifle caliber fired cartridge case was submitted for examination and was entered into the National Integrated Ballistic Information Network (NIBIN) database. Approximately one month later, a .22 Long Rifle caliber Smith & Wesson, model M&P 15-22, semiautomatic rifle was submitted for function testing, and was then returned to the submitting agency. A subsequent NIBIN entry was made using test-fired cartridge cases from the examined rifle and a NIBIN association was established between these entries and the previously-entered evidence cartridge case. Similar characteristics were observed within their rectangular firing pin impressions. Gross impressed striations were observed running parallel with the long axis of the firing pin impression (**Figure 1**). Upon microscopic comparison of the single evidence fired cartridge case to test-fired cartridge cases, a significant amount of agreement was observed in the firing pin impressions, which at first glance appeared to possibly be individual (**Figure 2**). Not only was agreement observed amongst the gross impressed marks, but it was also observed in the fine impressed striae between the gross marks. Because the gross and fine impressed striae were parallel, extended across the majority of the impression, and were virtually unchanged from end to end, they were suspected as being subclass characteristics.

The side walls of the firing pin impressions were evaluated. Toolmarks were present on the side walls, but it was unknown if they were impressed or striated. In any event, these side wall toolmarks lacked sufficient agreement necessary for identification. Due to the suspected subclass characteristics found in the flat areas of the firing pin impressions, along with the lack of sufficient agreement

Figure 1: Firing pin impressions on evidence cartridge case (L) and test fire (R)

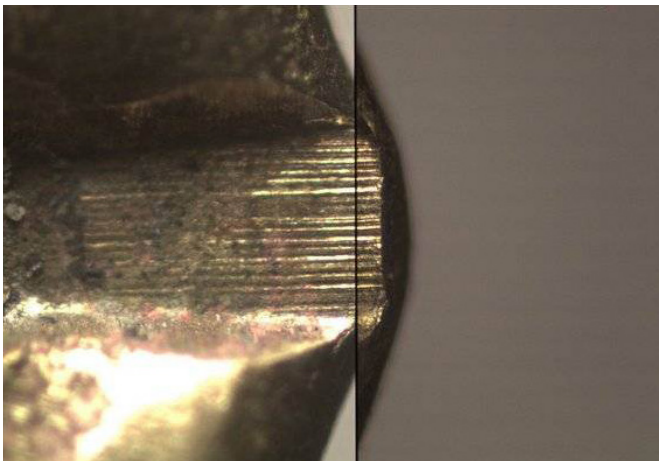

Figure 2: Comparison of firing pin impressions on evidence cartridge case (L) and test fire (R)

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in the toolmarks observed in the side walls, the examiner assigned to the case requested the original submitting agency to resubmit the firearm to the lab for additional testing. This would allow the firing pin's features to be more carefully evaluated for the presence of subclass characteristics.

The manufacturing marks on various surfaces of the suspect rifle's firing pin were evaluated and were found to exhibit a high potential for subclass carryover (**Figures 3-5)**. Consistent, parallel, and relatively unchanging striations were observed near the outer edge of the flat striking surface of the firing pin. However, further inward toward the bottom of the firing pin face (flat) were characteristics that appeared more random and individual in nature. The working surfaces on the bottom and sides of the firing pin that had the potential for producing toolmarks in a firing pin impression also exhibited gross striations from manufacture that were similar to those observed on the firing pin's flat striking surface.

Research and Literature Review

When Gene Rivera researched subclass carryover in Smith & Wesson SW40VE Sigma series pistols, he recommended that examiners not focus on rendering identifications based on one type of mark, especially in instances where subclass carryover is suspected. He acknowledged that this is especially difficult when that particular mark is the only type of mark reproducing itself during testing [1].

The inventor of the M&P 15-22, Jason Dubois [2], was contacted regarding the manufacture of its firing pins. He commented that the firing pins were formerly manufactured in-house at Smith & Wesson on a Swiss screw machine (an automated lathe used to turn metal parts). After turning operations, the chisel tips were profile milled. At the time of this research, however, Smith & Wesson contracted with an undisclosed vendor to manufacture the M&P 15-22 firing pins. Currently, Smith & Wesson finishes these firing pins by heat-treating, tumbling in batches, and coating with black oxide.

