

## Chamber Lip Marks Produced by Glock Pistols

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**Keywords:** chamber, chamber lip mark, cycling marks, Glock

### ABSTRACT

*A Glock pistol received in casework was found to produce cycling marks not previously documented in the scientific literature. The toolmarks are produced as the cartridge moves across the intersection of the feed ramp and the chamber, either through manual or automatic cycling.*

### Introduction

As with all toolmarks, it is important for the examiner to determine 1) what working surface created the toolmark, 2) if the toolmarks are reproducible and potentially identifiable, and 3) in the case of firearm toolmarks, whether the toolmark was created as a result of firing or if it can be produced by the cartridge being cycled through the action. While a primary goal in firearm identification, by definition, is "to determine if a bullet, cartridge case or other ammunition component was FIRED by a particular firearm" [1], with unfired components such as cartridges, the goal may be to determine if the item was cycled through the action of a particular firearm or, more simply put, marked by a particular firearm.

Depending on relevant, case specific details, toolmarks produced by manual or automatic cycling of autoloading firearms have the potential to provide important information in investigations. Examples of these include: 1) when cartridges are found in the possession of a person of interest or at their residence that are later identified as having been cycled through the same unknown firearm which was discharged at a crime scene, and 2) when a cartridge found at a crime scene that corroborates a witness statement that a jammed or misfired cartridge was cleared during the shooting event, among others. The presence of these toolmarks may also assist the examiner in providing a list of firearm makes that potentially produced the toolmarks on the cartridge(s).

### Evidence Observations and Testing

During the examination of fired cartridge cases and an unfired cartridge as part of routine case work, the author

noted shallow, striated toolmarks on the case walls of the fired cartridge cases and the unfired cartridge near the case mouth. Overall, the marks had a slightly arched shape and were often present in multiples, separated by an unmarked space (**Figure 1**). Upon microscopic comparison, the marks were found to be reproducible and appeared to possess sufficient agreement for identification (**Figure 2**). The firearm submitted for comparison to these items was a Glock 19 Gen4 semi-automatic pistol, with a magazine. Since the marks were observed on both fired and unfired specimens, it was clear that they could be created through cycling. Based on stereoscopic examination of the unfired cartridges submitted, as well as similar cartridges from the ammunition reference collection, it was determined that these marks were not created during the manufacturing of the ammunition as the marks were not observed on any of the other unfired cartridges.

It was first hypothesized that the marks may have been produced by the forward edge of the magazine. To test this hypothesis, two cartridges were cycled through the action of the firearm using the submitted magazine, two cartridges were manually inserted into the chamber and extracted, and two cartridges were cycled through the action of the firearm using a reference collection magazine. All the cartridges were examined before testing to ensure they were devoid of any marks from cycling, manufacturing or otherwise. The marks in question were produced regardless of which magazine was used. However, the cartridges that had been manually inserted into the chamber and extracted did not possess the marks. Based on this information, two conclusions could be made. Firstly, that the toolmarks were not created by the magazine, and secondly, that they were not produced by the chamber. The marks were only produced when a cartridge was cycled from a magazine, indicating that movement of the cartridge between the magazine and the chamber produced the observed striated marks.

Date Received: March 13, 2021

Primary Review Completed: July 11, 2021

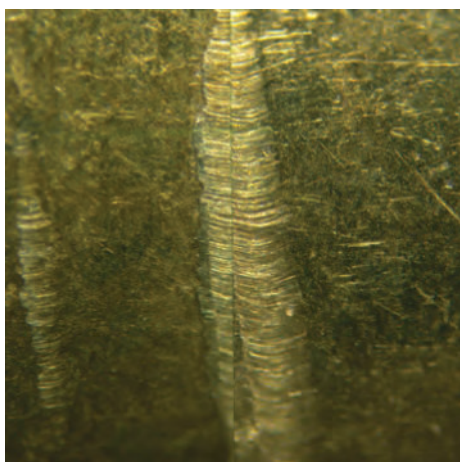
Secondary Review Completed: August 16, 2021



