

Feed Ramp Marks Produced from a Ruger model LCP

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ABSTRACT

Reproducible cycling marks due to contact with the feed ramp and frame may be found on the nose of a cartridge cycled or bullet fired in a Ruger model LCP pistol.

Introduction

A local agency submitted a Ruger, model LCP, .380 Auto pistol to the laboratory for entry into the National Integrated Ballistic Information Network (NIBIN) database. While looking at the test fires under the stereoscope it was observed that two of the three test fired bullets had two triangular indentations on opposing sides of the nose and a linear indentation between these two triangular indentations (**Figure 1**).

Upon further examination with the comparison microscope it was observed the triangular marks were impressed, striated (**Figure 2**) and could be identified to each other (**Figure 3**). The linear indentations were striated and could also be identified to each other (**Figure 4**). These marks also aided in placing the land and groove impressions in phase.

The firearm was examined, and during this inspection, wear marks with copper colored trace material were observed on the edges of the feed ramp area of the barrel (**Figure 5**). The feed ramp is the surface in the receiver or barrel of a firearm along which the cartridge rides in feeding from the magazine to the chamber [1]. There was also a noticeable wear mark on top of the magazine well just below the feed ramp (**Figure 5**).

The Firearm

The Ruger model LCP has a blued, through-hardened steel slide. It also has a black, glass-filled nylon grip frame [2], which is injection molded [3]. The LCP has a locked breech action with a tilting barrel. After a cartridge is fired in the firearm, the slide and barrel recoil to the rear. The barrel is cammed downward to allow the slide to fully recoil [4]. This rearward movement and slight downward angle places the feed ramp edges slightly over the magazine well (**Figure 6**). The difference in the positions of the barrel can be observed in **Figures 5 and 6**.

The LCP barrel is processed through a variety of operations

including; machining, heat treating, cleaning and polishing. The barrel blank is turned, drilled, reamed and milled (**Figures 7 through 10**). The feed ramp area is produced with a 3/8" diameter ball end mill. The axis of the ball end mill is parallel to the axis of the barrel as it feeds out from the barrel's inner diameter to produce the feed ramp feature (**Figures 11 & 12**). **Figure 13** shows the barrel in stages from turning to drilling and finally to milling. More milling is done to produce additional features on the barrel. The barrel is then sent to polishing after it is heat treated, pickled and cleaned. The feed ramp is hand polished with a cylindrically shaped fine grinding tool. The tool is leather bonded and made of 120 grit white aluminum oxide (**Figure 14**). [3]

Experiment

PART 1: Confirmation of the Origin of the Marks

For this part of the experiment, fingernail polish was used to confirm where the marks originated. The bottom of the feed ramp was painted with "Fuchsia Power" nail polish and the top of the magazine well was painted with "Black Out" nail polish. Two copper jacketed flat nose cartridges were placed in the magazine. The first cartridge was chambered and fired. The second cartridge was allowed to chamber, but was ejected. This same process was followed with two copper jacketed round nose cartridges.

The fuchsia color transferred to the two triangular indentations on the flat nose bullet and to the long linear impression on the top of the round nose bullet. The black color transferred to the area between the triangular indentations for the flat nose bullet and below the long linear impression for the round nose bullet (**Figure 15**). For the remainder of this paper, the triangular indentations (flat nose bullets) and the long linear impression (round nose bullets) will be referred to as the feed ramp mark(s). The linear indentation between or under the feed ramp mark(s) will be referred to as the frame mark.