Because Mr. Dubois was not at liberty to disclose the vendor's identity, the manufacturing methods of these firing pins could not be determined. However, close observation revealed the flat striking surface, sides, and bottom beveled portion of the firing pins appeared to be cut, rather than ground or filed. Mr. Dubois further said that this firing pin is exclusive to the M&P 15-22 rifle and the M&P 15-22P, which is the pistol version of this firearm, but the vendor may use similar manufacturing techniques for other firing pins they produce.

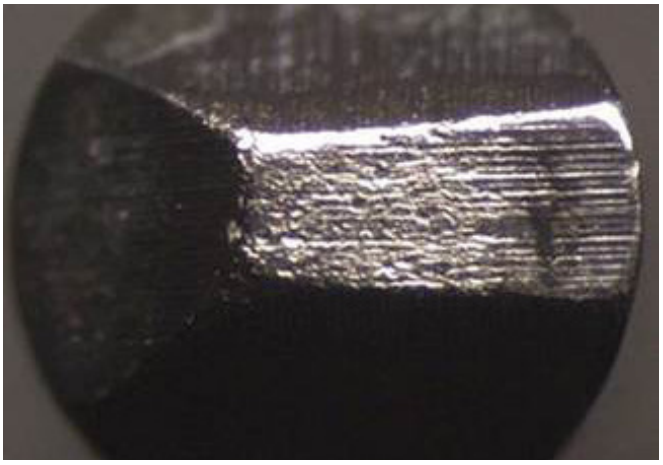

Figure 3: View of flat surface of firing pin

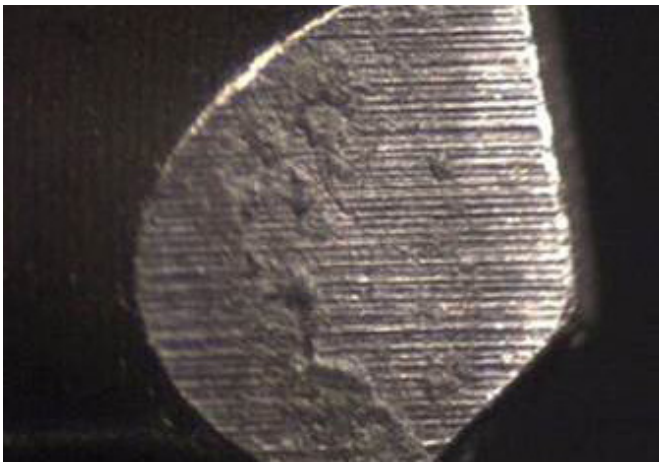

Figure 4: Right-side view of firing pin, as situated in the firearm

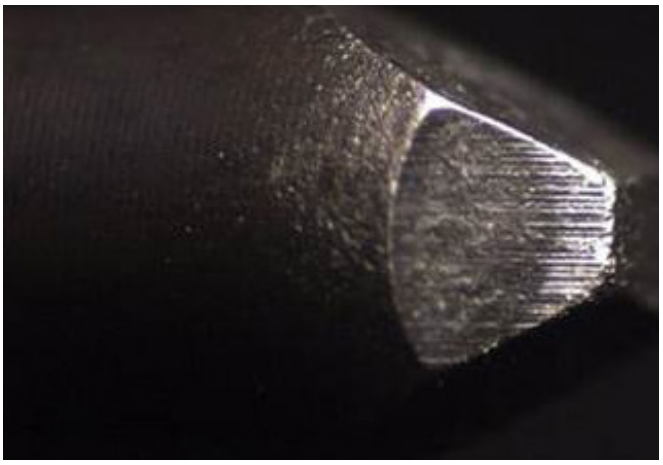

Figure 5: Bottom view of firing pin

It should also be noted that previous research has been conducted regarding Smith & Wesson manufacturing center fire pistols which contain firing pins that have been Metal Injection Molded (MIM) [3]. Both metal cutting and MIM processes lead to the possibility of subclass carryover.

