Persistence of Subclass Carryover in Smith & Wesson M&P15-22 Rifle Firing Pins

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Keywords: anvil marks, firing pin, M&P 15-22, rifle, rimfire, Smith & Wesson, subclass characteristics

ABSTRACT

In 2016, firing pin impressions observed in test shots obtained from nineteen Smith & Wesson M&P 15-22 rifles displayed subclass carryover. This follow-up research was conducted to determine if the subclass characteristics observed in firing pin impressions would change during the firing of 3,500 cartridges from each of two .22 Long Rifle caliber Smith & Wesson M&P 15-22 rifles.

Introduction

In 2016, nineteen .22 Long Rifle caliber, Smith & Wesson, model M&P 15-22 rifles were test fired for the purpose of comparing firing pin impressions. The inter-comparison of test-fired firing pin impressions of these two rifles revealed subclass carryover. Three examiners were able to associate thirteen of the nineteen tested rifles into two groupings [1].

Research was initiated to explore the persistence of subclass characteristics throughout use. The tested rifles involved in this study belonged to the Michigan State Police Training Division, and had been subjected to three years of use and application of cleaning methods. Although the rifles had been used to train new recruits in past years, it could not be determined how many cartridges each rifled fired in the course of training between the years 2016 and 2019. Therefore, additional testing was required in order to determine if the previously observed subclass characteristics changed.

Two of the rifles previously tested that displayed significant correspondence in all four surfaces of their firing pin impressions in the first part of this research were selected for additional test fires. A total of 3,500 cartridges were fired from each of the two selected rifles. Test-fired cartridge cases obtained were compared and then inter-compared.

Research & Literature Review

In 2005, Francesco Vinci, et. al., fired 2,500 rounds sequentially in a .45 Auto caliber, centerfire, semiautomatic pistol. Researchers concluded test fired cartridge cases "did not show significant changes in the individual characteristics of the marks left by the mechanical parts of the weapon in the course of firing 2500 rounds sequentially". Additionally, Vinci reported, "In a previous study in which 5000 rounds were fired, identifications were not significantly altered when the weapon was not cleaned; however, gunshot residue can over time affect the surface of the metal and produce changes" [2].

Jan Gouwe, et. al., fired 10,000 .40 S&W caliber cartridges in a Glock model 22 semiautomatic pistol, revealing "all 10,000 cases could be identified to each other" in 2008. While the research pertained to firing pin aperture shear in centerfire pistols, that research demonstrated "striations, in many instances, are capable of existing over the course of extended firings" [3].

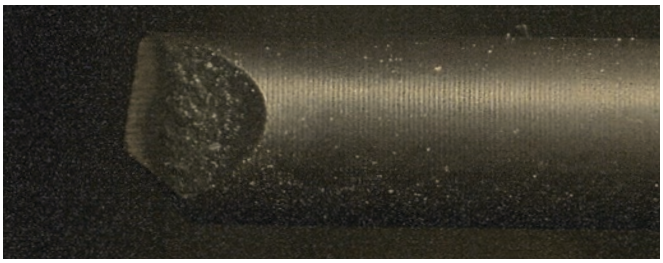

Figure 1: Rifle #10 firing pin shaft

Materials & Methods

Two of the nineteen rifles previously test-fired were selected for this study. The basis of the two rifles selected was the high correspondence observed in all four surfaces of their firing pin impressions. The firing pins of both rifles were removed and photographed. The firing pins displayed rings along the length of their shafts, consistent with being machine turned **(Figure 1)**.

Date Received: May 22, 2019
Primary Review Completed: July 1, 2019
Secondary Review Completed: July 15, 2019