**Figure 1: Lip mark location.**



**Figure 3A: Area of interest.**

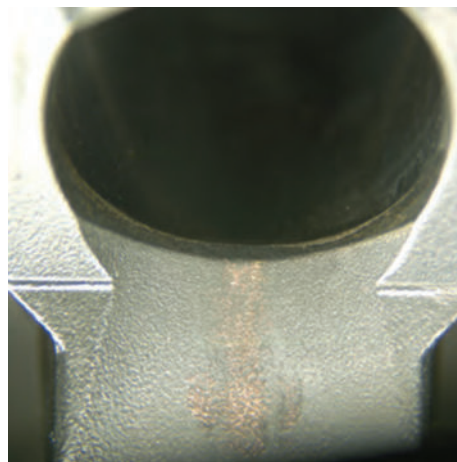


**Figure 2: Lip mark agreement.**

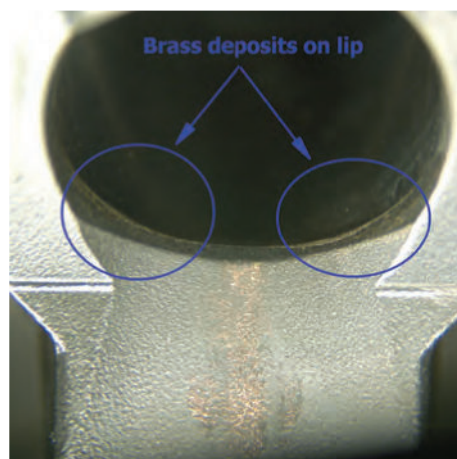
Stereoscopic examination of the chamber revealed a raised “lip” between the feed ramp and the chamber. The “lip” is essentially the lower starting edge of the chamber and will subsequently be referred to as the “chamber lip” (**Figure 3A**). Brass residue was visible on the chamber lip. It was hypothesized that this could be the origin of the marks observed (**Figures 3B & 3C**). Using Paper Mate® Liquid Paper® an unfired cartridge was whitened on the area where the marks were observed. Cycling the cartridge through the action and subsequent examination of the chamber revealed white residue on the chamber lip.

#### Testing with Glock Pistols from Laboratory Reference

Glock 19 pistols and their respective magazines from the laboratory firearm reference collection were used to evaluate whether the marks were produced by different Generations in 9mm Luger.



**Figure 3B: Chamber lip with brass deposits.**



**Figure 3C: Chamber lip with brass deposits.**

Firearms used:

- #1 Glock 19 Gen2
- #2 Glock 19 Gen3
- #3 Glock 19 Gen3
- #4 Glock 19 Gen4

Each pistol was cleaned before use. Four cartridges were manually cycled through the action of each pistol and three cartridges were fired in each. The magazines were only loaded with one cartridge at a time (**Table 1**).

Preliminary evaluation of the test samples produced as described above indicated that when the marks are produced, they are reproducible, the marks may be created by multiple Generations of Glock 9mm pistols, and the marks may be created on both fired and cycled ammunition components.

Firearm	Cycled cartridges	Fired cartridge cases
#1 Glock 19 Gen2	2 out of 4 ID	0 out of 3 ID
#2 Glock 19 Gen3	4 out of 4 ID	2 out of 3 ID
#3 Glock 19 Gen3	4 out of 4 ID	3 out of 3 ID
#4 Glock 19 Gen4	4 out of 4 ID	3 out of 3 ID

**Table 1: Chamber lip marks on cycled and fired cartridge cases with 9mm Luger caliber Glock pistols**

### Further Testing

Additional Glock pistols, in various calibers, were obtained to further evaluate the production of the chamber lip marks. One cartridge was loaded into a magazine and cycled through a designated pistol. This process was repeated three times, and was repeated for each pistol (**Table 2**). Firearm calibers chosen for testing were 380 Auto, 9mm Luger, 40 S&W, 10mm Auto, and 45 Auto. Three firearms for each caliber were used. Note: Only two cartridges and two firearms in 10mm Auto caliber were used due to limited availability of ammunition at the time of testing.

Based on the additional testing, it was found that chamber lip marks can be produced in multiple caliber Glock pistols; however, the 9mm Luger caliber Glock pistols consistently produced the best quality marks that could be identified to a specific pistol. These marks were not observed on the cycled 40 S&W or 45 Auto caliber cartridges. Other Glock pistols in these calibers may or may not produce chamber lip marks.