Because the same firing pin design is used in the S&W M&P 15-22 and 15-22P, the possibility exists that subclass carryover could be prevalent on both of these models. Without due care and caution, a false-positive identification could be made if no other marks were utilized in making the identification.

Materials & Methods

Four pre-scribed Remington (Peters) .22 Long Rifle caliber cartridges were fired in each of nineteen Smith & Wesson M&P 15-22 rifles assigned to the Michigan State Police Training Academy. It should be noted that consecutively manufactured rifles would not likely improve the validity of this study due to Smith & Wesson's procurement of firing pins from an outside vendor, and their use of batch finishing processes.

The serial numbers of the Smith & Wesson M&P 15-22 firearms tested were as follows:

#01 – DTZ1285	#11 – DTZ2130
#02 – DTZ1304	#12 – (Test shots not obtained due to operability issues)
#03 - DTZ1588	#13 – DTZ2626
#04 – DTZ1861	#14 – DTZ2628
#05 – DTZ1878	#15 – DTZ2896
#06 – DTZ1911	#16 – DTZ2932
#07 - DTZ1914	#17 – DTZ3150
#08 - DTZ1915	#18 - DTZ3249
#09 - DTZ2069	#19 – DTZ3994
#10 – DTZ2072	#20 – DTZ4014

Microscopic Examination and Results

Test-fired cartridge cases obtained from the nineteen tested rifles were microscopically examined, and the class characteristics, such as size and shape, of the firing pin impressions were observed to be similar. Additionally, many of these impressions exhibited gross (and some fine), parallel characteristics that were generally similar to those observed in the evidence fired cartridge case initially received for examination.

The test-fired cartridge cases obtained from the nineteen tested rifles were then inter-compared by three examiners, who were able to associate thirteen of the nineteen tested rifles into two groupings (Group X and Group Y). The extent of agreement observed in the flat surfaces of the firing pin impressions within these two groups was such that an examiner unfamiliar with subclass influence might potentially identify the specimens in Group X as having been struck by the same firing pin, and the specimens in Group Y as having been struck by the same firing pin (but a different one from that of Group X). Group X consisted of test-fired cartridge cases from the rifles numbered #2, #5, #10, #11, #14, and #19 (**Figures 6-8**), and Group Y consisted of test-fired cartridge cases from the rifles numbered #3, #4, #7, #8, #9, #15, and #16 (**Figures 9-11**). An inter-comparison of cartridge cases from Groups X and Y showed no significant microscopic agreement for identification purposes (**Figure 12**).

The test-fired cartridge cases from the rifles numbered #13 and #20 (Group Z) exhibited some subclass agreement, but the agreement was not such that a trained examiner would consider associating the two together. The test-fired cartridge cases from rifles numbered #1, #6, #17, and #18 (Group O) did not exhibit subclass characteristics that were observed in other tests. Instead, the characteristics appeared random and individual in nature. The test-fired cartridge cases in Group O could neither be associated together, nor to any other tests obtained.

Although not as persistent as the subclass characteristics observed in the flat areas of the impressions, the striated marks in the rear and side walls of a smaller number of test firing pin impressions from Groups X and Y also exhibited some subclass agreement. However, when the edges (the junction, or meeting point, of two flat surfaces) of the firing pins were examined closely, individual characteristics were observed in the form of imperfections. Because of these imperfections, many of the gross striations on the side and bottom surfaces of the firing pins did not extend cleanly to each apex of the

