Sub Class Characteristics of Sequentially Rifled 38 Special S&W Revolver Barrels

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Abstract:

This article illustrates subclass characteristics found in groove impressions on lead bullets that were fired from 10 sequentially manufactured 38 Special, Smith & Wesson revolver barrels. These subclass characteristics were present on some, but not all of the ten sequential barrels and in some but not all of the grove impressions. These barrels were rifled using the step cutting broach-manufacturing process. These subclass characteristics were <u>not</u> found on the land impressions of the fired lead bullets or on the land or groove impressions of the copper-jacketed bullets

Background:

Test bullets were fired[1] from 10 sequentially rifled Smith & Wesson (S&W) 38 Spl. Revolver barrels. The barrels were obtained from R.G. Jinks of Smith and Wesson in 1979 for use in exercises in Toolmark Comparison Criteria classes offered by the Bureau of Forensic Service and subsequently by the CCI. The following rifling operations[2] were completed in sequential order with barrel #1 being the first one through each operation, and barrel #10 being the last.

1. Barrels were micro honed to improve bore finish (assumed to be performed before the rifling process).
2. They were rifled (i.e., multi step, single pass broach).
3. They were button burnished.
4. Forcing Cone Cut

Each of the 10 sequentially rifled barrels was individually mounted in the same S&W revolver frame, which was then used to fire five (5) sets, each consisting of three .38 SPL. Lead bullets, followed by three Jacketed Soft Point (JSP) test bullets in sequential order for each barrel, using water recovery. The barrels were not cleaned prior to, or during, the firing of each test set. No casts were made of the rifling in these test barrels prior to or after the tests were fired. All barrels were returned to S&W after firing each set. Attempts to have these barrels returned for evaluation after the subclass phenomena was discovered were unsuccessful.

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Each test set from each barrel #1 to #10 consists of three (3) lead tests, followed by three (3) JSP tests numbered sequentially in the order in which they were fired. Each barrel was fired a total of 30 times and the test firings alternated between sets of three lead bullets followed by sets of three copper jacketed bullets. The bullets were labeled sequentially from T1 up to T30. Thus five sets were fired (a set consisting of three lead bullets followed by three copper-jacketed bullets).

Discussion:

Subclass characteristics are defined[3] as discernable surface features of an object which are more restrictive than "Class Characteristics" in that they are produced incidental to manufacture, 2) Are significant in that they relate to a smaller group source and 3) Can arise from a source which changes over time. It is critical for the examiner to have a thorough understanding of the influence of subclass characteristics so that they can be recognized when they are present so that striae produced by them do not form the basis for identification.

The photographs in Figure 1 to 5 illustrate the correspondence in the subclass features in the groove impressions of the lead bullets. These are illustrated with the use a Reichert comparison microscope with an approximate magnification of 30X. These five photographs depict the best correspondence of the subclass characteristics found on these bullets. If these striae were not caused by subclass features of the rifling tool, the extent of this agreement would be sufficient for an identification. There are a few other areas showing correspondence but not to the extent exhibited in figures 1-5. In particular, the groove impressions of bullets # 4, #5 and #6 appear to best illustrate the agreement of the subclass characteristics. Overall it appears that barrel 6 test #2, groove #3, provides the

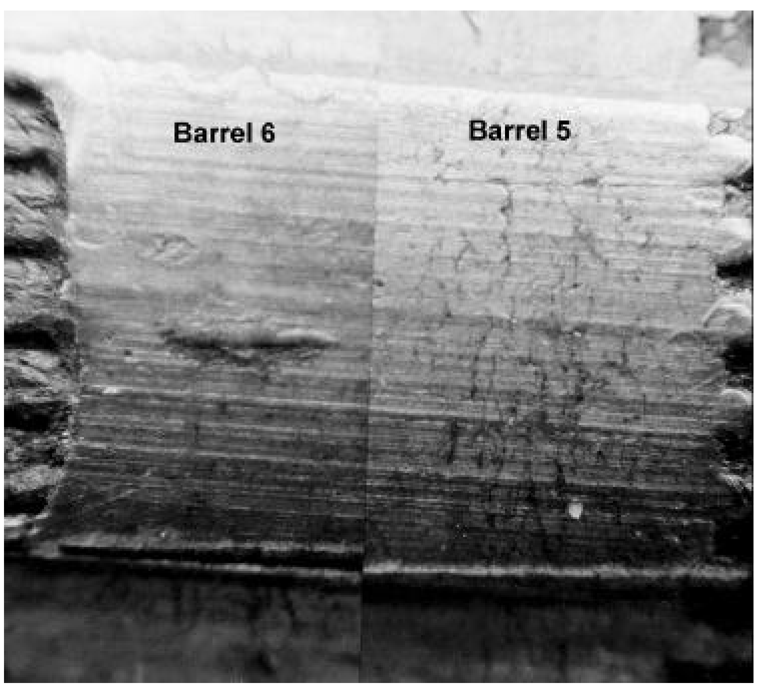

Fig. 1 Groove impressions barrel 6 T-1 (G-3) to barrel 5 T1 (G5)

best correspondence to the other grooves. The land impressions of these lead bullets did not illustrate any subclass characteristic features.