To assess if the magazine loaded condition affects the production of chamber lip marks, a single Glock 19 Gen 4 pistol and magazine were used for testing. Prior to loading, each cartridge was marked according to its location in the magazine. The cartridges were then cycled through the pistol's action and examined for the presence of chamber lip marks. Examination of the cartridges revealed the presence of chamber lip marks on all of the cartridges.

### Evaluation of Potential Subclass Characteristics of Chamber Lip Area

A visual evaluation of the feed ramp and entrance to the chamber (the chamber lip area) of the tested pistols was performed to determine the potential for subclass characteristics in chamber lip marks. Some of the pistols' feed ramps had apparent grinding/honing marks running perpendicular to the ramp (**Figure 4**), while others had a granular appearance (**Figure 5**). These granular marks are most likely due to the finishing processes (such as sandblasting, tumbling and coating) applied by Glock (2021 discussion with Omar Felix as well as factory tour notes provided by him; unreferenced, see "Acknowledgements"). The entrance to the chambers have apparent reaming/honing marks that run perpendicular to the axis of the bore. The chamber lip represents the intersection of these two separate machining operations. As the cartridge travels up the feed ramp and into the chamber, the cartridge is running perpendicular to the machining marks mentioned. Based on this examination, the potential for subclass in chamber lip marks was found to be extremely remote. These marks are produced by randomly occurring imperfections, and if they are reproduced, they can be used for identification purposes.

### Conclusions and Summary

Microscopic comparison of chamber lip marks produced on cartridges cycled through and/or fired from the same Glock pistol indicated the marks to be reproducible. Examination of the manufacturing toolmarks on the feed ramp, the chamber, and their intersection (chamber lip) revealed the potential for subclass characteristics to be very low. Based on this information and the subsequent microscopic comparison of these toolmarks, chamber lip marks were found to be identifiable to a specific Glock pistol (**Figures 6 to 12**). Intercomparison of cartridges cycled and/or fired from different Glock pistols were found to possess different patterns of individual characteristics (**Figures 13 to 15**). The possibility of making an incorrect identification was found to be low. Since these marks can be produced through either cycling and/or firing, the examiner needs to be cautious when interpreting these marks as 'fired in' marks when they are

Chamber lip marks on cycled cartridges		
380 Auto	Mark on cartridge case visible	Marks on cartridge cases identified
G42 A	3 out of 3	3 out of 3
G42 B	3 out of 3	2 out of 3
G42 C	3 out of 3	2 out of 3
<b>9mm Luger</b>		
G17 Gen4 A	3 out of 3	3 out of 3
G17 B	3 out of 3	3 out of 3
G17 Gen4 C	3 out of 3	3 out of 3
<b>40 S&amp;W</b>		
G22 Gen4 A	0 out of 3	-
G26 B	0 out of 3	-
G27 C	0 out of 3	-
<b>45 Auto</b>		
G21 A	0 out of 3	-
G21 B	0 out of 3	-
G41 Gen4 C	0 out of 3	-
<b>10mm Auto</b>		
G20 Gen4 A	2 out of 2	2 out of 2
G29 B	1 out of 2	-

**Table 2: Chamber lip marks on cycled cartridges from different caliber and generations of Glock pistols**



**Figure 4: Feed ramp with grinding or honing marks.**

present on fired cartridge cases.

Testing conducted with the Glock 19 Gen4 pistol and a magazine loaded to capacity indicated that the magazine spring pressure on cartridges does not affect the production of chamber lip marks. The marks were created on all cartridges from the magazine.



**Figure 5: Feed ramp with granular appearance.**

Knowledge of the potential presence of chamber lip marks, their source, low subclass potential, and potential reproducibility from Glock pistols may aid an examiner in casework.

It should be noted that this research was only done with Glock pistols. The possibility that these marks can be produced by other make/model pistols of a similar design cannot be excluded.



**Acknowledgments**

I would like to thank Charles Clow of the Dallas Police Department for his encouragement and for his help with this project. I would also like to thank Omar Felix of the Palm Beach Sheriff's Office for information provided regarding Glock pistol manufacturing processes.

