Determination Regarding the Technological Viability of Microstamping Components, Pursuant to Penal Code section 27532

California State Senate Bill 452 - Firearms 2023-2024

I. Executive Summary

As required by California Penal Code section 27532, subdivision (a), the California Department of Justice (DOJ) has investigated the technological viability of microstamping components. The investigation was led by the DOJ's Bureau of Forensic Services (BFS) and performed in consultation with other DOJ personnel with relevant legal and subject matter expertise. The DOJ's technological viability investigation also included input from relevant stakeholders, who were invited by letter to provide written comments relevant to the Department's technological viability investigation.

Based on this investigation, the DOJ has determined that it is technologically viable for microstamping components (engraved firing pins) to imprint a unique microscopic array of characters, referred to as a "microstamp," on spent cartridge cases discharged by a firearm into which the microstamping component has been installed. The DOJ also concludes that engraved firing pins can impart a legible microstamp on expended cartridge cases with regularity, including after sustained or repeat firing.

This investigation did not set out to determine that microstamping components are a perfect technology that could be used to solve all firearm crimes. Although "technological viability" is not defined in Penal Code section 27532, the terms "microstamp," and "microstamping component" are defined in section 27531. "Microstamp" is defined as "a microscopic array of characters that may be used to identify the specific serial number of a firearm from spent cartridge casings discharged by that firearm." A "Microstamping component" is defined as "a firing pin or other component part of a semiautomatic pistol that, when installed, produces a microstamp on at least one location of the expended cartridge case each time the pistol is fired." Combined, these definitions suggest that "technological viability" means determining whether a microstamping component can produce a microscopic array of characters on an expended cartridge case that "may be used" to identify a specific firearm. Applying this standard, the DOJ's investigation determined that microstamping components have demonstrated technological viability in accordance with subdivision (a) of Penal Code section 27532.

Multiple studies—discussed in more detail below—have found that for most firearm and ammunition types evaluated, microstamping components can transfer all of the information needed to identify a complete microstamp on a majority of cartridge cases discharged by firearms into which those components have been installed. These studies have indicated that more advanced forensic and imaging techniques can help examiners confirm or decipher complete microstamp character information more often. They also indicate that microstamping components can imprint corresponding microstamps in multiple formats on the same cartridge case, allowing examiners, for example, to use the microstamp characters imprinted from the circumference of a microstamping firing pin as a backup or fail-safe to confirm the corresponding microstamp characters imprinted from the face of the microstamping firing pin. Additionally, even partial microstamp transfers could provide valuable, intentionally transferred investigative leads to help solve and prosecute more firearm crimes more often, particularly when examiners have access to multiple cartridge cases discharged by the same firearm. This is no different from using a partial fingerprint, license plate number, or firearm serial number as an investigative lead.

As a result, and as discussed below, the DOJ's investigation determined that microstamping components have demonstrated technological viability in accordance with subdivision (a) of Penal Code section 27532.

II. California Senate Bill 452

In 2023, California Governor Gavin Newsom signed Senate Bill 452 (Blakespear) (2023 Cal Stats. ch. 253), which amended California's Unsafe Handgun Act and added separate Penal Code provisions that adopted new requirements concerning microstamping components in semiautomatic pistols sold or transferred in the state. Senate Bill 452 defines a "microstamping component" as "a firing pin or other component part of a semiautomatic pistol that, when installed, produces a microstamp on at least one location of the expended cartridge case each time the pistol is fired."[1] A "microstamp" is defined as "a microscopic array of characters that may be used to identify the specific serial number of a firearm from spent cartridge casings discharged by that firearm."[2] A "semiautomatic pistol" is defined as "a pistol, as defined in [Penal Code] Section 16530, that has an operating mode that uses the energy of the explosive in a fixed cartridge to extract a fired cartridge and chamber a fresh cartridge with each single pull or activation of the trigger."

Commencing January 1, 2028, Senate Bill 452 generally requires licensed firearms dealers to ensure that semiautomatic pistols sold, offered for sale, exchanged, given, transferred, or delivered by those dealers in California are certified as "microstamping-enabled" by the pistol's manufacturer, a licensed firearms dealer, or a gunsmith that serviced the pistol to install a qualifying microstamping component.[3] This requirement takes effect only if the DOJ has first made two separate determinations regarding: (1) the technological viability of microstamping components; and (2) the commercial availability of microstamping components and/or microstamping-enabled firearms.

For the first of these determinations, Senate Bill 452 requires the DOJ to "engage in an investigation to determine the technological viability of microstamping components producing microstamps on spent cartridge casings discharged by a firearm into which the microstamping component has been installed. The investigation shall include input from relevant stakeholders."[4]

If the DOJ determines that microstamping components are technologically viable, then Senate Bill 452 also requires the DOJ to do the following:

- On or before September 1, 2025, "provide written guidance on performance standards for persons, associations, partnerships, corporations, or other entities engaged in the business of producing microstamping components";[5]

- On or before January 1, 2026, commence accepting applications for licensing such entities that produce microstamping components that meet DOJ performance standards;[6]
  On or before July 1, 2026, provide grants or enter into contracts with one or more entities licensed to produce microstamping components that meet DOJ performance standards to make those microstamping components available for sale or other distribution at a reasonable cost to firearm manufacturers, licensed firearms dealers, and gunsmiths engaged in the business of

1 Cal. Pen. Code, § 27531, subd. (b). All further statutory references are to the California Penal Code, unless otherwise noted.
2 Section 27531, subd. (a).
3 Section 27533. See also, Section 27531, subd. (c) (defining "Microstamping-enabled"). This microstamping requirement under Penal Code Section 27533 is subject to certain exceptions, including for semiautomatic pistols manufactured or delivered to the dealer prior to January 1, 2028, and for private party firearms transactions conducted through a licensed firearms dealer.
4 Section 27532, subd. (a).
5 Section 27532, subd. (b). This guidance on performance standards "shall include processes and standards for those entities [engaged in the business of producing microstamping components] to demonstrate that a representative sample of the microstamping components they manufacture produce legible microstamps with reasonable reliability, including after repeated firing."
6 Section 27532, subd. (c).

installing microstamping components in California;[7] and

- On or before July 1, 2027, make a determination regarding whether microstamping components are available at commercially reasonable prices from licensees producing microstamping components and/or whether "options of microstamping-enabled firearms are readily available for purchase" in California.[8]

If the Department determines that microstamping components or microstamping-enabled semi-automatic firearms are available, then on January 1, 2028, a licensed firearms dealer would become prohibited from selling, offering for sale, exchanging, giving, transferring, or delivering a semiautomatic pistol, unless the pistol has been verified as a microstamping-enabled pistol.

III. Fired Component Examination and Identification

Standard forensic firearms examination includes evaluation of microscopic marks imparted on fired components of ammunition. Ammunition cartridges are composed of a cartridge case, primer, propellant (gunpowder), and a projectile (bullet).

a. Incidental Marks

When a cartridge is fired, microscopic marks are transferred from the firearm to the cartridge case. These marks are typically from the firearm's breech face, chamber, and firing pin. Standard forensic examination of fired components includes microscopic evaluation of the marks produced by the firearm and transferred to the cartridge case during the cycle of fire. These marks are visually compared on multiple fired cartridge cases to try to determine if the same weapon left the same distinct marks on different fired cartridge cases. These marks are sometimes referred to as "incidental marks."