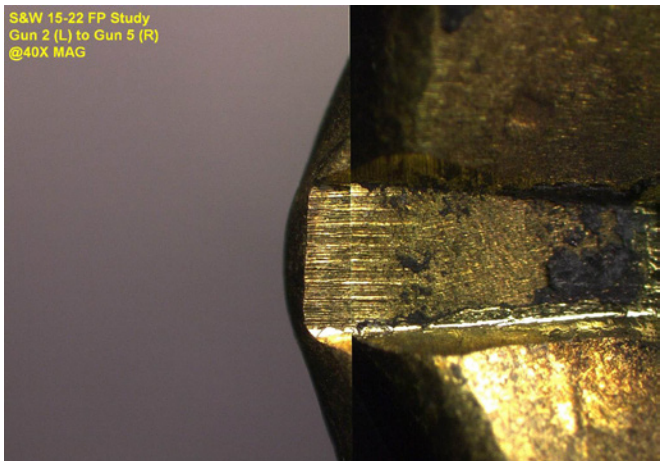

Figure 6: Marks in bottom of firing pin impressions from two firearms in Group X

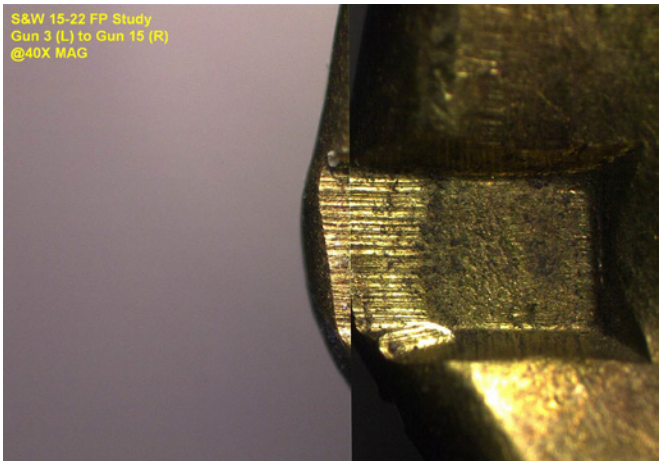

Figure 9: Marks in bottom of firing pin impressions from two firearms in Group Y

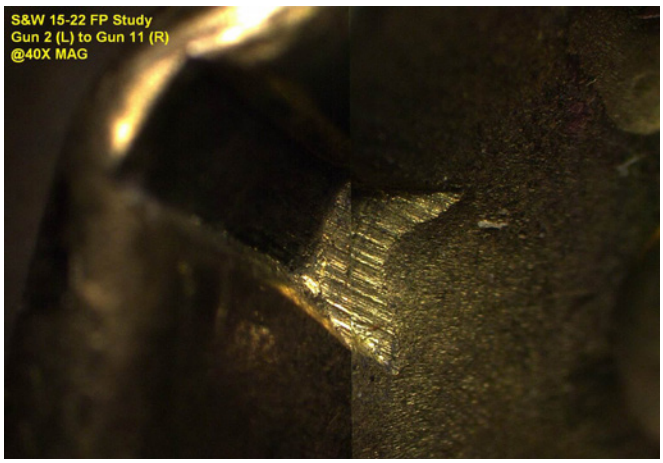

Figure 7: Marks on edge of firing pin impressions from two firearms in Group X

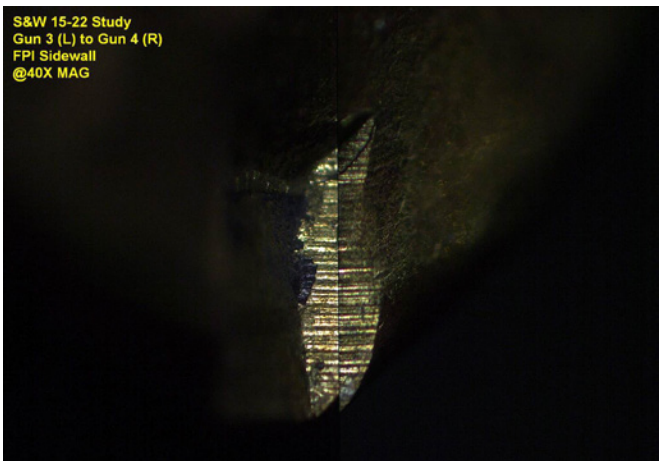

Figure 10: Marks on edge of firing pin impressions from two firearms in Group Y

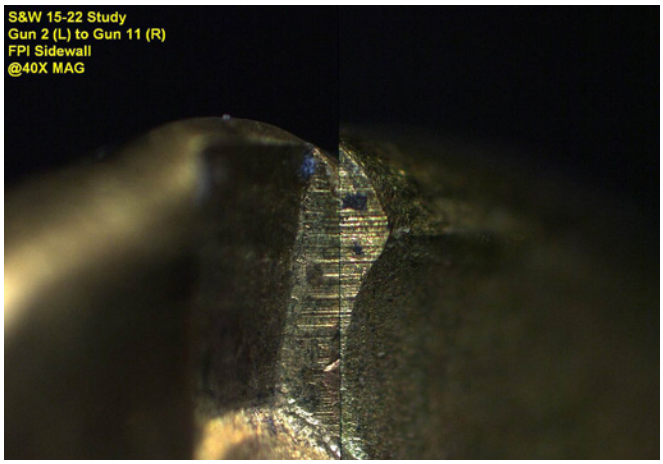

Figure 8: Marks on edge of firing pin impressions from two firearms in Group X

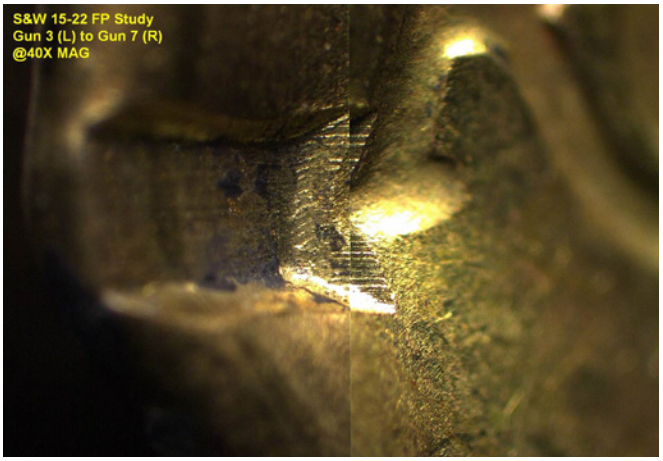

Figure 11: Marks on edge of firing pin impressions from two firearms in Group Y

respective edges. The imperfections along the apex of each firing pin edge could create unique striations on the side walls of the firing pin impressions as the firing pin is driven into the softer material of the cartridge case. These individual marks could also coexist with subclass characteristics imparted by areas of the firing pin where the gross striations did extend more cleanly to the edges, which could be the reason why the subclass agreement observed in the striated marks on the rear and side walls was less extensive than that observed in the flat areas of the firing pin impressions. The individual characteristics in these side and bottom marks would make identification possible if no other marks were available for comparison, as long as the striae in the impressions that were due to subclass characteristics could be eliminated from consideration by examining the working surfaces of the firing pin (**Figures 13 & 14**). The possibility remains, however, that false-positive identifications could be made if examiners rely solely on the striated marks of the rear and side walls of the firing pin impressions for identification if these striations were caused by subclass influence, especially if no firing pin is available for examination.

Finally, test-fired cartridge cases obtained from the nineteen rifles were compared with test-fired cartridge cases from the submitted evidence rifle and fired cartridge case. The firing pin impressions were found to exhibit the same class characteristics, such as size and shape, but lacked agreement of either subclass or individual characteristics. The original examiner was ultimately inconclusive in his final determination regarding the initial NIBIN association after examining all possible identifying marks within the firing pin impressions. However, it should be noted that the scope of this research focused solely on the firing pin and its related marks, rather than any additional cycling marks an examiner might utilize to render a conclusion.

Conclusions

First, examiners must carefully evaluate tools and toolmarks prior to conducting examinations, especially marks appearing to be continuous and parallel, showing virtually no variation along their length. A comparison of test-fired cartridge cases from the original case examination showed that not only was there agreement of the gross, parallel marks in the flat area of the firing pin impressions, but there was also considerable agreement of the fine impressed striae that existed between the grosser parallel marks. These fine marks initially appeared to be individual in nature, but were determined to be subclass when additional test-fired cartridge cases were compared.