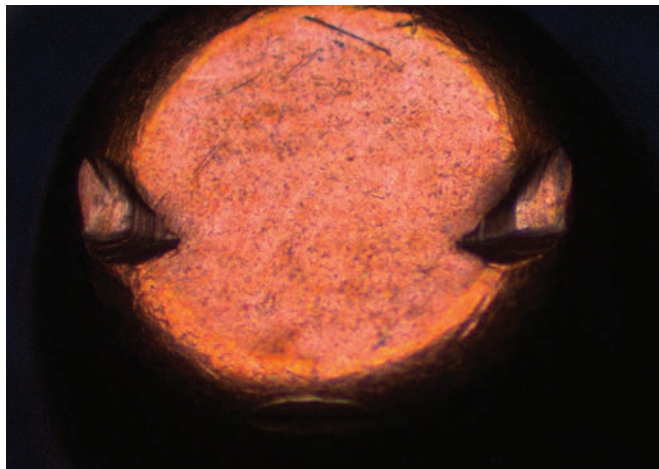


Figure 1: Ruger LCP Questioned Marks

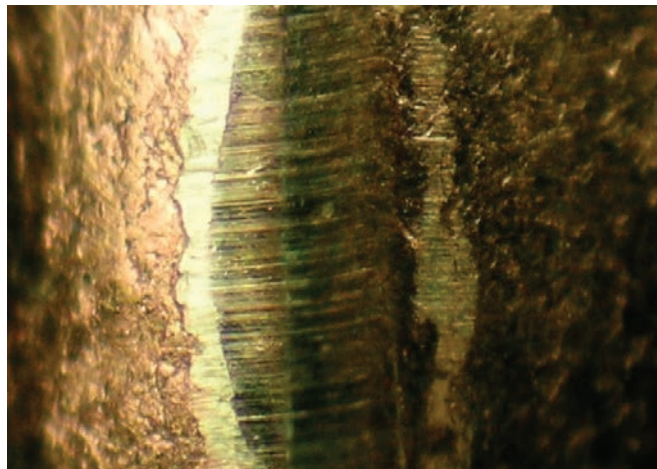


Figure 4: Frame Mark Comparison

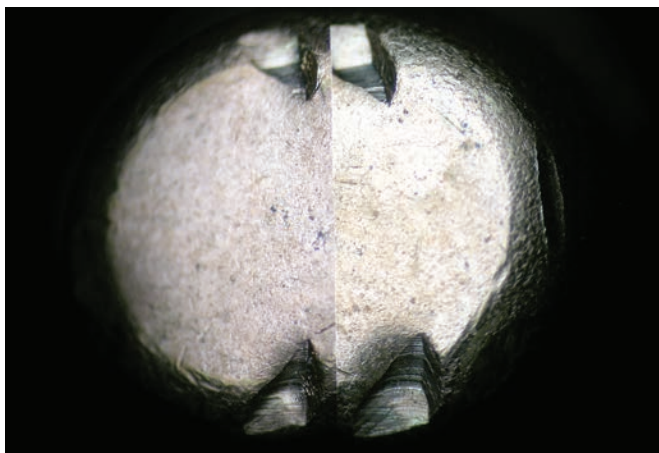


Figure 2: Ruger LCP Questioned Marks – (Striations Visible)