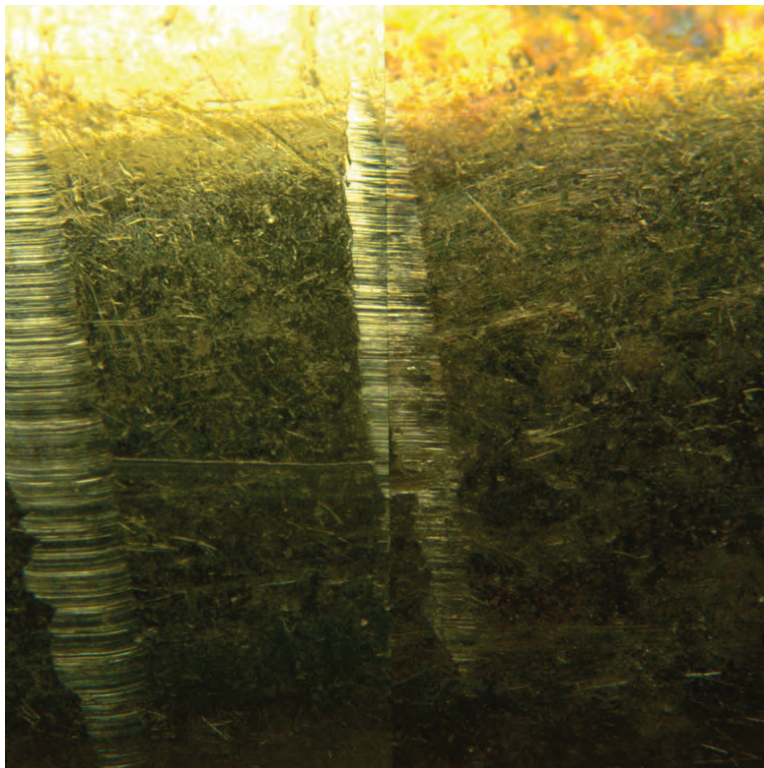
**Note**

Attempts were made to contact Glock via email for more information, but no response was received. Manufacturing process information used in this research was provided from notes taken by colleagues during factory visits.

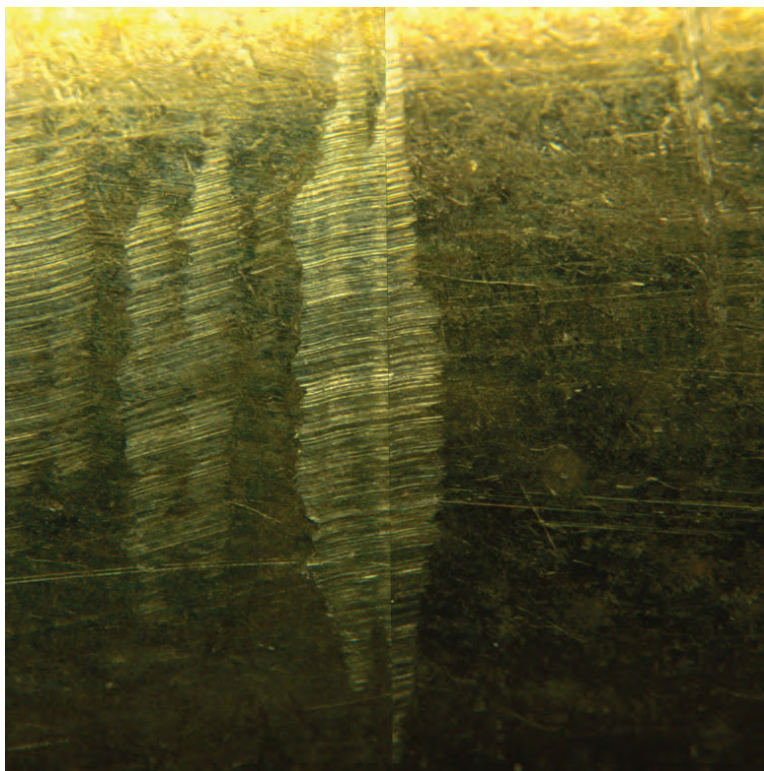
**References**

[1] AFTE Glossary Version 6.110619. 6th ed. 2013. p. 52.