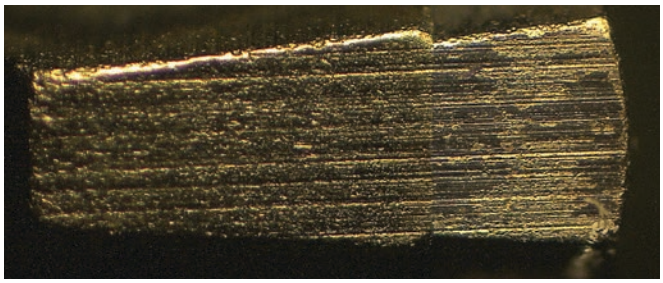

Figure 2: Rifle #10 firing pin (L) to Rifle #11 firing pin (R) 40x

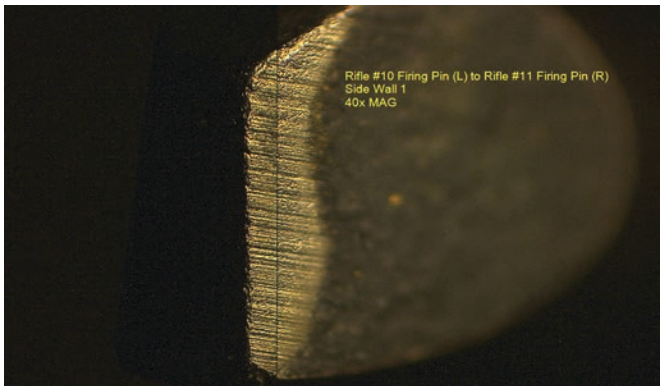

Figure 3: Rifle #10 firing pin (L) to Rifle #11 firing pin (R) - Side wall (1) - 40x

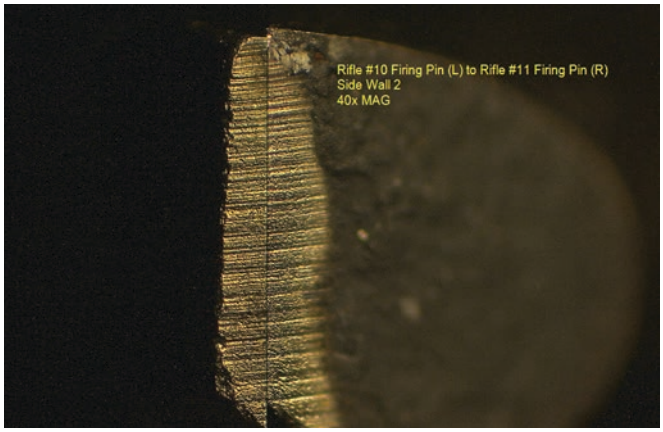

Figure 4: Rifle #10 firing pin (L) to Rifle #11 firing pin (R) - Side wall (2) - 40x

The four surfaces of the firing pin head that contact the cartridge case (face, both sides, and the back) displayed straight and parallel marks, consistent with having been produced by milling operations. In his 2018 article, Ron Nichols described side milling operations as producing straight and parallel marks which "can result in the formation of subclass characteristics" [4]. The finishing processes of these firing pins could not be confirmed,

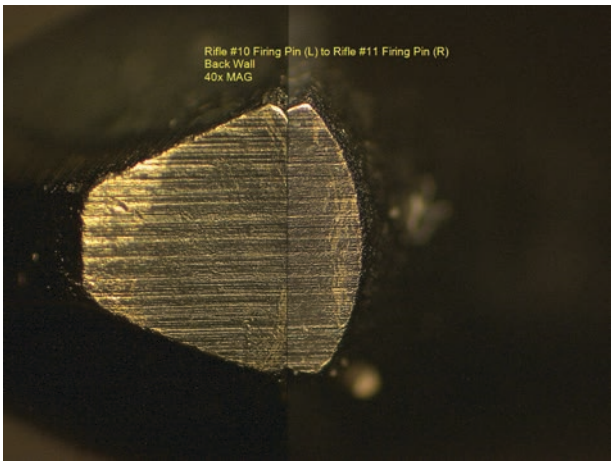

Figure 5: Rifle #10 firing pin (L) to Rifle #11 firing pin (R) - Back wall (1) - 40x

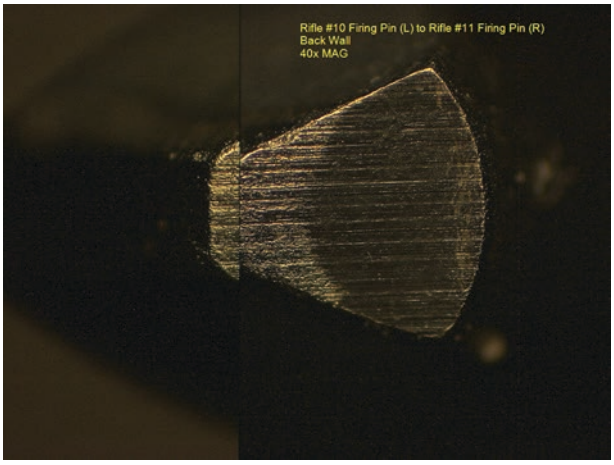

Figure 6: Rifle #10 firing pin (L) to Rifle #11 firing pin (R) - Back wall (2) - 40x

as representatives from Smith & Wesson have not been at liberty to disclose this information in either 2016 or 2019.