Figure 5: Ruger LCP – Barrel Position Forward

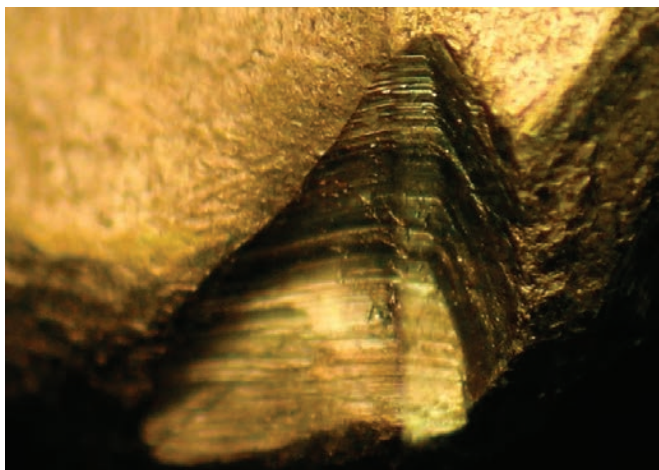


Figure 3: Feed Ramp Mark Comparison



Figure 6: Ruger LCP – Barrel Position Rearward

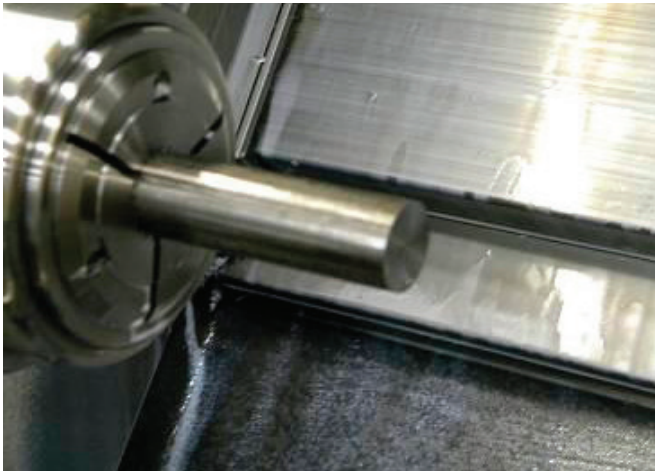


Figure 7: Barrel Blank*

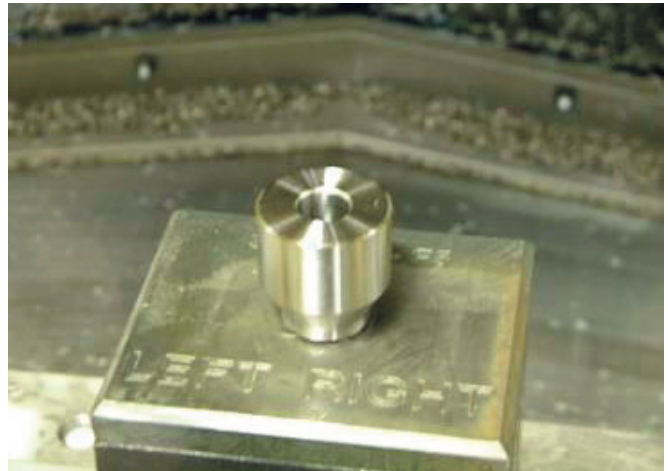


Figure 10: Barrel Loaded on CNC Machine for Center Milling*



Figure 8: Barrel Blank after Turning and Drilling*

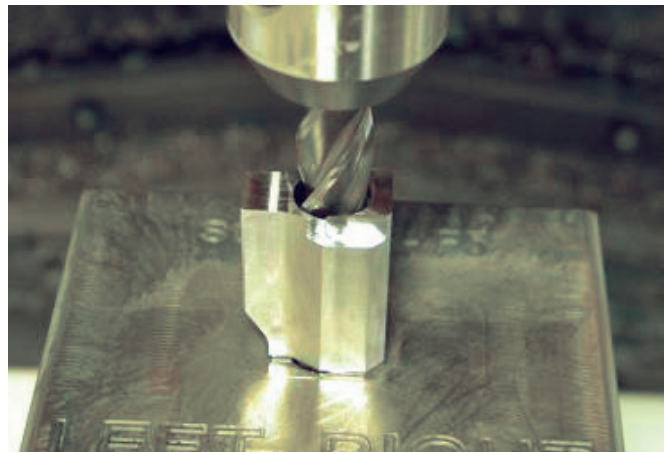


Figure 11: Creation of the Feed Ramp Area*



Figure 9: Reaming on the Back Side of the Barrel*

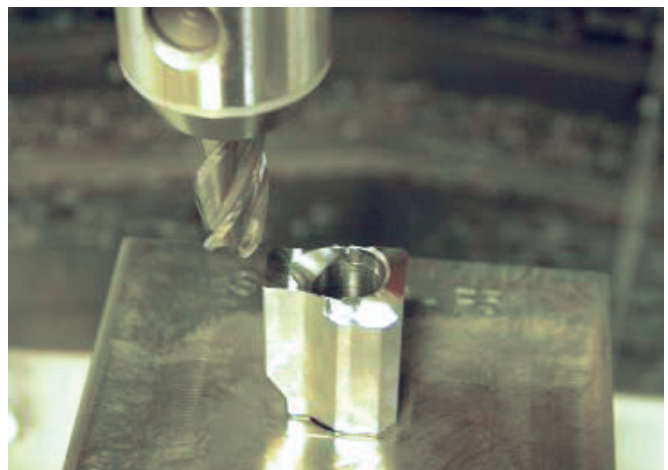


Figure 12: Creation of the Feed Ramp Area*

PART II: Evaluation of the Reproducibility of the Marks

Four different types of Winchester 95 grain ammunition were used for test fires and labeled as groups A, B, C and D (**Table 1**). The cartridges and bullets were engraved with the numbers 1 through 4. Cartridge 4 was the first cartridge loaded into the magazine and then cartridge 3, 2 and 1 were loaded. For each set of test fires, the magazine was inserted and the slide was brought to the rear and released to chamber the first round. The firearm was then fired 3 times, allowing cartridge 4 to be chambered, but not fired. Cartridge 4 was then manually ejected from the chamber.

The results for Groups A, C and D were similar. For these three groups, the first test fire failed to grossly demonstrate that the nose of the bullet impacted with the feed ramp or the top of the magazine well. However, some striations could be located in the areas where the marks were found on the other test fires. For bullets 2 and 3 and cartridge 4, marks similar to the original test fires were observed (**Figure 16**).

Group B's feed ramp mark was different from the feed ramp marks of Groups A, C or D. However, using the long linear impression, the test fires could be identified to each other (**Figure 17**). The frame mark on the test fires for Group B could also be identified to each other.