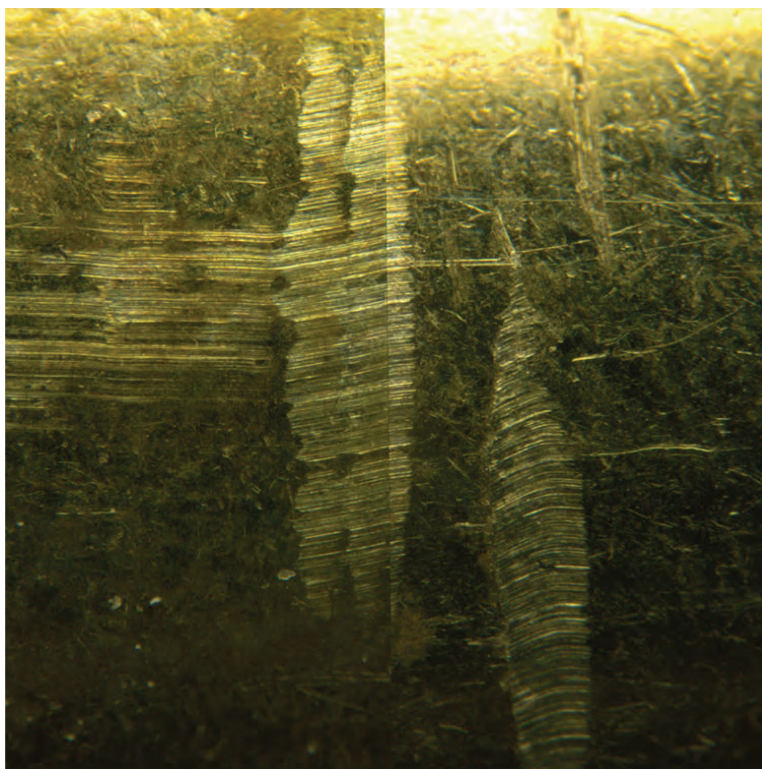
Note: This paper was presented at the AFTE 2021 Annual Training Conference in Miami, FL.