Figure 2 shows the face of the firing pin from rifles #10 and #11. **Figures 3 and 4** show the two long sides of the firing pin wall from rifles #10 and #11. **Figures 5 and 6** show two different areas of the back wall of the firing pins from rifles #10 and #11.

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

- #10 – DTZ2072
- #11 – DTZ2130

In total, 3,500 .22 Long Rifle caliber Federal Ammunition cartridges were fired in each of the two rifles. Thirty-five sets of test shots were retained for comparison purposes: Test shots #1 & #2, #100 & #101, #200 & #201…#3,499, & #3,500.

The firing pin and breech face of rifle #10 were cleaned prior to test firing, cleaned after every one hundred shots fired, and cleaned immediately preceding the 3,500th shot.

The firing pin and breech face of rifle #11 were cleaned prior to test firing, and only once again immediately preceding the 3,500th shot. No additional cleaning of rifle #11 during test firing was performed in order to determine if gunshot residues would affect the subclass and individual qualities of the firing pin impressions.

The test-fired cartridge cases obtained from rifle #10 were first compared to each other. Figures 7, 8 and 9 show the bottom, one side and back of the firing pin impression of shot 1 to shot 3,500 from rifle #10. The test-fired cartridge cases obtained from rifle #11 were also compared to each other. **Figures 10 and 11** show the bottom and one side of the firing pin impression of shot 1 to shot 3,500 from rifle #11. The test-fired cartridge cases obtained from both rifles were compared to the test fired cartridge cases obtained from the same rifles in 2014. **Figure 12** depicts the firing pin impression in a cartridge case from rifle 11 in 2014 and a cartridge from this 2019 study. Finally, the test-fired cartridge cases from both rifles were inter-compared. **Figures 13 and 14** show two areas of the firing pin impression from cartridges fired in rifle 10 and 11. **Figures 15 and 16** shows both side walls of the firing pin impression from cartridge fired in rifles 10 and 11.

Microscopic Examination & Results

Subclass characteristics – both impressed from the face of the firing pin and striated from the side and back walls of the firing pin – persisted over extended firings, such that considerable agreement was still observed between the two sets of test shots when they were inter-compared.

There existed significant agreement in subclass characteristics when the first test shot of each rifle obtained in 2014 was compared to the 3,500th test shot of each rifle obtained in 2019.