All four ammunition components for each group were compared to each other using the feed ramp and frame marks, if present. Even the hollow-point bullets exhibited feed ramp marks that could be located and identified to each other (**Figure 18**). However, the frame mark for the hollow-point bullets could only be located on cartridge 4. The four groups were then compared to each other. Even though the feed ramp mark differed in appearance in Group B to the other 3 groups, some agreement was located on the very edges of each impression. The results for these comparisons can be found on **Table 1**.

The next step was to see if these marks could be located on different LCPs and other firearms similar in design. Eight Ruger LCP firearms and two Kel-Tec P3AT firearms were test fired and evaluated for the feed ramp and frame marks. A Diamondback pistol was test fired, although the feed ramp area varied from that of the LCP and P3AT. No feed ramp or frame marks could be located on the nose of the bullets test fired in the Diamondback.

In addition to the test fires, cartridges were cycled only through eight firearms of similar design; four Ruger LCP firearms and four Kel-Tec (P38T, P3AT, P-32 and P-11) firearms. These cycled cartridges were also evaluated for the feed ramp and frame marks. For these cycled cartridges, a striated mark was



Figure 13: (Left to Right) Barrel from Turning to Drilling to Milling*



Figure 14: Hand Polishing of the Barrel/Feed Ramp*



Figure 15: Ruger LCP Test Fires (fingernail polish transfer)

located mostly on one side of the nose of the bullet and on some cartridges accompanied by a striated diagonal mark (Figure 19). These marks were not as deep or obvious as the indentations located on the fired bullets or chambered cartridges in the first section of this paper. However, several of these marks could be identified to each other and even the diagonal mark had sufficient agreement between test fires for an identification. (Figure 20).

Table 2 shows the ammunition used, whether or not feed ramp and frame marks were located, and whether or not an identification could be made. Ammunition type and amount of samples varied due to availability.