Incidental marks can include distinctive lines, dents, or scratches that are caused by characteristics unique to a specific firearm, such as tiny imperfections and irregularities on the firearm's parts—such as the firing pin or barrel—that were produced randomly during manufacture or from subsequent wear and tear.[9] A typical scenario includes a firearm recovered from a suspect being test-fired by forensic examiners. The test-fired cartridge cases are compared to fired cartridge cases found at a crime scene. Microscopic evaluation and comparison of the test-fire cartridges with those found at a crime scene could link the cartridge cases to a common source weapon, if the microscopic lines, dents, scratches, or other marks are deemed sufficiently similar. This comparison analysis would require recovering and testing the specific firearm used in the offense.[10]

The authors of a 2008 study evaluating microstamping components ("The Howitt Study") observed the following about forensic analysis of incidental marks: "[E]jected cartridge cases are one of the key pieces of evidence used in solving firearm-related crimes. More precisely, it is the microscopic markings, such as those impressed onto the back of the cartridge case by the firing pin, that forensic firearms examiners scrutinize in order to determine whether an identification with the crime gun can

7 Section 27532, subd. (d).

8 Section 27532, subd. (e). If DOJ determines that microstamping components or microstamping-enabled firearms are available pursuant to Section 27532, subd. (e), then DOJ is also required make publicly available a list of all licensees producing microstamping components meeting DOJ's performance standards and to notify licensed firearms dealers, gunsmiths, and manufacturers operating within California of the list of available microstamping component producers. DOJ is also required to update its determination and the list of licensees producing microstamping components annually thereafter. Section 27532, subd. (f).

9 *See, e.g.*, Association of Firearm and Tool Mark Examiners, "What is Firearm and Tool Mark Identification: Cartridge Case & Projectile Examination," www.afte.org/about-us/what-is-afte/what-is-firearm-and-tool-mark-identification.

10 See, e.g., Andrew Punzo, Comment, "Microstamping: Hot Lead or Dud Round?," 49 Seton Hall L. Rev. 375, 377 (2018).

be made. This examination and comparison process is highly meticulous, time consuming and requires a forensic scientist with specialized equipment, training and experience."[11]

b. Intentional Marks ("Microstamping")

Microstamping (sometimes referred to as "intentional firearm microstamping") seeks to supplement the forensic firearm examination tools described above by laser-engraving a unique microscopic code on a firearm's firing pin so that it stamps intentional, as opposed to incidental, marks on cartridge cases when a firearm is fired.[12] The goal of this technology is to cause firearms to intentionally stamp a microscopic signature unique to that firearm, similar to a license plate or serial number, on cartridge casings discharged by that firearm.[13]

Inventors Todd Lizotte and Orest Ohar developed microstamping component technology in the 1990s while developing microidentification and micromachining technologies for the electronic and computer industries.[14] The Howitt Study, discussed above, stated that the inventors "developed a micro-machining technology that utilized a solid-state ultraviolet laser to machine an array of microscopic characters onto the tip of a firearm's firing pin,"[15] and that this "method is similar to that used to engrave codes on computer chips."[16]

These lasers form microscopic "embossing structures"— a unique microscopic code—on the face of the firing pin, which is the area that makes contact with the primer or rim of the cartridge case when the weapon is fired.[17] The Howitt Study observed that:

> By normal standards, the tip of a firing pin is small (typically about 0.075 inches in diameter), however in the micro-machining world this diameter is sufficiently large enough that a wide variety of letters, numbers, symbols and or barcodes can be machined on its surface. These characters are not readily visible to the naked eye, but can be easily viewed under an optical microscope at approximately 20 times magnification or with a scanning electron microscope (SEM).[18]

11 D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 6 (2008).

12 *See, e.g.*, TacLabs, "What is Microstamping: How Does IFM Work?", https://tac-labs.com/forensics/home/what-is-microstamping/how-ifm-works/; D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 6 (2008). The inventors of microstamping technology secured a series of patents for intentional firearm microstamping between 2004 and 2007, which are now in the public domain. *See* New Jersey Office of the Attorney General, 2024 Microstamping Viability Report, p. 6, https://www.nj.gov/oag/safe/downloads/2024-0227_Microstamping-Viability-Report-and-Appendices.pdf (citing U.S. Patent No. 6,833,911 B2 (filed Feb. 21, 2003) (issued Dec. 21, 2004); U.S. Patent No. 6,886,284 B2 (filed Aug. 29, 2002) (issued May 3, 2005); U.S. Patent No. 2006/0174531 A1 (filed May 1, 2003) (issued Aug. 10, 2006); U.S. Patent No. 7,204,419 B2 (filed Jul. 18, 2003) (issued Apr. 17, 2007)).

13 *See, e.g.*, TacLabs, "What is Microstamping: How Does IFM Work?", https://tac-labs.com/forensics/home/what-is-microstamping/how-ifm-works/; D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 6 (2008).

14 *See, e.g.,* Andrew Punzo, Comment, "Microstamping: Hot Lead or Dud Round?," 49 Seton Hall L. Rev. 375, 377 (2018) (citing An Act Concerning the Identification of Certain Firearms and the Criminal Possession of Firearms, Coalition to Stop Gun Violence: SB 607 Before the J. Comm. on the Judiciary, 2008 Leg., Reg. Sess. 15 (Conn. 2008) (statement of Josh Horwitz, Executive Director of the Coalition to Stop Gun Violence), https://www.cga.ct.gov/2008/JUDdata/Tmy/2008SB00607-R000317-The%20Coalition%20to%20Stop%20Gun%20Violence,%20Josh%20 Horwitz-TMY.PDF)).

15 D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 16 (2008).

16 *See id.* at 6.

17 *See, e.g.*, TacLabs, "What is Microstamping: How Does IFM Work?", https://tac-labs.com/forensics/home/what-is-microstamping/how-ifm-works/.

18 D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 16 (2008).

The firing pin is part of the internal firing mechanism in a firearm. When the firearm's trigger is pulled, the firing pin strikes the primer or rim of a cartridge case and causes the bullet to fire.

When the face of the firing pin strikes the primer or rim of the cartridge case, the unique laser-machined code structures engraved on the firing pin are intended to stamp a corresponding impression (a "microstamp") onto the cartridge case that could serve as a unique identifier when that cartridge case is recovered at a crime scene.[19]

This is similar to incidental marks imparted onto fired cartridge cases evaluated in standard forensic firearms examinations. However, by imparting intentional marks unique to the firearm, microstamps could provide more information to forensic analysts, even if some portion of the microscopic code is not fully imprinted and even if a suspect firearm had not yet been recovered for further forensic testing.

Different types of microstamp code structures have been produced and tested, including microscopic codes consisting of alphanumeric characters engraved in the center of the firing pin, as well as radial barcode lines, dot codes, and geometric "gear codes" engraved around the circumference of the firing pin.[20] The Howitt Study noted that "[t]hrough continuous testing and development, this technology has progressed from a basic alphanumeric code laser-machined on the face of the firing pin (known as first-generation firing pins) utilizing a masking method, to the current direct-writing process that can place three different encoding formats on a given firing pin: an alphanumeric code, a gear code, and a radial bar code. (The latter are known as second-generation firing pins)."[21] The inventors of this technology describe the non-alphanumeric codes, such as the gear code, engraved on the circumference of the firing pin as corresponding to and confirming the alphanumeric code; this additional microstamp information is intended to serve as a supplementary fail-safe to communicate the same information to a forensic examiner as the alphanumeric code. "If the alpha-numeric characters are deformed, or partially removed due to the firing and cartridge ejection process" for instance, "the gear code could provide important information that could either fill in any gaps in a distorted alpha-numeric code, or be used to replicate the code if the alpha-numeric identifier is entirely illegible."[22]

19 *See id.*; TacLabs, "What is Microstamping: How Does IFM Work?", https://tac-labs.com/forensics/home/what-is-microstamping/how-ifm-works/.

20 *See* D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 17 (2008); L.S. Chumbley, *et al.*, "Clarity of Microstamped Identifiers as a Function of Primer Hardness and Type of Firearm Action," Association of Firearm & Tool Mark Examiners (AFTE) Journal, Vol. 44, No. 2, pp. 145, 147 (2012) ("The gear code is deciphered by dividing the circular code into eight equal sectors, excluding the wedge at the top of the gear code in Figure 1. Beginning at the wedge, the code is read clockwise. Within each sector, the notches are read as a six-bit binary code. For example, the first sector is read as 011001, which corresponds to the letter "S" and the first identifier in the alphanumeric code.").

21 *See* D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 6 (2008).