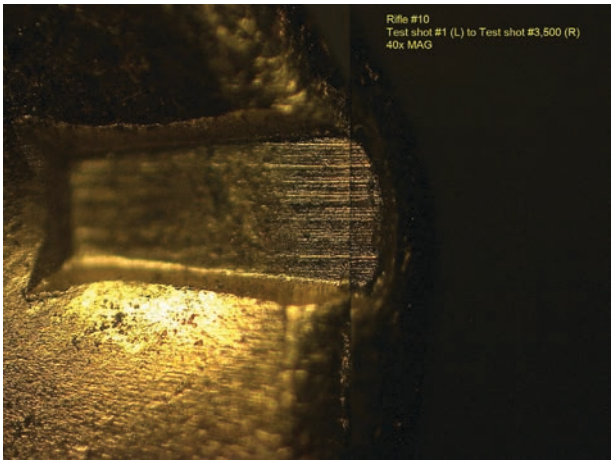

Figure 7: Rifle #10 Test shot #1 (L) to Test shot #3,500 (R) Bottom - 40x

Figure 8: Rifle #10 Test shot #1 (L) to Test shot #3,500 (R) Side - 40x

Figure 9: Rifle #10 Test shot #1 (L) to Test shot #3,500 (R) Back - 40x

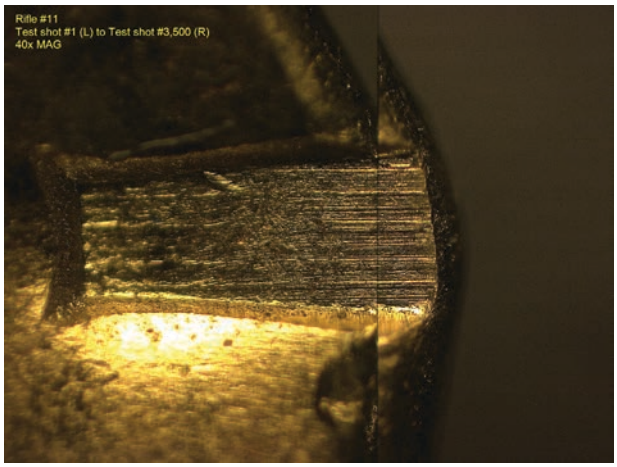

Figure 10: Rifle #11 Test shot #1 (L) to Test shot #3,500 (R) Bottom - 40x

Figure 11: Rifle #11 Test #1 (L) to Test #3,500 (R) Side - 40x

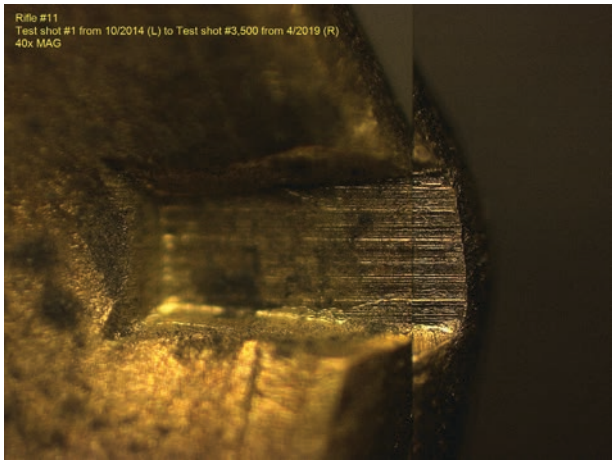

Figure 12: Rifle #11 Test from 2014 (L) to Test #3,500 from 2019 (R) - 40x

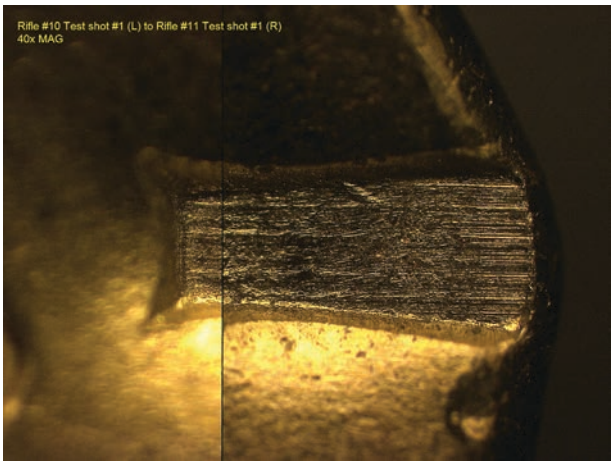

Figure 13: Rifle #10 Test 1 (L) to Rifle #11 Test 1 (R) - 40x

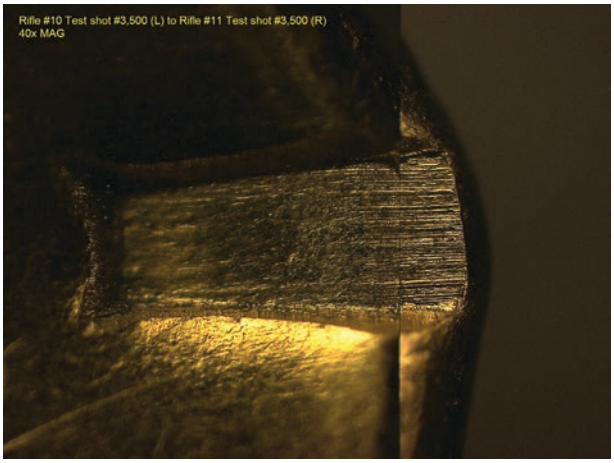

Figure 14: Rifle #10 Test 3500 (L) to Rifle #11 Test 3,500 (R) - 40x

There appeared to be no significant changes to the striated or impressed firing pin marks, regardless of whether the firing pin and breech face were cleaned.