It should be noted that there was variation in appearance of the markings, especially with regards to the cartridges that were only cycled. On some of the cycled only cartridges it was difficult to determine if the marks were present because they were not as grossly defined as those that had the force of recoil aiding in the bullets' impact with the feed ramp. For both groups of cycled cartridges and test fired bullets it could be observed that occasionally the nose of the bullets impacted one side of the feed ramp more than the other (Figure 21) and other bullets had markings that were inconsistent (Figure 22). Even though some of the frame and feed ramp marks could be located on the Kel-Tec cycled ammunition components, none of them had sufficient agreement for identification. Also, none of the frame marks located on the test fired bullets or cycled cartridges for any of the firearms could be identified to each other in this second portion of this research. Because the majority of these firearms were test fired by other examiners and not available for examination, it is unknown what attributed to the inability to make an identification with regards to the frame mark.

Conclusion

Originally it was thought that the cartridges needed to be fired in the firearm in order to observe the frame and feed ramp marks. However, these marks can appear from the force of recoil on the nose of the bullet of the next cartridge being chambered and to a lesser extent to cartridges that are simply cycled through the action of the firearm. These marks are reproducible and have individual characteristics. Identifying these marks to each other is an indication of cycling only and can assist in phasing the bullets.

Acknowledgements

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Figure 16: Ruger LCP Test Fires (Left to Right, Group A, C, B & D)



Figure 17: Feed Ramp Mark Comparison (Group B)

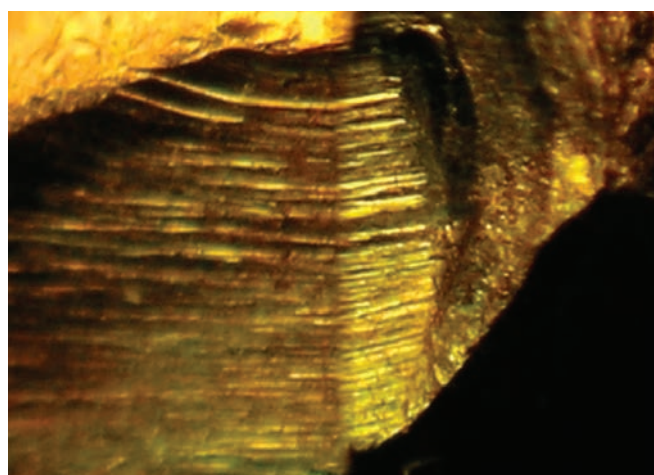


Figure 18: Feed Ramp Mark Comparison (Group D)

Winchester - Copper Jacket Flat Nose (<i>Target/Range</i>)		
Group A	Feeding Ramp Mark(s)	Frame Mark
1	Small groups of striations visible. No deep impressions.	Small group of striations visible.
2	Yes	Yes
3	Yes	Yes
4	Yes	Yes - lacks striations
ID 1-2	No	No
ID 1-3	No	No
ID 1-4	No	No
ID 2-3	Yes	Yes
ID 2-4	Yes	No
ID 3-4	Yes	No
ID A to B	No	Yes (A3-B3)
ID A to C	Yes (A3-C2)	No
ID A to D	Yes (A4-D4)	Yes (A3-D4)

Winchester - Brass Jacket Soft Point (<i>WinClean</i>)		
Group C	Feeding Ramp Mark(s)	Frame Mark
1	Small groups of striations visible. No deep impressions.	No obvious mark
2	Yes	Yes
3	Yes	Yes
4	Yes	Yes
ID 1-2	No	N/A
ID 1-3	No	N/A
ID 1-4	No	N/A
ID 2-3	Yes	No
ID 2-4	Yes	Yes
ID 3-4	Yes	No
ID C to A	Yes (A3-C2)	No
ID C to B	No	No
ID C to D	Yes (C4-D4)	No

Winchester - Copper Jacket Round Nose		
Group B	Feeding Ramp Mark(s)	Frame Mark
1	No obvious mark	Small group of striations visible.
2	Yes*	Yes
3	Yes*	Yes
4	Yes*	Yes
ID 1-2	N/A	No
ID 1-3	N/A	No
ID 1-4	N/A	No
ID 2-3	Yes	Yes
ID 2-4	Yes	Yes
ID 3-4	Yes	Yes
ID B to A	No	Yes (A3-B3)
ID B to C	No	No
ID B to D	No	Yes (B2-D4)

