E38 Identification of Bullets Fired From Consecutively Manufactured Double-Broached Ruger® SR9c® Barrels Utilizing Comparison Microscopy and Confocal Microscopy

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After attending this presentation, attendees will be aware of tool marks produced by double-broached Ruger® barrels, the process of conducting a blind validation study, pattern matching error rates, methods for distinguishing between subclass and individual characteristics on test-fired barrels, acquisition techniques for bullets using 3D confocal microscopy, and correlation procedures used to evaluate 3D topographies from test-fired bullets.

This presentation will impact the forensic science community by supporting traditional means of pattern-matching methods for identification and by beginning to establish/develop an objective non-traditional means to evaluate the rendering of an identification. Additionally, this presentation will serve as a confirmation to the firearms/tool marks theory of identification that the extent of sufficient agreement of individual characteristics occurring in tool marks produced by the same tool exceeds that agreement which occurs in tool marks produced by different tools. This presentation will also inform the forensic community about applications of an emerging technology within comparative-based disciplines.

This study was conducted to evaluate tool marks imparted on pistol barrels as a result of a double-broach rifling process. Qualified examiners in the Federal Bureau of Investigation's (FBI's) Firearms/Toolmarks Unit (FTU) participated in this blind study to compare test-fired bullets from double-broached barrels in order to determine if the presence of subclass characteristics is a cause for concern when rendering identifications.

Test fires were examined from 15 double-broached Ruger® pistol barrels. Twelve barrels were manufactured within a single production run of a broach (run 9mm PBS 650), ten being consecutively manufactured (designated CM 0-CM 9) and two selected from further down the production run (designated CM 22 and CM 33). Three barrels/pistols were selected from the FBI FTU Reference Firearms Collection (RFC) and are designated D1893, D1925, and D1994. Pistols D1893 and D1925 are model SR9®. The production run barrels and pistol D1994 are model SR9c®, the compact version of the SR9®. The pistol frame/slide from D1994 was used to fire the production run barrels. One cartridge was fired through each production run barrel by Ruger® prior to this study.

The ammunition selected for this study was Remington® UMC® 9mm Luger®, 115 grain, copper full metal jacket. Ten cartridges were fired from each of the 14 barrels and six cartridges from D1994 to provide a total of 146 cartridges. Cartridges were fired into a ballistic water tank to preserve the condition of the bullets. Cartridges were laser engraved with a unique randomly selected numerical identifier, between 100 and 500, prior to firing.

The first six test fires collected from each barrel (first two cartridges for D1994) were used to provide samples for FTU examiner trainees and other research projects. The seventh through tenth test fires collected from each barrel (third through sixth for D1994) were used to create five individually unique test sets for this study. Each test set contained 12 fired bullets, including at least one matching pair from four or more production run barrels and one or more matching pairs from RFC pistols. Each test set also contained an instruction sheet and an answer worksheet, which insured all 66 bullet comparisons were completed for each test set. This was a blind validation study because test sets were placed into a room where the test administer could not see participants pick-up/return the test sets, participating FTU examiners were not provided with any information in regard to the origin of bullets in the test sets, there were no "knowns," and the nature of the answer worksheet ensured the test administer could not tell which examiner completed the worksheet.

Upon return of the test sets from examiners, a 3D topography of each individual land from every test bullet was acquired using a Sensofar® S neox confocal microscope, which provided a total of 360 (5 tests, 12 bullets, 6 lands each) acquired 3D topographies for comparison analysis. The 3D topographies were analyzed with the application of a Cross-Correlation Function (CCF_{MAX}) that provided an objective numerical value that represents the similarity between two topographies. The numerical values were used to determine if there was significant and sufficient variation of individual characteristics between two test fires to correctly render a conclusion or if there were subclass characteristics present which would prevent a conclusion from being correctly rendered. Results from the examiners' conclusions using traditional comparison microscopy were compared to results obtained using confocal microscopy combined with CCF_{MAX}.

Subclass Characteristics, Firearm Identification, 3D Topography

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