22 *See* T. Grieve, *et al.,* "Gear Code Extraction from Microstamped Cartridges," Association of Firearm & Tool Mark Examiners (AFTE) Journal, Vol. 45, No. 1, p. 64-65 (2013).

The images below are taken from the Howitt Study and show different types of microstamping code structures engraved on the tip and circumference of a firing pin. (The DOJ added the blue arrows to point to the alphanumeric code engraved on the face of the firing pin).

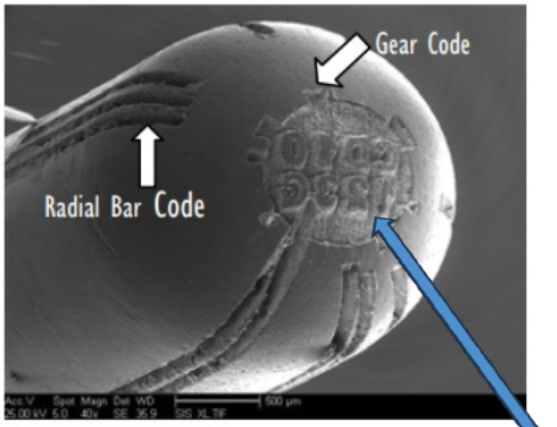

Figure 1

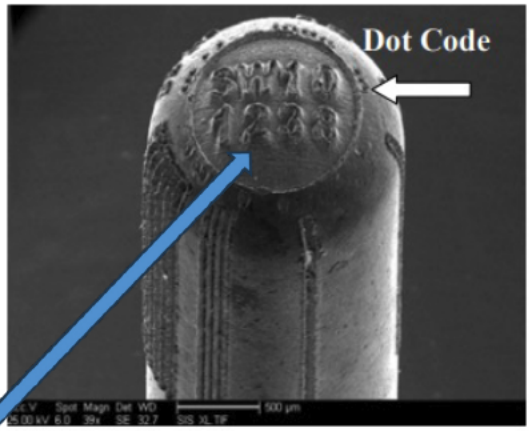

Figure 2

Alphanumeric Code

Alphanumeric characters have been engraved in two different formats, as shown in the images above: if the characters are engraved to be legible from left to right on the face of the firing pin, as in the image on the right, the impressions stamped on the cartridge case will appear backwards. If the alphanumeric characters are engraved backwards on the firing pin, as in the image on the left, the microstamped impression would be more directly legible from left to right on the cartridge case when viewed under a microscope.[23]

IV. Technological Viability of Intentional Microstamping Components

Penal Code section 27532, subdivision (a) requires the DOJ to "determine the technological viability of microstamping components producing microstamps on spent cartridge casings discharged by a firearm into which the microstamping component has been installed." For the purposes of this determination, the DOJ considered whether microstamping components installed in semiautomatic pistols, such as firing pins engraved with a unique, identifiable alphanumeric code, have been shown to successfully transfer all or some of the engraved information from the microstamping component onto cartridge cases fired by that firearm.[24]

As set forth below, based on the DOJ's review of relevant studies, observation of live-fire testing, and input letters received from relevant stakeholders, the answer is yes: firing pins engraved with microstamp codes have been shown to regularly and successfully transfer identifiable microscopic character information from the firing pin to the expended cartridge case, including after sustained or repeated firing.

23 *See* D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 17 (2008).

24 Most studies have evaluated the performance of firing pins engraved with a microscopic array of alphanumeric characters. In May 2013, DOJ issued a certification that the microstamping technology used to imprint these characters was available to more than one manufacturer unencumbered by any patent restrictions, and DOJ promulgated regulations (pursuant to now repealed provisions of the Unsafe Handgun Act) to require new semiautomatic pistol models to incorporate microstamping mechanisms that imprinted an 8-12 character alphanumeric microstamp. See Cal. Code Regs., tit. 11, § 4049, subd. (j). Tac-Labs and its president and CEO, Todd Lizotte, have produced microstamping firing pins engraved with both alphanumeric characters and other supplementary code structures, including a "gear code" around the circumference of the firing pin, intended to correspond to and confirm the alphanumeric code.

a. Independent Studies Find that Intentional Microstamping is Technologically Viable:

The DOJ identified and reviewed the limited number of research studies that have been published evaluating the performance of microstamping components, which include peer-reviewed articles published in the Association of Firearm and Tool Mark Examiners ("AFTE") Journal and the 2008 Howitt Study conducted by the University of California at Davis, Forensic Science Graduate Group.[25]

All the studies the DOJ reviewed, including the studies cited by stakeholder input letters, demonstrate that intentional microstamping technology produces identifiable alphanumeric and/or gear code structures on the firing pin that can be regularly transferred and imprinted onto spent cartridge casings fired by firearms in which the firing pin is installed.

i. The Chumbley Study (2012)

The most recent and comprehensive peer-reviewed study evaluating microstamping components was a 2012 study (the "Chumbley Study") funded by the U.S. Department of Justice evaluating the performance of microstamping firing pins in transferring a six-character alphanumeric microstamp on cartridge cases fired by three different semiautomatic pistol models: the Sig Sauer model P226, Taurus model PT609, and Hi-Point model C9.[26] (As discussed below, authors from the 2012 Chumbley Study also conducted a more limited follow-up study in 2013 (the "Grieve Study"), which examined some of the same cartridge cases from the Chumbley Study using more advanced imaging techniques to identify additional microstamp information).[27]

The Chumbley Study's authors stated the three semiautomatic pistol models tested "were selected to represent a range of performance and ejection properties" with firing actions "typical of the types that leave fired cartridges at crime scenes," and noted that these models also represented high, medium, and lower market price points.[28] The researchers fired each handgun 1,000 times, using 10 different types and brands of ammunition with a range of cartridge and primer materials.[29] After firing, the primers of the cartridges were examined and graded as to the quality of the microstamped impression by two separate examiners. The examination involved use of a stereomicroscope[30] equipped with

25 See the References Section at the end for a list of these peer-reviewed articles.

26 L.S. Chumbley, *et al.*, "Clarity of Microstamped Identifiers as a Function of Primer Hardness and Type of Firearm Action," Association of Firearm & Tool Mark Examiners (AFTE) Journal, Vol. 44, No. 2, pp. 145-155 (2012). The DOJ acknowledges—as the New Jersey Attorney General's Office observed in its report on microstamping viability—that the co-inventors of microstamping were among the seven co-authors of the Chumbley Study. See Office of the New Jersey Attorney General, Statewide Affirmative Firearms Enforcement (SAFE) Office, "2024 Microstamping Viability Report," p. 9, fn. 25 (Feb. 28, 2024), https://www.nj.gov/oag/safe/downloads/2024-0227_Microstamping-Viability-Report-and-Appendices.pdf. There were also five other members of this research team, including four members of Iowa State University and one retired member of the Illinois State Police. Additionally, the study was released in a peer-reviewed publication. Multiple entities submitting stakeholder input letters both in support of and opposition to a technological viability determination cited to this study's findings and conclusions. The co-inventors of microstamping components were also among the authors of the follow-up Grieve Study in 2013, which was similarly released in a peer-reviewed publication and cited by stakeholders both in support of and opposition to a technological viability determination.

27 *See* T. Grieve, *et al.,* "Gear Code Extraction from Microstamped Cartridges," Association of Firearm & Tool Mark Examiners (AFTE) Journal, Vol. 45, No. 1, p. 64-74 (2013).

28 *See* Chumbley, *et al.*, "Clarity of Microstamped Identifiers as a Function of Primer Hardness and Type of Firearm Action," Association of Firearm & Tool Mark Examiners (AFTE) Journal, Vol. 44, No. 2, 145, 147 (2012).

29 This study evaluated ten ammunition brands: Brown Bear (using cartridges made of lacquered steel with a brass primer), DAG (brass with brass primer), Federal – American Eagle (brass with nickel primer), Remington – UMC (brass with nickel primer), PMC (brass with brass primer), Silver Bear (zinc-plated steel with brass primer), CCI Blazer (aluminum with nickel primer), Cor-Bon (brass with nickel primer), Independence (brass with nickel primer), and Sellier & Bellot (brass with a brass primer covered with red lacquer sealant*). Id.* at 148.