The build-up of gunshot residues in the uncleaned rifle did not appear to alter the subclass characteristics much, if at all. While the buildup of gunshot residues may create a potential for masking individual characteristics, or a change of the characteristics already present, characteristics that could potentially be interpreted to be individual were not entirely reliable. This is due to the fact that many characteristics that had an individual appearance proved to be subclass carry-over and could potentially be misinterpreted as individual characteristics.

Figure 15: Rifle #10 Test 3500 (L) to Rifle #11 Test 3,500 (R) Side 1 - 40x

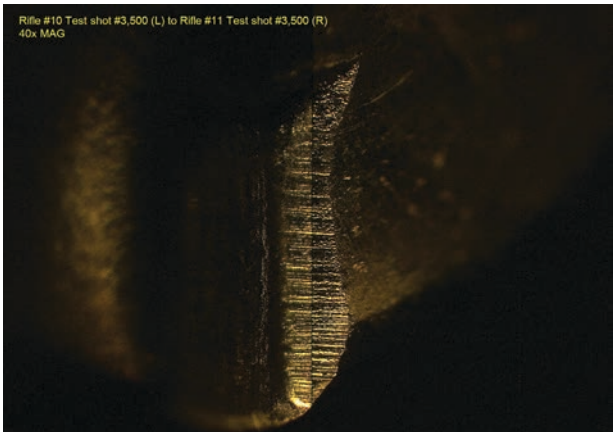

Figure 16: Rifle #10 Test 3500 (L) to Rifle #11 Test 3,500 (R) Side 2 - 40x

Differences were observed almong the edges of the firing pins from rifles #10 and #11 as seen in **Figures 17, 18** and **19**. These features have then been impressed , as well as among within the edges of the firing pin impressions and when the cartridge cases from rifles #10 and #11 were inter-compared, they were distinctly different from each other in this area as seen in **Figures 20, 21 and 22**. The edge/corners formed by the intersections of flat surfaces such as the face and side of a firing pin, even when both flat surfaces display sub-class features, are an excellent area for examination as random topographical features are created at those intersections which cannot be controlled by machining operations. Therefore if edges/ corners of a firearm component have made contact with a cartridge case, the impression formed by that edge/ corner, such as in a firing pin impression, should always be critically assessed as it provides a reliable area for comparison and identification.

Similarities were observed in each of the edges of the firing pin impressions when the first and the 3,500th test shots obtained from rifle #10 were compared; this is apparent in **Figures 23, 24 and 25**. Likewise, similarities were observed in each of the edges of the firing pin impressions when the first and the 3,500th test shots obtained from rifle #11 were compared; also apparent in **Figures 26, 27 and 28**. This showed that these edge/corner marks were quite persistent and had changed little over the period of study despite thousands of cartridges being discharged.

Conclusions

In 2016, it was observed in the first part of this research that all four surface areas – the flat area (face), bottom wall, and both side walls – of the firing pin impressions of the nineteen test-fired rifles had the potential to display agreement in subclass characteristics. Therefore, it was recommended to compare all four surface areas, as well as the edges – where each flat surface intersected its adjacent flat surface – of the firing pin impressions, prior to rendering a conclusion. Based upon the characteristics observed in this research, it is still highly recommended to compare the edges of the firing pin impressions prior to rendering a conclusion.

However aAs this part of the research demonstrated, however , all four surface areas of both rifles' firing pin impressions persisted in displaying a quantity and quality of subclass agreement that, if misinterpreted, could be mistaken for sufficient agreement of individual characteristics for identification. Therefore, extreme caution must be exercised when making comparisons of firing pin impressions with the characteristics shown in this research.

Although the scope of this research was to determine the persistence of subclass characteristics in their firing pin impressions, it was observed that individual characteristics were observed present within the subclass characteristics, making identification to a specific firearm possible. However, it was also observed that many fine marks that appeared to be more individual in nature were, in fact, subclass. These finer marks were parallel to the grosser marks and could be observed on both sets of firing pin impressions. Therefore, rendering a conclusion based on fine marks alone is not recommended.