Next, the manufacturing process used to produce the Smith & Wesson M&P 15-22 firing pins is such that it creates

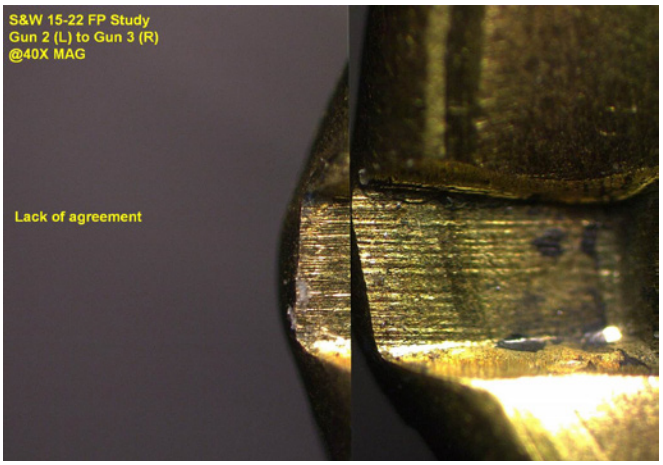

Figure 12: Differences in firing pin impressions from Group X (L) vs Group Y (R)

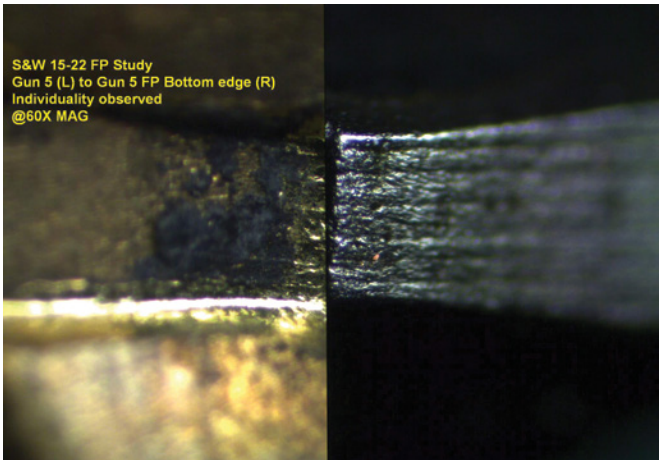

Figure 13: Bottom edge of firing pin impression compared to bottom edge of firing pin

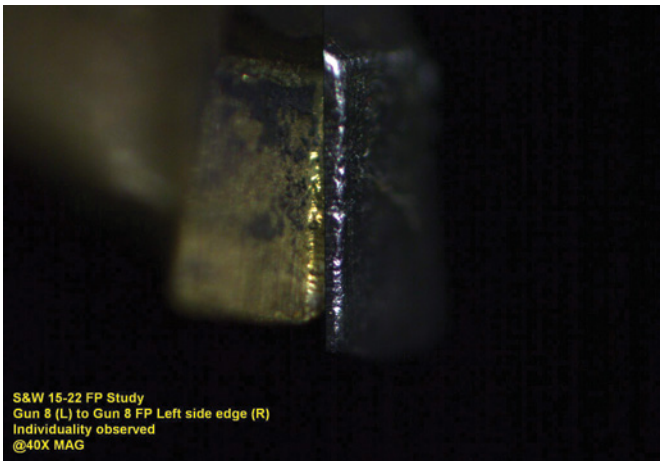

Figure 14: Left side edge of firing pin impression compared to left edge of firing pin

the potential for subclass carryover. It is essential that examiners evaluate tool working surfaces prior to conducting examinations, since these evaluations will help the examiner determine whether these surfaces are capable of creating individual toolmarks.

Finally, many of the firing pin impressions in this study exhibited subclass agreement in one or more of the four surface areas of the impression – the flat area, bottom wall, and both side walls – which, if misinterpreted, could be mistaken for sufficient individual agreement for identification. It is highly recommended when comparing these impressions that examiners compare all four surface areas, as well as the edges (where the flat area meets the bottom and side walls) of the firing pin impressions, prior to rendering a conclusion.

Should the manufacturer of the firing pins for the Smith &Wesson M&P 15-22 rifles ever be identified, additional research and testing could be done to determine the source of the subclass characteristics.

References

[1] Rivera, G.C., "Subclass Characteristics in Smith & Wesson SW40VE Sigma Pistols", AFTE Journal, Vol. 39, No. 3, July 2007, pp. 247-253.
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