Winchester - Copper Jacket Hollow-Point (<i>SXT 380</i>)		
Group D	Feeding Ramp Mark(s)	Frame Mark
1	No obvious mark	No obvious mark
2	Yes	Small group of striations visible.
3	Yes	Small group of striations visible.
4	Yes	Yes
ID 1-2	N/A	N/A
ID 1-3	N/A	N/A
ID 1-4	N/A	N/A
ID 2-3	Yes	No
ID 2-4	Yes	No
ID 3-4	Yes	No
ID D to A	Yes (A4-D4)	Yes (A3-D4)
ID D to B	No	Yes (B2-D4)
ID D to C	Yes (C4-D4)	No

Key	
*	Different type of feed ramp marks
Yes	Identification was made
No	Insufficient agreement for an identification
N/A	No comparison because the mark(s) was not located

Table 1

Test Fired	Firearm	Caliber	# of CJFN # of CJRN # of BJSP		Frame Mark Present			Feed Ramp Mark Present			Frame Mark ID			Feed Ramp Mark ID		
					CJFN	CJRN	BJSP	CJFN	CJRN	BJSP	CJFN	CJRN	BJSP	CJFN	CJRN	BJSP
T1	Diamondback	.380 auto	2	3	0	0	N/A	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
T2	Kel-Tec 3PAT	.380 auto	3	3	0	0	N/A	2	3	N/A	No	No	No	No	No	N/A
T3	Kel-Tec 3PAT	.380 auto	3	2	1	0	1	1	2	1	No	No	No	No	No	No
T4	Ruger LCP	.380 auto	4	0	0	2	N/A	2	N/A	N/A	No	N/A	N/A	No	N/A	N/A
T5	Ruger LCP	.380 auto	3	3	3	2	2	2	2	1	No	No	No	Yes	Yes	Yes - To CJFN
T6	Ruger LCP	.380 auto	4	3	0	3	2	3	2	N/A	No	No	N/A	Yes	No	N/A
T7	Ruger LCP	.380 auto	4	2	0	3	2	3	2	N/A	No	No	N/A	Yes	No	N/A
T8	Ruger LCP	.380 auto	3	0	0	0	N/A	2	N/A	N/A	N/A	N/A	N/A	No	N/A	N/A
T9	Ruger LCP	.380 auto	3	0	0	2	N/A	2	N/A	N/A	No	N/A	N/A	No	N/A	N/A
T10	Ruger LCP	.380 auto	3	0	0	2 - faint	N/A	2	N/A	N/A	No	N/A	N/A	No	N/A	N/A
T11	Ruger LCP	.380 auto	4	0	0	2 possible	N/A	2 possible	N/A	N/A	No	N/A	N/A	No	N/A	N/A
Cycled																
C1	Ruger LCP	.380 auto	4	0	0	0	N/A	4 - faint/1 side	N/A	N/A	No	N/A	N/A	No	N/A	N/A
C2	Ruger LCP	.380 auto	3	0	0	0	N/A	3 - faint/1 side	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A
C3	Ruger LCP	.380 auto	3	0	0	2 possible	N/A	3 - faint/1 side	N/A	N/A	No	N/A	N/A	Yes	N/A	N/A
C4	Ruger LCP	.380 auto	4	0	0	0	N/A	4 - faint/1 side	N/A	N/A	N/A	N/A	N/A	Yes - Diagonal Mark only	N/A	N/A
C5	Kel-Tec P38T	.380 auto	3	0	0	2 - faint	N/A	0	N/A	N/A	No	N/A	N/A	No	N/A	N/A
C6	Kel-Tec P3AT	.380 auto	2	0	0	2 - faint	N/A	0	N/A	N/A	No	N/A	N/A	No	N/A	N/A
C7	Kel-Tec P-32	32 auto	0	2	0	na	2 - faint	N/A	0	N/A	N/A	No	N/A	N/A	No	N/A
C8	Kel-Tec P-11	9mm	0	0	2	N/A	N/A	0	N/A	2/1 side	N/A	N/A	No	N/A	N/A	No

