D11 Firing Pin Aperture: Uncertainty of Measurement and Usefulness for Class Characteristics

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After attending this presentation, attendees will gain a better understanding of: (1) the accuracy and reliability of firing pin aperture marks; (2) the use of discernible class characteristics during the examination process; (3) differences in the appearance of sequential test fires; and, (4) measurements obtained from test fires and casts of the actual firing pin apertures.

This presentation will impact the forensic science community by showing how discernible class characteristics for elimination can affect the outcome of the examination process.

In 1985, the Association of Firearm and Tool Mark Examiners (AFTE) Committee formalized the Criteria for Identification. Their goal was to reach consensus on articulating the three principles for the theory of identification as it related to tool marks – identification, inconclusive, and elimination. One of the examinations integral to the firearms/tool mark examination process is the evaluation of class characteristics, particularly when it comes to the measurements. Class characteristics are those features that are predetermined prior to manufacture (design features) and are restrictive to a particular group (i.e., caliber). For elimination, the AFTE criteria requires there to be a significant disagreement of discernible class characteristics and/or individual characteristics. This study examines the threshold for what is a significant disagreement in class characteristics, through the evaluation of firing pin apertures using the same firearm with different brands of ammunition. When a cartridge or shotshell is fired, the base of the cartridge and primer is forced against the breech face under high pressures. These high pressures sometimes cause the primer to flow into the firing pin aperture creating an outline of the firing pin aperture. When a firearm is manufactured, the size and shape of a firing pin aperture is designed to an acceptable tolerance to allow for the proper passage of the firing pin. A difference in firing pin aperture dimensions between two cartridge cases would indicate a difference in class characteristics, thus allowing for elimination. This study evaluates this effect, the measurement, and the impact of uncertainty of measurement when making an elimination.

In a cartridge case comparison, where firing pin aperture marks are present, the measurement of this feature may be considered a discernible class characteristic. In this particular study, each examiner and trainee made a series of firing pin aperture measurements of test fired shotshells and cartridge cases. These measurements were recorded and the uncertainty of measurement was determined to evaluate the threshold of elimination based on measurable differences. Two types of 9mm Luger ammunition, CCI Blazer, and American Eagle (Federal), were test fired in a Cobray M-11/Nine pistol. The CCI Blazer ammunition included an aluminum cartridge case with a nickel primer, while the American Eagle ammunition consisted of a brass cartridge case with a brass primer. Additionally, two types of 12 gauge ammunition, Winchester #8 Shot and Winchester 00 Buckshot, were test fired in a Mossberg 500-A shotgun. The Winchester 12 gauge, 2 ¾, #8 shot shotshell contains a low brass, gray hull, and copper primer. The Winchester 12 gauge, 2 ¾, 00 buckshot shotshell contains a low brass, red hull, and copper primer. Casts made of the breechfaces, to include the firing pin aperture on the pistol and shotgun, were collected prior to test firing. Both the apertures present on these test fires and those present on casts of the actual firing pin apertures were measured for this study. Prior to performing any measurements, a performance check was conducted on the stage micrometer using a National Institute of Standards and Technology (NIST) traceable calibrated caliper. The measuring platform was also checked to determine if it was level. One comparison microscope was used for all measurements. There were a total of eighty samples – forty shotshells and forty cartridge cases. Each sample was marked with a permanent marker to indicate the position of the extractor mark. There were two measurements recorded for each shotshell and cartridge case – one with the extractor in the three o'clock position and one in the six o'clock position. The approximate line of symmetry for each firing pin aperture was determined using the crosshair reticule. Once the line of symmetry was found, the micrometer was zeroed and the diameter on the aperture was measured. Each participant then recorded their results of the measurements on a data sheet. It should be noted that differences were observed in the general appearance of

firing pin aperture marks on the two types of cartridges that were test fired. This presentation will provide the firearms examiner with some useful data regarding the accuracy and reliability of firing pin aperture measurements and their use as a discernible class characteristic.

Firing Pin, Uncertainty, Elimination