30 A stereomicroscope is a simple optical microscope designed for low magnification observation, typically by using light reflected from the surface of an object to produce a three-dimensional visualization of the sample being examined.

a polarized light for illumination and a simple rubric where two examiners recorded the number of characters that were clearly visible under the stereomicroscope on each cartridge case.[31] The first examiner was instructed to be strict in making his assessment, indicated that all six alphanumeric characters were legible only if "all six characters were clearly visible" on the spent cartridge case under the stereomicroscope. A rating that only three of the six characters were legible "would mean only three characters could be read easily immediately." The second examiner had no training in forensic examinations and this examiner's examination also involved examination under a stereomicroscope with a polarized light source.

Both examiners found that across 1,000 test-fires, all six alphanumeric characters were successfully transferred and legible under the stereomicroscope on a large majority of cartridge cases fired by all three semiautomatic pistol models.

Both examiners found some variation in performance depending on the type of firearm and ammunition used, and observed a relationship between the price point of the firearm and microstamp transfer; the higher-priced pistol models more frequently imprinted all six characters in a manner that was clearly legible under a stereomicroscope.[32] One ammunition brand using a heavy lacquer sealant covering the primer prevented clear observation of the microstamp characters for cartridge casings ejected from the Taurus and Hi-Point pistols.[33]

However, across 900 test fires for each firearm model involving nine other ammunition brands, all six alphanumeric characters were rated as successfully transferred and clearly visible under a stereomicroscope by both examiners on 98.1% of cartridge cases fired by the Sig Sauer pistol model, 94.2% fired by the Taurus pistol model, and 73.7% fired by the Hi-Point pistol model.[34] Five of the six alphanumeric characters were rated as successfully transferred and clearly visible by both examiners on 99.4% of the 900 cartridge cases fired by the Sig Sauer, 98.8% fired by the Taurus, and 88.6% fired by the Hi-Point.[35] Four of the six alphanumeric characters were rated successfully transferred and clearly visible by both examiners on 99.4% of the 900 cartridge cases fired by the Sig Sauer, 99.3% fired by the Taurus, and 94.3% fired by the Hi-Point.[36]

The lacquer sealant covering the primer on one type of ammunition cartridge prevented clear observation of the characters for cartridge casings ejected from the Taurus and Hi-Point pistols. Across 100 test fires from the Sig Sauer model using this lacquered ammunition, the examiner found all six characters were clearly visible on 61% of cartridge cases and at least five out of six characters were clearly visible on 83%.[37] After the lacquer was removed, for this ammunition type, all six alphanumeric characters were rated as clearly legible on 56% of the Taurus and 49% of the Hi-Point fires, and at least five out of six characters were rated as clearly legible on 82% of the Taurus and 64% of the Hi-Point fires.[38]

These findings do not indicate that 100% of the microstamped characters were clearly decipherable on 100% of fired cartridge cases under stereoscopic examination. As the study authors noted, "the interaction of any particular brand of ammunition with any given firearm is stochastic in nature.

31 See *id.* at 148.
32 See *id.* at 149.
33 See *id.* at 149-50. Some ammunition manufacturers apply a lacquer sealant over the primer to prevent moisture or other matter from seeping inside the cartridge and preventing ignition.
34 See *id.* at 151-52 (with two raters reporting all six characters clearly visible on 887 and 883 out of 900 cartridges fired by the Sig Sauer model, 848 and 854 out of 900 fired by the Taurus, and 663 and 684 out of 900 fired by the Hi-Point).
35 *Id.* (reporting at least five out of six characters clearly visible on 895 and 892 out of 900 cartridges fired by the Sig Sauer model, 891 and 889 out of 900 fired by the Taurus, and 797 and 802 out of 900 fired by the Hi-Point).
36 *Id.* (reporting at least four out of six characters clearly visible on 899 and 895 out of 900 cartridges fired by the Sig auer model, 894 and 894 out of 900 fired by the Taurus, and 849 and 862 out of 900 fired by the Hi-Point).
37 *Id.* at 149-50.
38 See *id.* at 149-50.

Such a variable process prevents perfect transfer in all cases[.]"[39] Nonetheless, even when using a "conscientiously conservative" approach to identifying a microstamp character as legible under a stereomicroscope, this study found that the evaluated microstamping components clearly imprinted all of a six-character alphanumeric code on most cartridge cases fired by a range of semiautomatic pistol models using a range of ammunition types, and successfully transferred most of the code on an even larger majority of fired cartridge cases. [40]

The Chumbley Study authors also noted that using more advanced imaging techniques than stereoscopic examination could help identify more microscopic characters on a single cartridge. After optical examination under a stereomicroscope, the Chumbley Study authors selected some of the lower-scoring cartridges for examination using a more advanced scanning electron microscope (SEM), and observed that "SEM imaging in many cases could reveal more of the identifier and gear code than was visible using simple optics." They also noted that "[p]revious studies have shown that a combination of better imaging, examination of multiple cartridges from the same weapon and a careful analysis of the gear code can bring out additional information that is not immediately obvious by a simple examination" under a stereomicroscope.[41]

ii. The Grieve Study (2013)

The Grieve Study was conducted as a follow-up to the Chumbley Study the following year.[42] The study authors examined 26 cartridge casings that the Chumbley Study graded as *not* imprinting all six alphanumeric characters in a manner that was "clearly legible" under a stereomicroscope. The researchers examined the same cartridge cases using a more advanced scanning electron microscope (SEM) and concluded that "using the SEM as an evaluation tool measurably increased the number of visible alpha-numerics, irrespective of the gear code."[43]

More specifically, the authors found that using the SEM microscope alone increased the number of visible alphanumeric characters on 24 out of these 26 cartridges, including on all four cartridges from these 26 that had previously been graded as having zero clearly legible alphanumeric characters under a stereomicroscope.[44] When using both SEM and the gear code to confirm or supplement the alphanumeric characters, 10 of these 26 cartridges were found to have all six characters clearly visible.[45] The study did document limitations and challenges in transferring all of the gear code, which is intended as a fail-safe to confirm or complete missing alpha-numeric characters: "While large pieces of the gear code did not transfer in many cases, SEM evaluation greatly improved the clarity ratings for nearly all selected cartridges."[46]

39 See *id*. at 155.
40 See *id*. at 151-52, 155.
41 *Id*. at 148-49. See also, e.g., TacLabs, "What is Microstamping: Technology Used to Extract IFM Codes from Cartridges?", https://tac-labs.com/forensics/home/what-is-microstamping/how-ifm-works/; Coalition to Stop Gun Violence & Educational Fund to Stop Gun Violence, "Microstamping Technology: Precise and Proven" (Jun. 2013), https://efsgv.org/wp-content/uploads/2013/06/Microstamping-Technology-Precise-and-Proven-Memo.pdf.
42 *See* T. Grieve, *et al.,* "Gear Code Extraction from Microstamped Cartridges," Association of Firearm & Tool Mark Examiners (AFTE) Journal, Vol. 45, No. 1, p. 64-74 (2013).
43 *Id*. at 72. The study also observed limitations in using the gear code to confirm alphanumeric characters and identified areas meriting future study specifically for improving and optimizing the gear code.
44 *See id*. at 74, Table IV.
45 *See id*.
46 *Id.* at 74.

iii. The Howitt Study (2008)

The Howitt Study was conducted by the University of California at Davis, Forensic Science Graduate Group, and evaluated the performance of multiple microstamping character formats (including arrays of eight alphanumeric characters, radial bar codes, gear code, and dot code structures) engraved on firing pins installed in five semiautomatic pistol models of varying make, model, and caliber, as well as two semi-automatic rifles and one pump action shotgun.[47] The authors also tested a variety of ammunition brands with each firearm.[48] Every cartridge case was analyzed optically utilizing a stereomicroscope. The authors noted that they did not investigate the use of alternative imaging methods to identify characters that were not fully transferred under a stereomicroscope, and also did not use other microstamp information (such as the gear code) to confirm or decipher the alphanumeric characters.[49]