Table 2

Key	
CJFN	Copper Jacketed Flat Nose
CJRN	Copper Jacketed Round Nose
BJSP	Brass Jacketed Soft Point
Yes	Identification was made
No	Insufficient agreement for an identification
N/A	No comparison because the mark(s) was not located

References:

- [1] *AFTE Glossary*, 5th Edition, 2007.
[2] "Ruger LCP Centerfire Pistol Features" 2013. Ruger Website. <http://www.ruger.com/products/lcp/features.html>. Accessed 2013 July 13.
[3] David, Rich (Ruger). Personal Communication, August 9, 2012 & September 23, 2013.
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**(Images Courtesy of Ruger)*

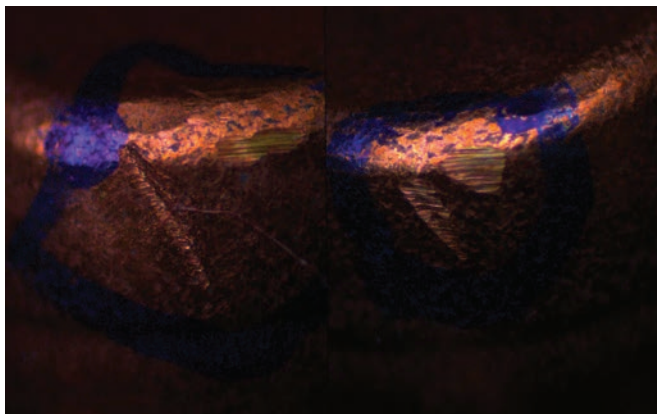


Figure 19: Feed Ramp Marks from Cycled Cartridges (Group C4)



Figure 21: Feed Ramp Marks with Concentration on One Side (Group T9)

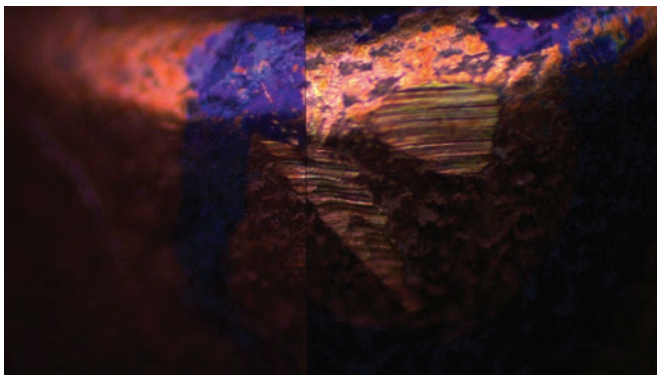


Figure 20: Feed Ramp Mark Comparison (Group C4)

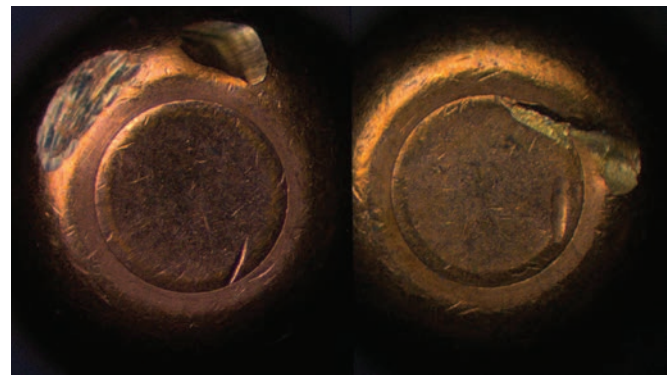


Figure 22: Inconsistent Feed Ramp Marks (Group T11)