**Figure 6: 9mm Luger Glock A ID chamber lip mark.**

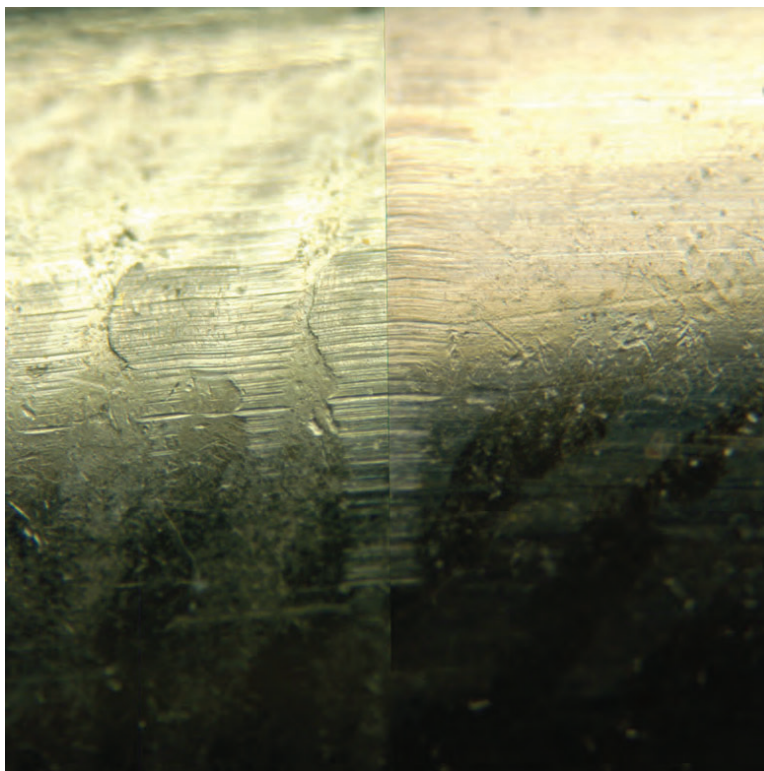


**Figure 7: 9mm Luger Glock B ID chamber lip mark.**

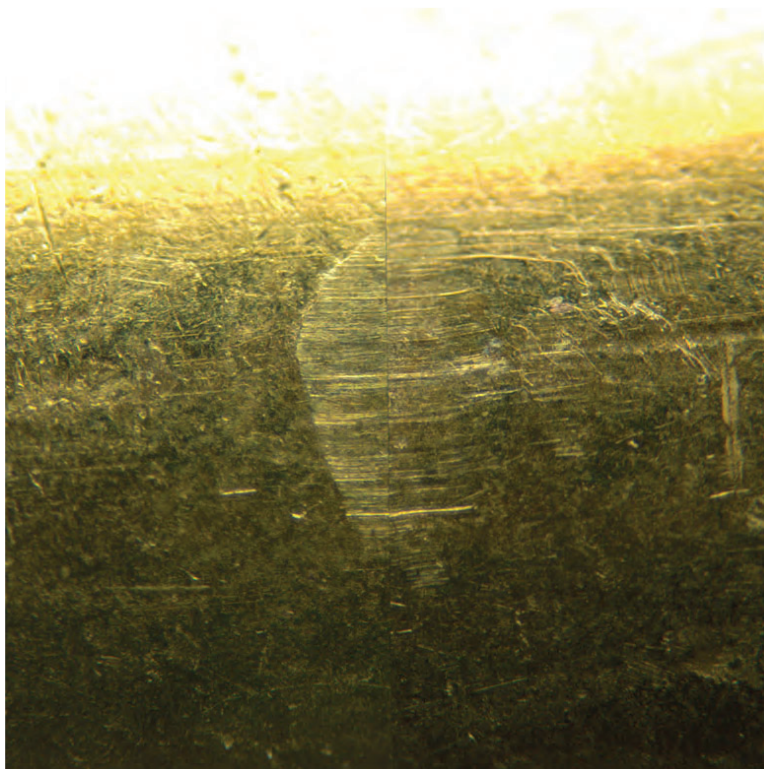