The Howitt Study counted an alphanumeric character as successfully transferred only if the character was "fully legible; partial character transfers were not counted."[50]

- For the Smith and Wesson Model 4006, .40 S&W, the alphanumeric characters showed an average overall transfer rate of 90%. The percentage of characters transferred on any one cartridge case ranged from 38% to 100%.[51]

- For the SeeCamp, .25 ACP-LWS, the alphanumeric characters showed an average overall transfer rate of 78%, even though most of the cartridge cases showed multiple strikes of the firing pin within the same firing pin impression.[52] The percent transfer for any one cartridge case ranged from 13% to 100%.[53]

- For the AMT "Backup," .380, the alphanumeric characters showed an average overall transfer rate of 95%.[54] The percent transfer for any one cartridge case ranged from 25% to 100%.[55]

- For the Sig Sauer P229, .40 Caliber semi-automatic pistol, the alphanumeric characters showed an average overall transfer rate of 94%.[56] The percentage of characters transferred on any one cartridge case ranged from 0% to 100%.[57]

- For the Colt 1911 Government Model, .45 ACP semi-automatic pistol, the alphanumeric characters showed an average overall transfer rate of 76%.[58] The percentage of characters transferred on any one cartridge case ranged from 0% to 100%.[59]

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47 D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 8 (2008). The firearms tested were: a Smith and Wesson Model 4006, .40 S&W semi-automatic pistol; Ruger Mark I, .22 Long Rifle (rimfire semi-automatic pistol); SeeCamp, .25 ACP-LWS (semi-automatic pistol); AMT " Backup", .380 auto (semi-automatic pistol) ; Sig Sauer P229, .40 Caliber (semi-automatic pistol); Colt 1911 Government Model, .45 ACP (semi-automatic pistol); Colt AR-15, .223 Caliber (semi-automatic rifle); Norinco AK-Series, 7.62x39mm (semi-automatic rifle); and Mossberg 500, 12 gauge (pump action shotgun).
48 *Id*. at 44
49 *Id.* at 23, 44.
50 *Id.* at 23.
51 *Id.* at 32.
52 *Id.*. at 34.
53 *Id.*.
54 *Id.*. at 35.
55 *Id.*.
56 *Id*. at 36.
57 *Id*.
58 *Id* at 37.
59 *Id*.

- The one rimfire model examined, the Ruger MK I, .22LR Semi-Automatic Pistol, showed a much lower transfer rate than the above-described centerfire models. The authors determined that a maximum of five out of the eight alphanumeric characters could contact the rim of the cartridge case, and reported that the average overall transfer rate for legible alphanumeric characters was 16% for this firearm, with the percentage of characters transferred on any one cartridge case ranging from 0% to 38%.[60]

The authors observed that, "[a]s shown, while the technology works with some firearms, it does not perform equally well for every encoding structure or for every semiautomatic handgun tested."[61] While they found comparatively lower character transfer rates for radial bar code and dot code formats, the authors concluded that "the alphanumeric encoding format has the potential to reliably transfer information from the firing pin to the cartridge case, thereby facilitating the identification of crime guns outfitted with micro-stamping technology."[62]

The Howitt Study also tested the durability and longevity of these code structures, including by firing six different Smith & Wesson semi-automatic pistols equipped with microstamping firing pins 2,500 times,[63] which the authors "felt to be adequate in comparison to the average number of rounds of ammunition fired over the lifetime of most semi-automatic pistols."[64] Certain microstamping formats (bar code structures and dot code structures) were found to be more susceptible to degradation from repeated firing. However, "[o]verall, the alphanumeric characters and the gear code structures proved to be capable of withstanding repeated firing," although "some degradation of the structures was seen with specific firearms." [65] The authors concluded that "The concept of laser-machined micro-characters on firing pins . . . can be a feasible technology."[66]

iv. The Krivosta Study (2006)

A study published in 2006 (the "Krivosta Study") evaluated the performance of the same microstamping-engraved firing pin removed and installed in 10 different "Government Model pistols of varying manufacturers and vintages" after each weapon had been fired 10 times with the same ammunition.[67] The microstamp impression was graded as "Satisfactory" if all eight of the alphanumeric characters engraved on the firing pin were found to be "decipherable" under this microscope, and the impression was graded as "Unsatisfactory" if one or more of the characters was found to be "un-decipherable" under this microscope.

The author found that all eight alphanumeric microstamp characters were transferred and decipherable ("Satisfactory") on 54 of the 100 discharged cartridge cases.[68] On the other 46, at least one of the eight characters was determined not to be decipherable under stereoscopic examination. The study did not report information about how many of the eight characters were legible on those remaining 46 cartridges, except to provide nine example images. Many of those images show what the study describes as "overlapping firing pin impacts" in which the firing pin struck the cartridge case more than once, essentially double stamping the microstamp in a manner that affected legibility of at least some characters.[69]

60 *Id*. at 33.
61 *Id*. at 8.
62 *Id*. at 10.
63 *Id*. at 7, 19-20, 25-26, 43.
64 *Id*. at 26.
65 *Id*. at 43.
66 *Id*. at 43.
67 *See* G. Krivosta, "NanoTag Markings from Another Perspective," AFTE Journal, Volume 38, Number 1, Winter 2006, pp. 41, 43. The study used "Winchester brand .45 auto caliber cartridges."
68 *Id*. at 43.
69 See *id*. at 45-46.

Compared to the 2012 Chumbley Study and 2008 Howitt Study referenced above, the 2006 Krivosta Study was older and examined earlier-generation microstamping technology. The 2008 Howitt Study described the Krivosta Study as conducting "[p]roof of concept testing" on "first-generation engraved firing pins" and observed that "[s]ince the advent of this technology, [the inventor] has continuously made changes to the morphology and arrangement of the micro-characters," and that "[t]hrough continuous testing and development, [microstamping] technology has progressed" to second-generation engraved firing pins.[70]

Compared to the Chumbley and Howitt studies, the Krivosta Study also examined a smaller number of microstamped cartridge casings, did not seek to optimize the firing pin for use in the firearms in which they were installed, and provided much less comprehensive information about the observed results. For example, this study did not report information about the number of cartridge cases on which some or most of the alphanumeric characters were legibly transferred under a stereomicroscope and, unlike the Chumbley Study and Grieve Study, did not evaluate whether more advanced imaging techniques could help extract additional information from partially transferred or overlapping microstamps.

Stakeholder input letters recommending against a technological viability determination relied in significant part on the Krivosta Study, noting that it found a lower percentage of microstamps fully legible under a stereomicroscope than the Chumbley Study or the Howitt Study on average. For the reasons described above, there were multiple reasons to place greater weight on other more recent and comprehensive studies' findings. But the Krivosta Study also demonstrated that on a majority of cartridge cases fired by a range of pistol models, a single "first-generation" microstamping component successfully imprinted all eight alphanumeric characters in a manner that was decipherable under a stereomicroscope, without using more advanced imaging techniques or supplementary code structures to identify additional information. As a result, the DOJ determined that the Krivosta Study was not inconsistent with the other more recent and comprehensive studies' findings that microstamping components are technologically viable.

b. Live-Fire Demonstrations Demonstrate that Intentional Microstamping is Technologically Viable

While all the studies referenced above are over a decade old, the standard techniques used in these studies are still in use today. The studies' findings are also reinforced by the results of recent live-fire demonstrations of microstamping components' performance conducted by the DOJ in February 2025 and by the State of New Jersey's Office of the Attorney General in 2023.

i. 2025 DOJ Demonstration

During a visit with TacLabs in New Hampshire in February 2025, DOJ representatives observed live fire demonstrations using ammunition provided by the DOJ. The firearms observed included a .45 caliber Smith and Wesson Model 1911 and a Gen 5, 9 mm Glock 43, which were both equipped with microstamping firing pins engraved by TacLabs.[71] Ten rounds of each caliber were fired into a "snail" trap[72] and the expended cartridge cases were collected by DOJ representatives for transportation to and examination by the DOJ's Bureau of Forensic Services (BFS). BFS's subsequent examination of the expended cartridge cases demonstrated that intentional microstamps were transferred.