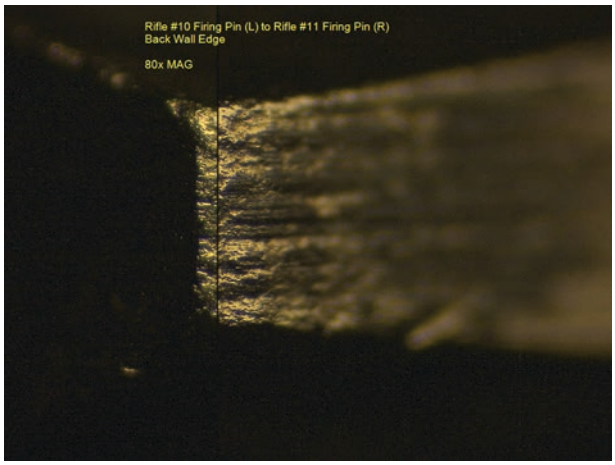

Figure 17: Back wall edge differences Rifle #10 firing pin (L) and Rifle #11 firing pin (R) - 80x

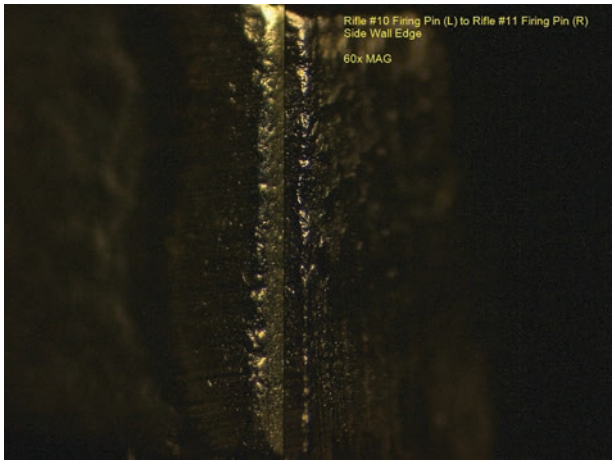

Figure 18: Side wall edge differences Rifle #10 firing pin (L) and Rifle #11 Firing pin (R) - 60x

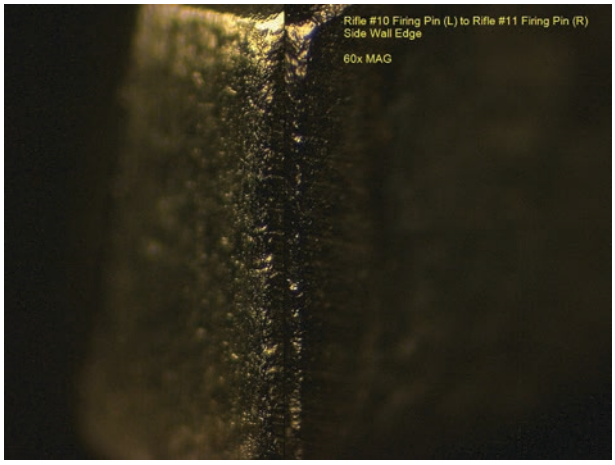

Figure 19: Side wall edge differences Rifle #10 firing pin (L) and Rifle #11 Firing pin (R) - 60x

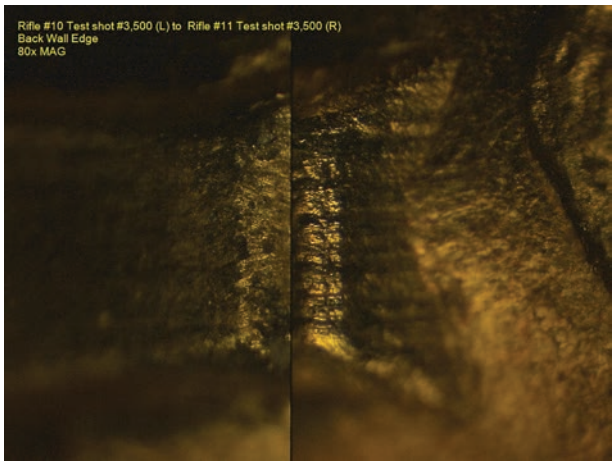

Figure 20: Rifle #10 Test 3500 (L) to Rifle #11 Test 3,500 (R) Back wall edge differences- 80x