**Figure 8: 9mm Luger Glock C ID chamber lip mark.**

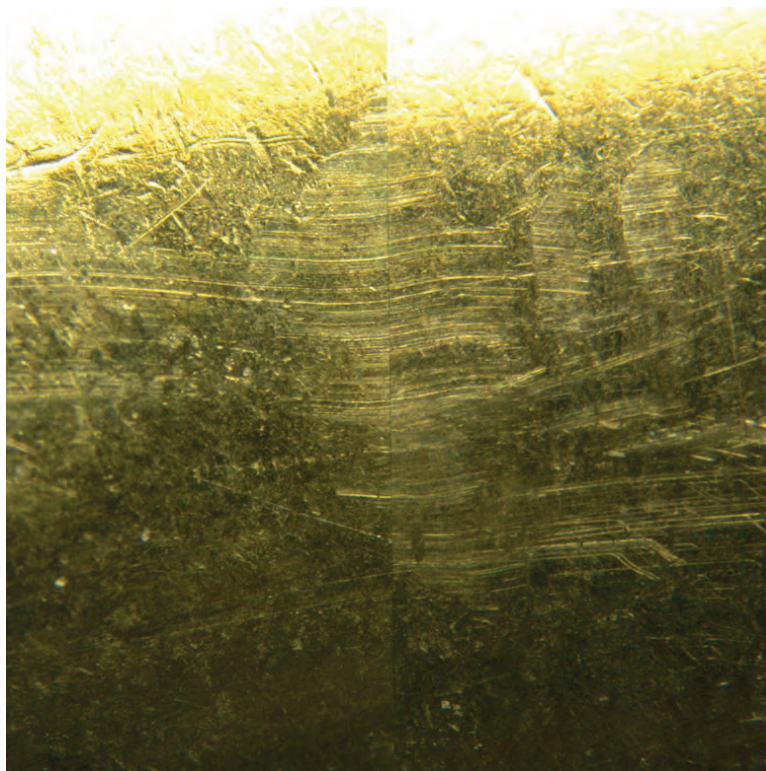




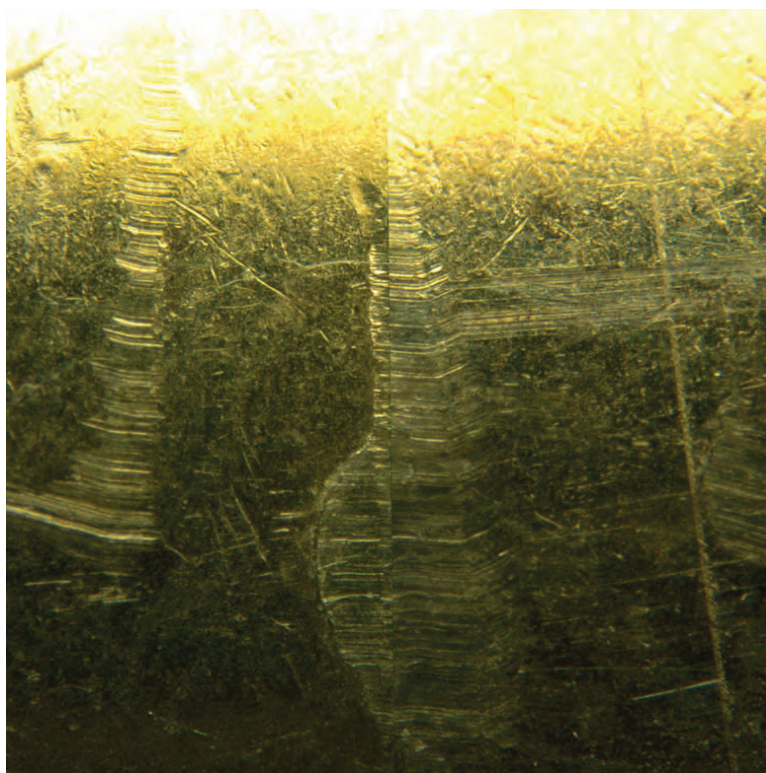
**Figure 9: 10mm Auto Glock A ID chamber lip mark.**