70 D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 16 (2008).

71 DOJ had also requested to observe and document test fires from a 22-caliber rim fire pistol but only received images from previous tests as TacLabs was unable to acquire the necessary firearm in time for the live-fire demonstration.

72 A snail trap is a firearms bullet trap that utilizes deflection ramps and a circular deceleration chamber to slow a fired bullet over a short distance and collect the fired projectile in a collection bin.

Images of all expended cartridge cases from this test are presented in Appendix A. The images were photographed utilizing a comparison firearms microscope with polarization filters to minimize glare. Though photographed with a comparison microscope, the images are similar to those that would be observed using a stereomicroscope and polarization. For each cartridge case, an overall photograph at low magnification is shown, along with a close-up of each microstamp on the cartridge primer. As the impression on the cartridge primer will be a mirror image of the firing pin microstamp, the close-up image was also flipped horizontally to show characters in a left-to-right orientation for easier viewing of standard English alphanumeric characters.

The microstamping component installed in the Gen 5 Glock 9mm produced a fully transferred microstamp on all ten fired cartridge cases. Though areas of firing pin drag were observed, and characters on the outside margins of the top row of 4 characters would need further evaluation to resolve, the alphanumeric characters were successfully imprinted in enough detail to narrow the list of characters if only a single cartridge case was examined. The full microstamp identifier was observable when evaluated over all ten items. One cartridge case demonstrated a double stamp similar to a "knock" or "stutter" which resulted in the microstamp being imprinted twice and slightly shifted. The characters in this cartridge case could still be resolved. Gear code information was also observed on several of the cartridge cases. Though not verified with TacLabs, the characters observed are:

TOP: C 5 2 3
BOTTOM: A V S J

The .45 Caliber, Model 1911 demonstrated less clarity of the alphanumeric characters in most expended cartridge cases. Evaluation of a single cartridge case may not lend a full, legible microstamp under a stereo microscope, but evaluation of all ten items provided sufficient information to discern the alphanumeric information. In this case, the gear code information was fully and clearly transferred in every fired cartridge case regardless of the clarity of the alphanumeric characters. The firing pin impressions for these items demonstrated similar issues with areas of drag and double impressions rendering some of the items unclear except for two or three of the eight characters.

The gear code and alphanumeric stencil were copied from the stencil obtained from the New Jersey study as they appear to be the same firearm. Though the characters were observed on the stencil prior to evaluation of the DOJ test fires, the characters are discernable from the ten items as:

TOP: C 5 2 3
BOTTOM: A V< J

The only character that was difficult to resolve was the "<" which could be similar to a "C", "K", or other symbol not resolvable by a template or guide.

In both cases, evaluation of the ten items for each firearm provided sufficient information to allow an examiner to narrow the list of possible registered firearms based on intentional toolmarks left by a microstamped firing pin. Coupled with traditional firearms toolmark analysis, the examiner would have more information about the likelihood of the cartridge case having been expended in the firearm.

These examinations utilized microscopy and photography to document and analyze the expended cartridge cases. More advanced technology, such as three-dimensional imaging, may provide more information including correlation coefficients and statistical probabilities based on intentional and unintentional marks left on fired cartridge cases.

ii. 2023 New Jersey Attorney General's Office Demonstration

The New Jersey Attorney General's Office conducted a live-fire microstamping demonstration in 2023 and issued a report in 2024 that concluded that microstamping components were technologically viable.

New Jersey enacted legislation in 2022 requiring the state's Attorney General to, among other things, "complete an investigation concerning the technological viability of microstamping-enabled firearms" based in part on "live fire testing evidence."[73] Accordingly, the New Jersey Attorney General's Statewide Affirmative Firearms Enforcement Office ("SAFE") administered a live-fire test at the New Jersey State Police Technology Center in August 2023 using a 1991 Colt Commander semiautomatic pistol that had been fired over 1,800 times previously and was equipped with a microstamping firing pin engraved with both an eight character alphanumeric code and a supplementary gear code.[74] The pistol was fired 50 times using three varieties of ammunition. Two SAFE examiners then examined 10 of the 50 expended cartridge cases, including the first expended cartridge case, the fiftieth, three collected randomly during a rapid-fire shooting interval, and five collected randomly from the remaining intervals.

Based on this live fire test, SAFE reported that, "[i]n sum, eight of the ten samples reproduced the entirety of the gear code, as well as at least half of the alphanumeric characters. Of the remaining two samples, one reproduced 80% of the gear code and seven of eight alphanumeric characters—a significant amount of information to aid a forensic examiner in associating a cartridge with the gun from which it was fired. The other reproduced 50% of both the gear code and the alphanumeric characters, which although incomplete could nevertheless be useful to a forensic examiner."[75]

In February 2024, SAFE published a "Microstamping Viability Report" including the results of its research review and live fire test. The report recommended that the New Jersey Attorney General certify microstamping-enabled firearms as technologically viable. The conclusions from the report stated: "SAFE's factual findings support the conclusion that microstamping-enabled firearms are technologically viable. SAFE's live-fire testing of a prototype microstamping-enabled firearm showed a successful transfer of a readily associable geometric marker even after 50 rounds were fired. When the geometric marker transfer was not complete, the cartridge cases nonetheless contained substantial transfers of the geometric marker or alphanumeric characters that conveyed legible, associable information for forensic examiners."[76] Based on the factual findings of SAFE's investigation, as documented in the report, the New Jersey Attorney General issued a certification that "viable microstamping-enabled technology" exists.[77]

c. Stakeholder Input

In accordance with Penal Code section 27532, subdivision (a), DOJ's technological viability investigation included input from relevant stakeholders, who were formally invited by letter to provide written comments relevant to the Department's technological viability investigation. DOJ invited written input from California law enforcement associations, firearm and ammunition industry groups and manufacturers, gun violence prevention policy and advocacy organizations, firearm rights policy and advocacy organizations, the Association of Firearm and Tool Mark Examiners, and other entities identified in bill analyses as supporters or opponents of Senate Bill 452.

73 N.J.S.A. 2C:58-2.13(b)(2).

74 Office of the New Jersey Attorney General, Statewide Affirmative Firearms Enforcement (SAFE) Office, "2024 Microstamping Viability Report," p. 6-8 (Feb. 28, 2024), https://www.nj.gov/oag/safe/downloads/2024-0227_Microstamping-Viability-Report-and-Appendices.pdf.

75 *Id*. at p. 8.

76 *Id*. at p. 9.

77 State of New Jersey, Office of the Attorney General, "Certification of Microstamping Technology Viability Pursuant to L. 2022, c. 57, N.J.S.A. 2C:58-2.13 to -2.15" (Feb. 28, 2024), at https://www.nj.gov/oag/safe/downloads/2024-0228_Microstamping-Viability-Certification.pdf.

DOJ's communication inviting written stakeholder input emphasized that the scope of DOJ's investigation was limited to examining "the 'technological viability of microstamping components producing microstamps on spent cartridge casings discharged by a firearm into which the microstamping component has been installed.'" DOJ received informative responses and evaluated that stakeholder input as part of its investigation.

Entities writing in favor of, and in opposition to, a technological viability determination often cited to the same set of studies—the same studies summarized above. These entities simply drew different conclusions about whether the same performance data reported in those studies indicated technological viability. Multiple stakeholders that recommended against a viability determination emphasized that microstamping has not demonstrated the capacity for *perfect* transfer of all characters across all firearm and ammunition types. For example, stakeholders that were skeptical of microstamping technology's viability relied in significant part on the 2006 Krivosta Study that found that all eight alphanumeric characters were legibly imprinted on a majority (54%) of examined cartridge cases across 10 different pistol models.[78] As described above, even this older study evaluating earlier-generation microstamping components found that all eight characters were legibly imprinted a majority of the time across a range of pistol models without using more advanced imaging techniques or supplementary code structures to identify other information.