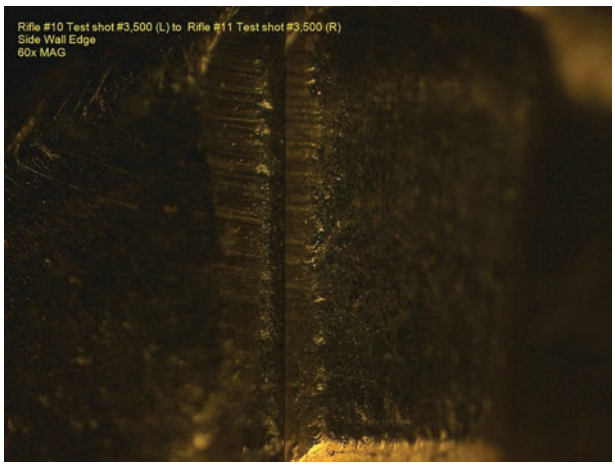

Figure 21: Rifle #10 Test 3500 (L) to Rifle #11 Test 3,500 (R) Side wall edge differences- 60x

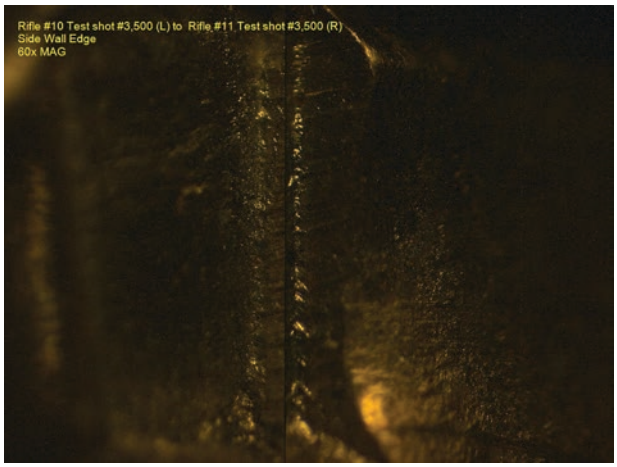

Figure 22: Rifle #10 Test 3500 (L) to Rifle #11 Test 3,500 (R) Side wall edge differences- 60x