Fig.2 Groove impressions barrel 4 T-2 (G-4) to barrel 5 T-1 (G-5)

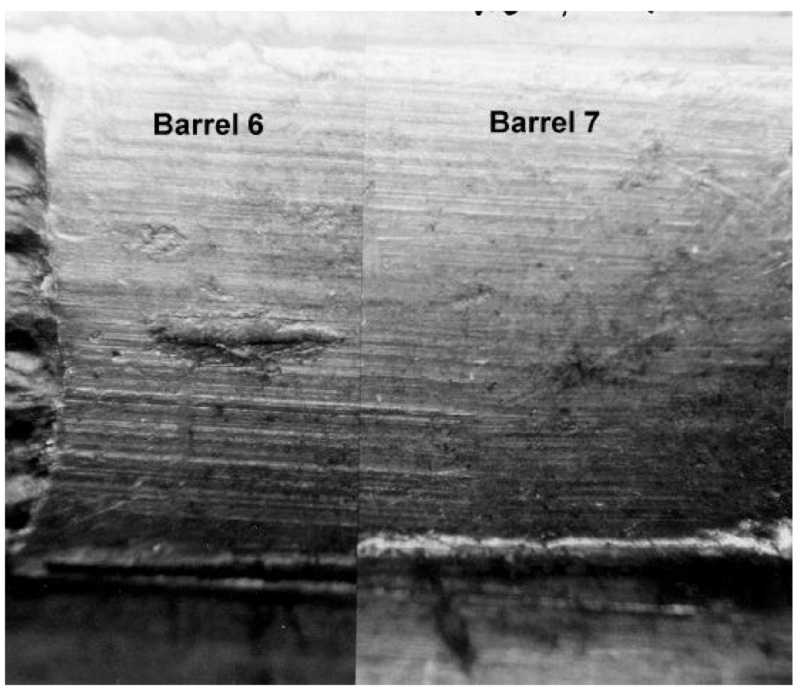

Fig. 3 Groove impressions barrel 6 T-2 (G-3) to barrel 7 T-1 (G-1)

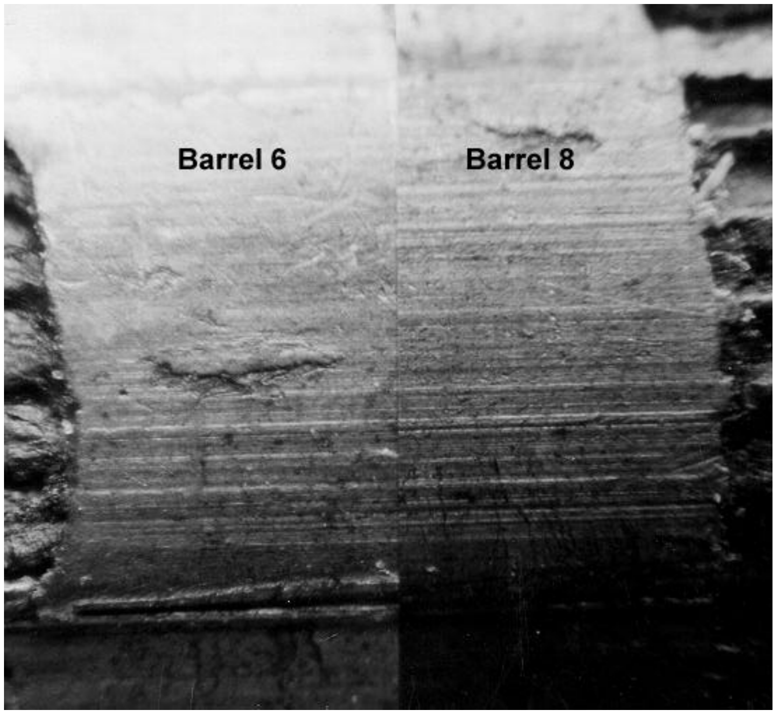

Fig. 4 Groove impressions barrel 6 T-2 (G-3) to barrel 8 T-1 (G-3)