Similarly, some stakeholder comments quoted from the 2012 Chumbley Study's statement that microstamping "is not a perfect technology, even on optimized weapons." But in context, the rest of this same quoted sentence in the Chumbley Study stated that "readable microstamping was achieved on most of the cartridge cases[,]"[79] which indicates technological viability.

Stakeholders that were skeptical of technological viability also stressed the aforementioned studies' findings indicating that there is variability in microstamping character transfer and potential for degradation of transfer rates over time. However, the fact that some firearm and ammunition types imprint fully legible microstamps less often than others or over time does not indicate that microstamping is a non-viable technology. Overall, alphanumeric and geocode structure formats have indicated feasibility and durability after repeated firing.

Some stakeholders cited the 2008 Howitt Study's statement that, "while [microstamping] technology works with some firearms, it does not perform equally well for every encoding structure or for every semiautomatic handgun tested."[80] That conclusion is consistent with findings in other studies, such as the Chumbley Study, that microstamping technology is both imperfect and technologically viable. Again, while the Howitt Study found particularly low transfer rates for the one rimfire pistol evaluated, for all other semiautomatic pistols examined, the microstamping component transferred 76%, 78%, 90%, 94%, and 95% of the alphanumeric characters on average, depending on the pistol model. The Howitt Study evaluated the performance of multiple microstamping character formats and concluded that "the alphanumeric encoding format has the potential to reliably transfer information from the firing pin to the cartridge case, thereby facilitating the identification of crime guns outfitted with micro-stamping technology."[81]

As described above, the available evidence indicates that it is technologically viable for microstamping components to produce microstamps on spent cartridge casings discharged by a firearm into which

78 *See* G. Krivosta, "NanoTag Markings from Another Perspective," AFTE Journal, Volume 38, Number 1, Winter 2006, pp. 41-47.

79 L.S. Chumbley, *et al.*, "Clarity of Microstamped Identifiers as a Function of Primer Hardness and Type of Firearm Action," Association of Firearm & Tool Mark Examiners (AFTE) Journal, Vol. 44, No. 2, pp. 145, 155 (2012).

80 D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 11 (2008).

81 D. Howitt, PhD, *et al.*, "What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science: How Viable are Micro-Marked Firing Pin Impressions as Evidence?," p. 10 (2008).

the microstamping component has been installed. Stakeholders in favor of a viability finding provided comments that were aligned with the DOJ's assessment: microstamping is not a perfect technology to solve all firearm crimes, but is a viable technology that could help solve and prosecute more of them more often.

Multiple stakeholders writing in favor of a viability finding also emphasized the important fact that even a partial microstamp can provide very valuable investigative information that can be used to help solve and prosecute crimes, analogous to investigators receiving a partial license plate from a vehicle or a partial fingerprint from a crime scene. Even when the evidentiary information is not 100 percent complete, it may aid in narrowing down the possibilities and developing probabilistic leads and evidence. Microstamping may increase the probability of linking a firearm with cartridge evidence recovered at a crime scene even if the firearm itself has not yet been recovered and test fired.

The studies referenced above also treated each cartridge case as an isolated piece of potential evidence. If, as is often the case, forensic examiners had access to multiple cartridge cases fired at the same crime scene, they could also use partially completed imprints from multiple cartridges to develop probabilistic leads and evidence to identify an associated firearm and suspect. The microstamp could provide one additional investigatory and evidentiary tool available to complement other tools used to identify a possible suspect and build and prove a criminal case.

Multiple stakeholders and studies evaluated by DOJ also raised a range of practical and policy implementation concerns (or conversely, practical and policy implementation rationales for supporting microstamping-related mandates). These included concerns that it may be fairly easy to defeat the goals of microstamping technology if individuals with criminal intent simply remove and file down the microstamping mark on the firing pin in a manner analogous to the illegal obliteration of firearm serial numbers. Some stakeholders also expressed concern that Senate Bill 452 will divert scarce law enforcement resources from other public safety-related efforts to disarm illegally armed individuals and enforce other firearm statutes. However legitimate, these and other practical and policy implementation concerns are not directly relevant to a determination regarding "the technological viability of microstamping components producing microstamps on spent cartridge casings discharged by a firearm into which the microstamping component has been installed." (Pen. Code, § 27532, subd. (a).)

Some practical implementation concerns may also be further addressed by other DOJ actions mandated by Senate Bill 452. Upon completing this technological viability investigation, the DOJ is required to engage in further activities to develop performance standards, administer a new licensing process, and, subject to appropriation of funds for this purpose, award grants or contracts to entities that produce microstamping components and who demonstrate that "a representative sample of the microstamping components they manufacture produce legible microstamps with reasonable reliability, including after repeated firing." (Pen. Code, § 27532, subds. (b)-(d).) These processes will provide an opportunity for entities engaged in development, optimization, and production of microstamping components to demonstrate that their components meet specified minimum performance standards.

Finally, it is also worth emphasizing that under Senate Bill 452, any mandates to install qualifying microstamping components in semiautomatic pistols sold in the state will not take effect unless the DOJ makes an additional, separate determination in the future regarding the commercial availability of microstamping-enabled firearms or microstamping components that meet minimum performance standards. (Pen. Code, § 27532, subd. (e).) If the DOJ cannot determine that microstamping components that meet specified performance standards are available at commercially reasonable prices from licensed producers, or that microstamping-enabled firearms are otherwise readily available for purchase in California, then the requirement at Penal Code section 27533 will not take effect.

V. Conclusion

DOJ concludes that microstamping components are technologically viable pursuant to Penal Code section 27532, subdivision (a). Microstamping components have been shown to regularly produce microstamps on spent cartridge cases discharged by a semiautomatic pistol into which the microstamping component has been installed.

References:

AFTE Journal – Volume 38, Number 1—Winter 2006 (pgs 41-47)

NanoTag Markings from Another Perspective

By: George G. Krivosta[1]

1 Suffolk County Crime Laboratory, Hauppauge, New York

AFTE Journal--Volume 40 Number 3--Summer 2008 (pgs 245-274)

Micro-Marked Firing Pins: Their Character, Durability and Legibility on Fired Cartridge Cases

By: Michael T. Beddow, M.S.; David Howitt, Ph.D.; Frederick A. Tulleners, M.A.; and Michael F. Giusto, B.S., Graduate Program in Forensic Science, University of California, Davis, CA 95616

(Note: Tulleners and Giusto were employed by the California Department of Justice-Bureau of Forensic Services as Criminalists: Giusto during the time period the studies were completed, Tulleners was retired)

What Micro Serialized Firing Pins Can Add to Firearm Identification in Forensic Science:

How Viable are Micro-Marked Firing Pin Impressions as Evidence? (2008)

By: David Howitt, PhD, Frederic A. Tulleners, and Michael T. Beddow

Forensic Science Graduate Group-University of California, Davis

Funded by the California Policy Research Center-University of California released May, 2008

(Tulleners was a Criminalist previously employed by the California Department of Justice-Bureau of Forensic Services)

AFTE Journal--Volume 44 Number 2--Spring 2012 (pgs 145-155)

Clarity of Microstamped Identifiers as a Function of Primer Hardness and Type of Firearm Action

By: L.S. Chumbley[1], J. Kreiser[2], T. Lizotte[3], O. Ohar[3], T. Grieve[1], B. King[1], D. Eisenmann[1]

1 Iowa State University, Ames Laboratory, Ames, Iowa

2 Illinois State Police, Retired, Springfield, Illinois

3 Pivotal Development, LLC, Manchester, NH

AFTE Journal -- Volume 45 Number 1 -- Winter 2013 (pgs 64-74)

Gear Code Extraction from Microstamped Cartridges

By: T. Grieve[1], L.S. Chumbley[1], J. Kreiser[2], T. Lizotte[3], O. Ohar[3]