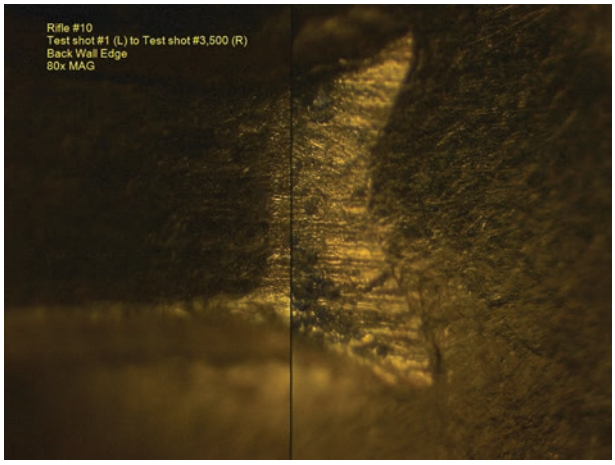

Figure 23: Rifle #10 Test 1 (L) vs Test 3500 (R) Back wall edge - 80x

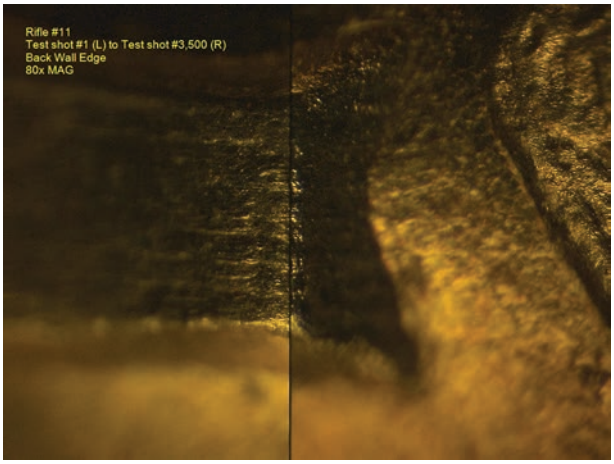

Figure 26: Rifle #11 Test 1 (L) vs Test 3500 (R) Back wall edge - 80x

Figure 24: Rifle #10 Test 1 (L) vs Test 3500 (R) Side wall edge - 80x

Figure 27: Rifle #11 Test 1 (L) vs Test 3500 (R) Side wall edge - 80x

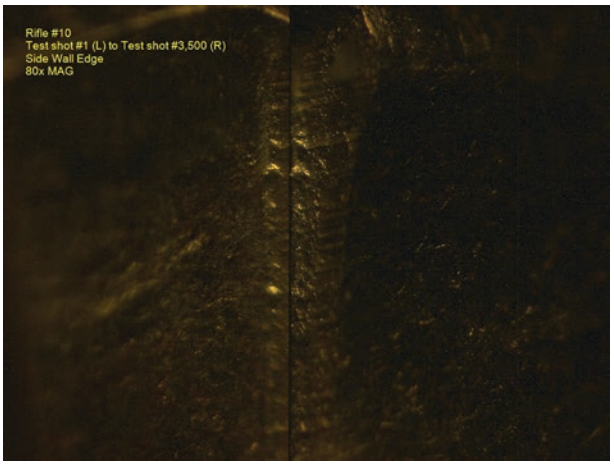

Figure 25: Rifle #10 Test 1 (L) vs Test 3500 (R) Side wall edge - 80x

Figure 28: Rifle #11 Test 1 (L) vs Test 3500 (R) Side wall edge - 80x

In the event similar suspected subclass characteristics are observed in case work, it is strongly recommended to support any identifications with comparison of other marks as proof of firing, such as anvil marks. Although not always robust, anvil marks from the two test-fired rifles displayed significant differences, such that test-fired cartridge cases could be differentiated. It is also strongly recommended to support any identifications with other possible markings from the chamber, extractor, and/or ejector.

Finally, it is unknown how many test firings would be necessary to significantly change the subclass characteristics in these particular firing pins, if at all. Although no longer used for training, since 2014, the rifles in this study had been previously used in unquantifiable firings by Michigan State Police recruits in training. Between thousands of firings over five years and the application of firearm cleaning abrasives, neither appeared to alter the subclass characteristics much, if at all, observed in the firing pin impressions.

Acknowledgements

The author wishes to thank the following:

- Mr. Chris Monturo, Precision Forensic Testing (OH), for consultation throughout this additional research.

- Mr. Johann Boden, Technical Lead, Law Enforcement Division, Federal Cartridge/Speer (MN), for sponsoring this research with the generous donation of all ammunition used.

- Sgt. Shaun Kolonich, Michigan State Police Forensic Laboratory, Lansing, Michigan, for assistance with test firing.

- Sgt. Shaun Kolonich, Sgt. Jeffrey Bedell, Sgt. Carissa Horan, Sgt. Russ Karsten, and Mrs. Rebecca Smith, Michigan State Police Forensic Laboratory, Lansing and Grand Rapids, Michigan, for assistance with microscopic comparisons.

References

[1] Lee, Michael., et. al. "Subclass Carryover in Smith & Wesson M&P15-22 Rifle Firing Pins", AFTE Journal, Vol. 48, No. 1, Winter 2016, pp. 27-32.

[2] Vinci, Francesco., et. al., "Morphological Study of Class and Individual Characteristics Produced by Firing 2500 Cartridges in a .45 Caliber Semi-Automatic Pistol", AFTE Journal, Vol. 37, No. 4, Fall 2015, pp. 368-373.

[3] Gouwe, Jan, et. al., "Comparison of 10,000 Consecutively Fired Cartridge Cases from a Model 22 Glock .40 S&W Caliber Semiautomatic Pistol", AFTE Journal, Vol. 40, No. 1, Winter 2008, pp. 57-63.

[4] Nichols, Ronald, "Subclass Characteristics: From Origin to Evaluation:, AFTE Journal, Vol. 50, No. 2, Spring 2018, pp. 68 – 88.