**Figure 10: 380 Auto Glock A ID chamber lip mark.**

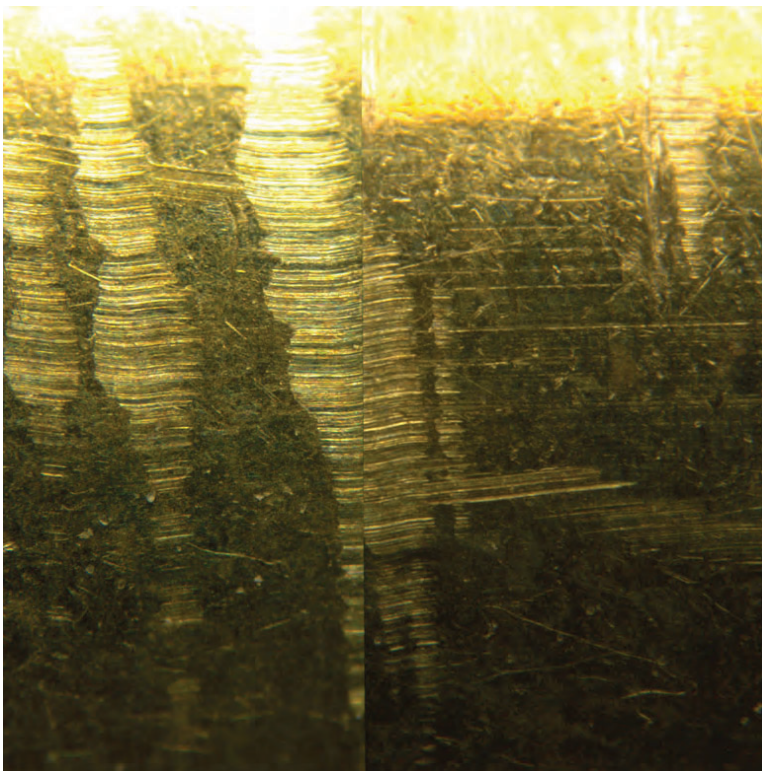


**Figure 11: 380 Auto Glock B ID chamber lip mark.**

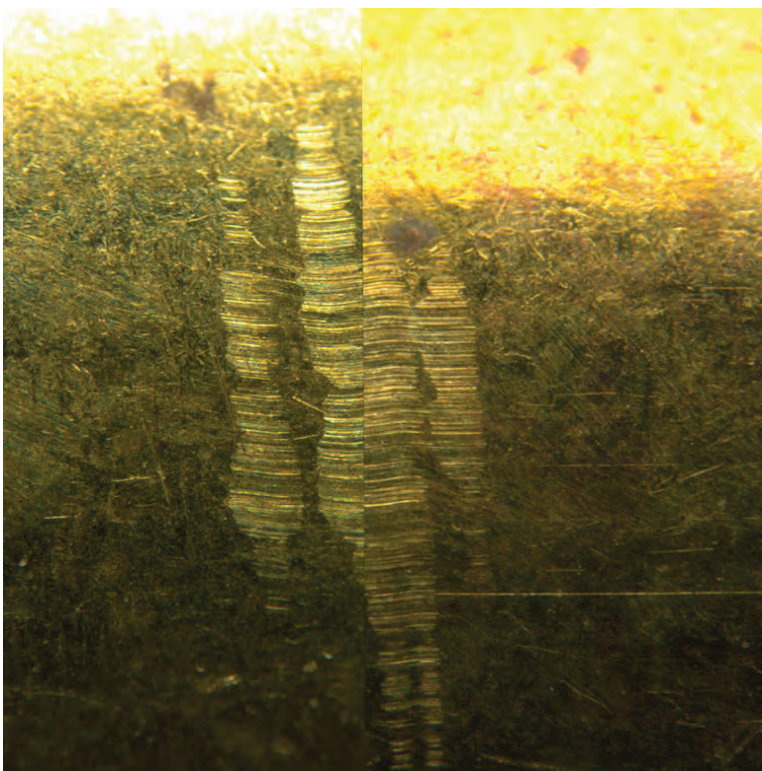


**Figure 12: 380 Auto Glock C ID chamber lip mark.**

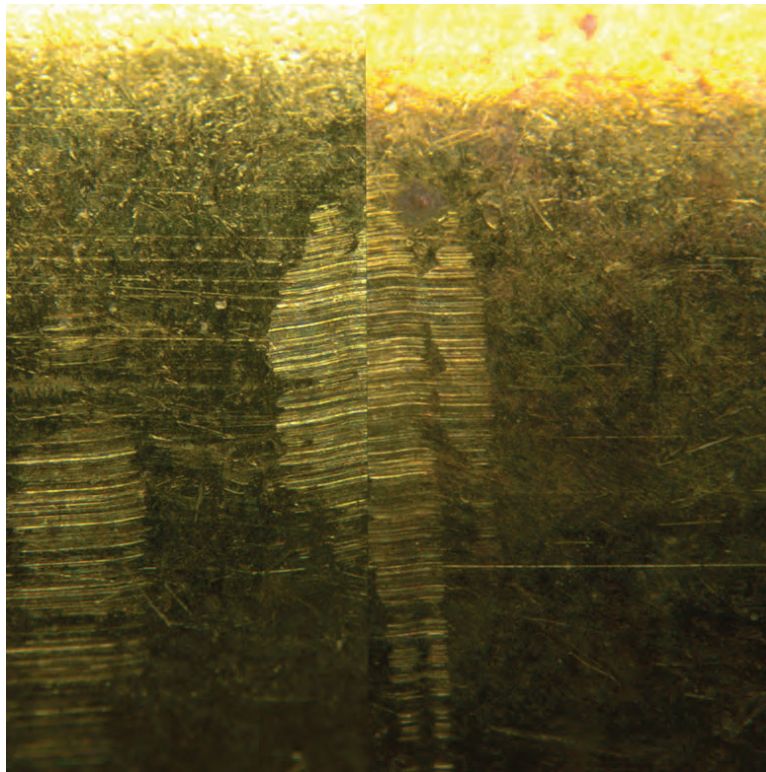




**Figure 13: 9mm Luger Glock A v Glock B non-match chamber lip mark.**



**Figure 14: 9mm Luger Glock A v Glock C non-match chamber lip mark.**



**Figure 15: 9mm Luger Glock B v Glock C non-match chamber lip mark.**