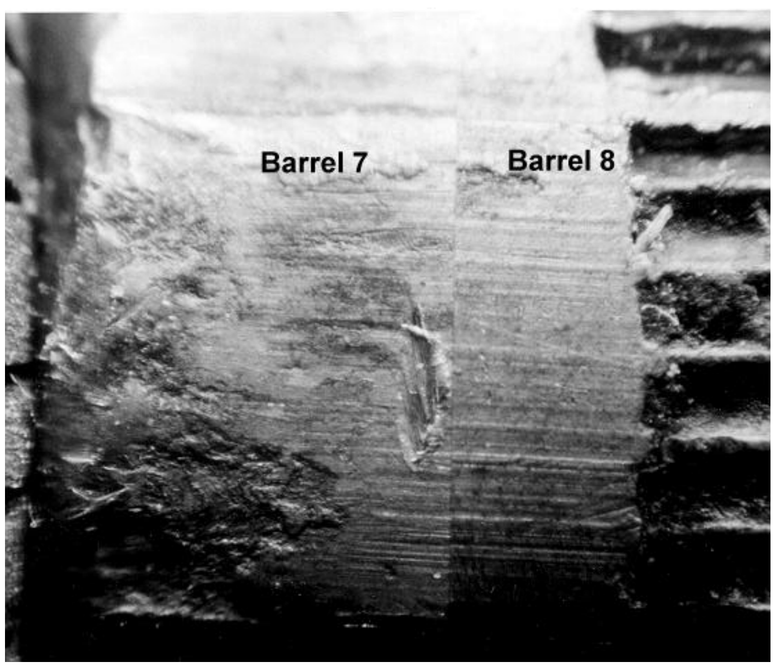

Fig. 5 Groove impressions barrel 7 T-1 (G-1) to barrel 8 T-1 (G-3)

Biasotti[4] previously illustrated a series of PLASTISOL[5] replicas of barrels manufactured by the step cutting broach process. From a comparison of PLASTISOL casts taken two inches apart, it is quite evident that there are substantial changes in the barrel groove striae to such an extent that one would not expect any reproducibility from consecutive barrels. However, subclass characteristics can occur if the tool is damaged and carries with it some major imperfections. Lomoro[6] illustrates a series of subclass characteristics from Titan revolvers caused by a similar manufacturing mechanism. These subclass characteristics were likewise found only in the groove impressions and not in the land impressions of the bullets. This subclass carry over noted by Lomoro consisted of much coarser striae than observed on the S&W barrels.

The evaluation of these S&W subclass characteristics was originally performed by Al Biasotti[7] who stated:

> "The subclass characteristics are noted in a limited number of groove impressions on lead tests from the 10 sequentially rifled S&W, 38 Spl., revolver barrels. Without having the barrels, or casts to examine, the reason why these remarkable subclass characteristics occurred cannot be fully explained. However, based on the limited extent of the similarities noted by my personal observations, it can be concluded that the similarities noted represent an extremely rare event that would not be expected to be encountered in actual case situations". While this statement may be true for the manufacture of revolvers, the current practice of having a long rifled barrel sectioned into multiple short pistol barrels may increase the chance for this type of subclass event.

Conclusion:

In a letter to CCI students, Biasotti's[8] conclusions were stated as:

> "The most important lessons to be learned from all of the striated toolmark-bullet comparison exercises are:
> 1. That the chance occurrence of more than 3 or 4 consecutively corresponding striae is an extremely rare event, rising exponentially with increasing combinations of 2 or more consecutively corresponding striae. Therefore, the concept of consecutive striae is the most effective criteria for determining common origin of toolmarks.
> 2. That the occurrence of subclass characteristics in rifled firearms barrels is a rare event that can be easily determined by the direct inspection of the rifling or a barrel cast; and where the barrel or barrel cast is not available, by applying a more consecutive criteria in determining common origin."

This expression of numerical criteria for identification has been refined recently and appears in a chapter by Biasotti and Murdock[9]

Summary:

Since 1991 the bullets have been used as part of a series of exercises in the annual "Toolmark Criteria for Identification" class held at the CCI. During these exercises numerous experienced, and some inexperienced, firearm examiners have had occasion to review these bullets both subjectively and objectively using striae counts. They have substantiated Biasotti's original premise that this correspondence is noted only in the groove impressions of a few lead bullets. Likewise, the land impressions of these lead bullets and the copper-jacketed test bullets have not shown the presence of any subclass characteristics. Nor have the groove impressions of the copper-jacketed bullets illustrated a degree of subclass characteristic correspondence that could be mistaken for an identification such as shown by the lead bullets. Unfortunately, due to the multiple handling of these bullets, the subclass characteristics of the lead bullets are currently not in the pristine shape they were in 1991.

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[1] Bullets were test fired in 1979 by two student aids, now criminalists, Mike Guisto (BFS Stockton) and Robert Thompson (BATF Walnut Creek)
[2] R. Jinks of Smith & Wesson - personal correspondence to Criminalist T. Johnson, August 6, 1980.
[3] AFTE Glossary Revision June 6, 1994.
[4] Biasotti, A. A. "Rifling Methods - A Review and Assessment of the Individual Characteristics Produced AFTE Journal, Vol. 13 No. 3 July 1981.
[5] PLASTISOL - A thermosetting plastic.
[6] Lomoro, V. J. "32 SWL Caliber, F.I.E. Corp., Titanic revolvers AFTE Newsletter # 20 June 1972, AFTE Journal Vol. 6 No. 2, April 1974 and AFTE Journal Vol. 9 No. 2 July 1977.
[7] Biasotti, A. "Letter to CCI E201 Criteria for identification course students" June 21, 1991.
[8] Biasotti, A. (6) Ibid.
[9] Biasotti, A and Murdock, J "Firearms and Toolmark Identification", Vol. 2 in MODERN SCIENTIFIC EVIDENCE AND: THE LAW AND SCIENCE OF EXPERT TESTIMONY (David L. Faigman, David H. Kaye, Michael J. Saks & Joseph Sanders eds.,