



D24 Analysis and Classification of .22 Caliber Firing Pin Impressions

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After attending this presentation, attendees will be able to describe the .22 caliber firing pin classification system and its application to forensic investigations. The objectives of this presentation are to explain a .22 caliber firing pin classification system, describe how to examine and compare morphological variations and measurements in cartridges, and to describe how to code and retrieve cartridge cases.

This presentation will impact the forensic science community by providing an innovative firing pin classification system that can be used to associate cartridge cases found at crime scenes to a firearm based on the firing pin morphology.

The classification system is an alternative to storing images with ballistic scanning software. Using this system, examiner's can code, file and retrieve .22 caliber cartridge cases for comparisons. The firing pin impressions from unidentified .22 caliber cartridge cases found at crime scenes can be associated with similar .22 caliber firing pin impressions on file using the classification system.

Twenty-five different types of .22 caliber firearms, ten rifles and fifteen handguns were test fired to collect a variety of firing pin impressions for analysis. The fifteen handguns included seven pistols and eight revolvers. The pistols tested included: Beretta Model 21A-22LR, Cobra Derringer, Davis Derringer, Ruger Mark II, Sig Sauer Mosquito, Thompson Center, and a Walter P22. The revolvers included: FIE Model 15, FIE Model TEX 22, Harrington & Richardson Model 922, High Standard, Iver Johnson, RG-10, RG-24, and Smith & Wesson Model 617. The rifles included seven semi-automatics and three single shot bolt actions. The semi-automatics included: Browning, Marlin Model 60, Marlin Model 75, Ruger 10/22, Savage Model 64G, Winchester Model 190, and Winchester Model 290. The single shot rifles included: Mossberg Model 26B, Remington Model 510, and Remington Model 547. All firearms used in this study were pre-owned and obtained from gun shops for test firing.

The bullet and propellant were removed from the cartridges and the priming mixture was neutralized before collecting the firing pin impressions. The priming mixture was soaked in isopropyl alcohol for 12 hours followed by another 12 hours in water and dried at 20°C (68°F). This process neutralized the priming mixture and prevented detonation while test firing to obtain an impression. A stereoscopic boom microscope equipped with a digital camera and measuring software was used to record the measurements of each cartridge impression.

The firing pin impressions were divided into groups based on geometric shapes and measurements. Group I firing pin impressions were square to rectangular in shape, Group II impressions were circular or semi-circular, and Group III impressions were angular or wedge shaped.

Group I impressions were first separated into small (S), medium (M), and large (L) based on the amount of surface area made by the firing impression. The (S) range for surface area was 0.60 – 0.89 mm², (M) 0.90 – 1.79 mm² and (L) 1.80 – 2.00 + mm². Next, they were separated into (S), (M), and (L) based on the width of the firing pin impression. The width range for (S) was 400-599 µm, (M) 600 – 799 µm, and (L) was 800 – 899 + µm. Finally, they were separated into (S), (M), and (L) based on the height of the firing pin impression. The height range for (S) was 800 – 1199 µm, (M) 1200 – 1599 + µm. Using these measurement ranges, the firing pin impressions could be classified into one of 27 divisions. In the firing pin classification system developed, the first letter in the three-letter arrangement represents the amount of surface area made by the firing pin impression, the second letter represents the width of the firing pin impression and the third letter represents the height of the firing pin impression. The classification

system was ordered as follows: SSS, SSM, SSL, SMS, SMM, SML, SLS, SLM, SLL, MSS, MSM, MSL, MMS, MMM, MML, MLS, MLM, MLL, LSS, LSM, LSL, LMS, LMM, LML, LLS, LLM, or LLL.

There was only one category for Group II impressions and that category was based on the radius of the firing pin impression. It was divided into (S), (M) and (L) divisions based on the radius of the firing pin impression. The (S) range for the radius was 200- 499 µm, (M) 500 – 599 µm, and (L) 600 - 699 + µm. There were no wedge shaped firing pins in the firearms sampled; however, they would be separated by surface area using the same range as used for Group I impressions.

When Group I firing pin impressions were classified based on the square surface area of the impression, 28% were (S). Within this (S) group, 6% were classified as SSM, 6% SSL and 6% SLS based on the firing pin impression height and width respectively. Seventeen percent of the impressions were (M) and within this group 11% were MMM. Only 1% of the firing pin impressions were in the (L) group.

Consequently, using this classification system, 20 out of 25 firearms could be eliminated in the SSM classification, 24 could be eliminated in the SSL, 24 eliminated in the SSM, and 24 in the SLS classification. For firing pin impressions with "M," out of the 25 impressions, 23 could be eliminated in MMM, 22



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in MML, 22 in MLM and 24 in LLL.

In conclusion, this system associates firing pin impressions from .22 caliber cartridge cases found at crime scenes to similar .22 caliber firing pin impressions filed in this classification system. As a result, cartridge cases can be examined to determine association to a firearm based on the firing pin morphology.

Firing Pin Impression, Cartridge Case, Firearm