1 Iowa State University, Ames Laboratory Ames, Iowa

2 Illinois State Police, Retired, Springfield, Illinois

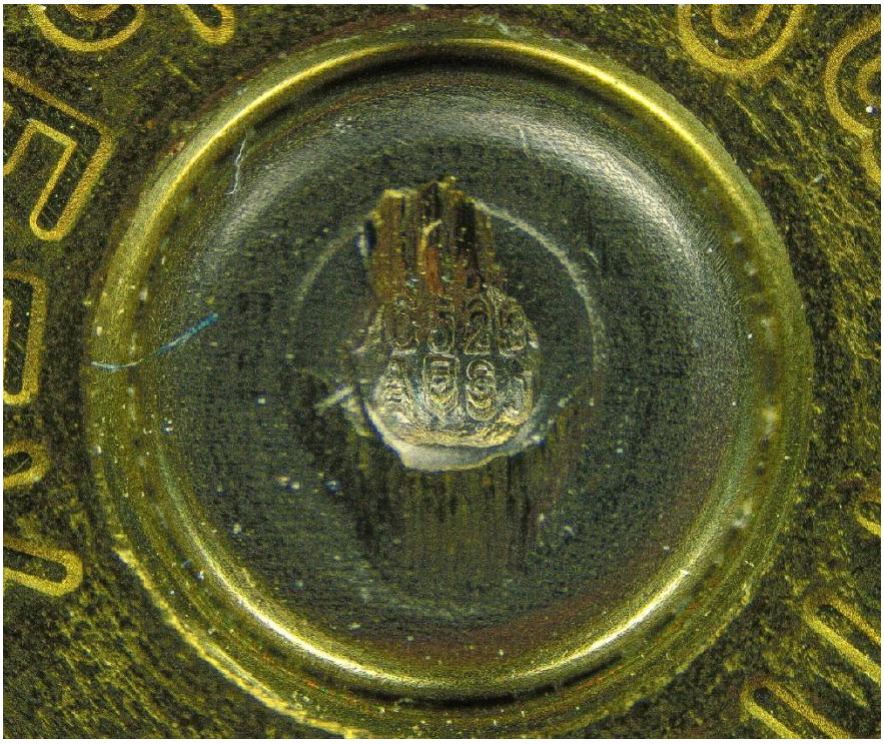
3 Pivotal Development, LLC, Manchester, NH

State of New Jersey, Office of the Attorney General, Statewide Affirmative Firearms Enforcement (SAFE) Office, "2024 Microstamping Viability Report" (Feb. 28, 2024),

https://www.nj.gov/oag/safe/downloads/2024-0227_Microstamping-Viability-Report-and-Appendices.pdf

APPENDIX A: Images of Microstamped Cartridge Cases from DOJ Microstamping Demonstration

Glock 9mm Gen 5: Leeds LCF3 with polarization filter

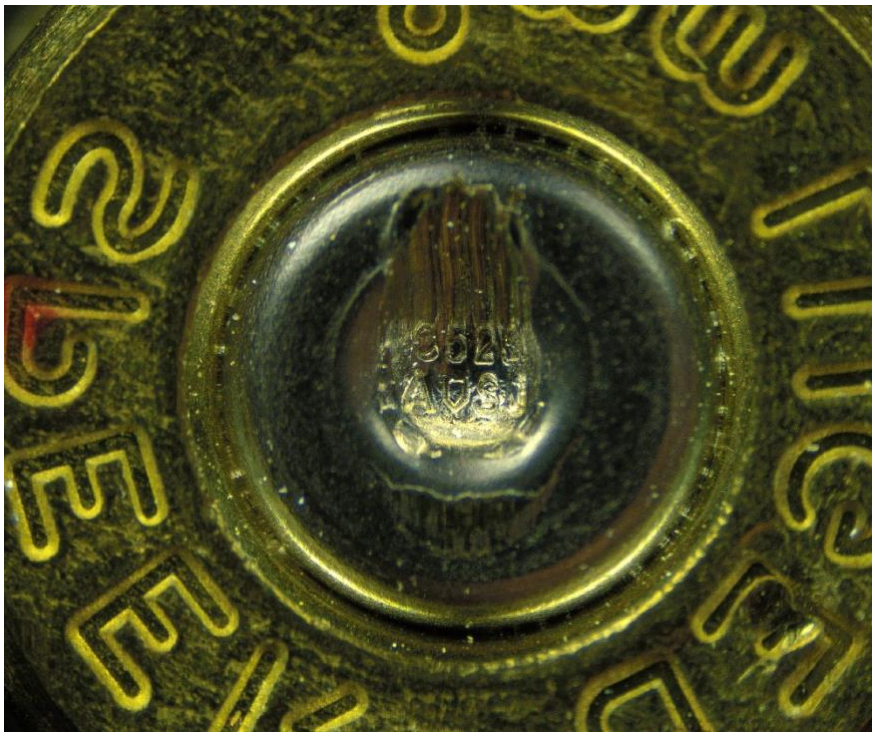


Item 1: Overall

Item 1: Close-up

Item 1: Close-up Flipped Horizontally

Glock 9mm Gen 5: Leeds LCF3 with polarization filter



Item 2: Overall

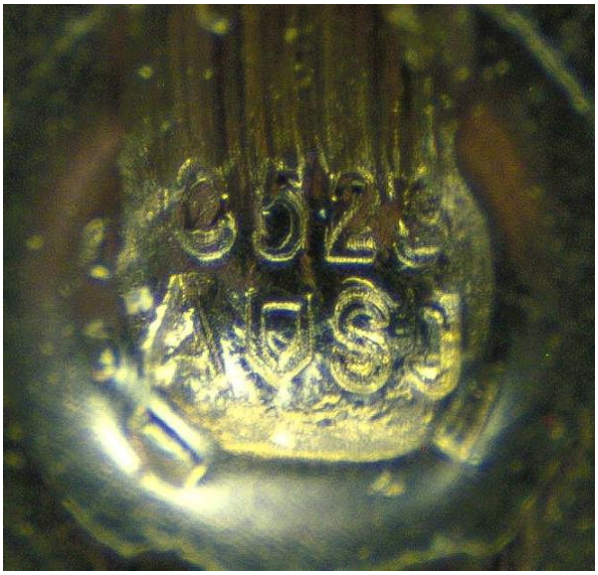
Item 2: Close-up

Item 2: Close-up Flipped Horizontally

Glock 9mm Gen 5: Leeds LCF3 with polarization filter

Item 3: Overall

Item 3: Close-up



Item 3: Close-up Flipped Horizontally

Glock 9mm Gen 5: Leeds LCF3 with polarization filter

Item 4: Overall

Item 4: Close-up

Item 4: Close-up Flipped Horizontally

Glock 9mm Gen 5: Leeds LCF3 with polarization filter

Item 5: Overall

Item 5: Close-up

Item 5: Close-up Flipped Horizontally

Glock 9mm Gen 5: Leeds LCF3 with polarization filter

Item 6: Overall

Item 6: Close-up

Item 6: Close-up Flipped Horizontally

Glock 9mm Gen 5: Leeds LCF3 with polarization filter

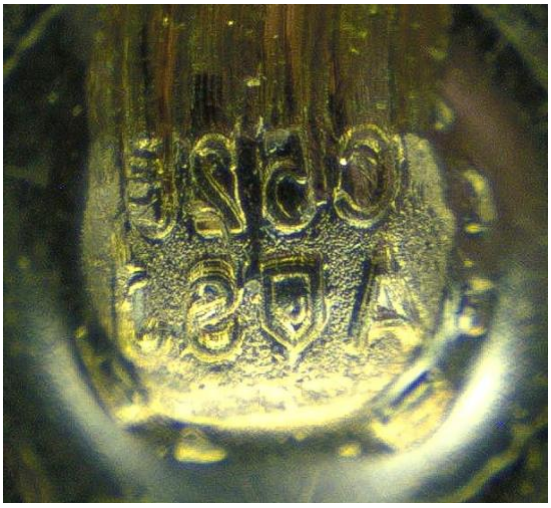
Item 7: Overall

Item 7: Close-up

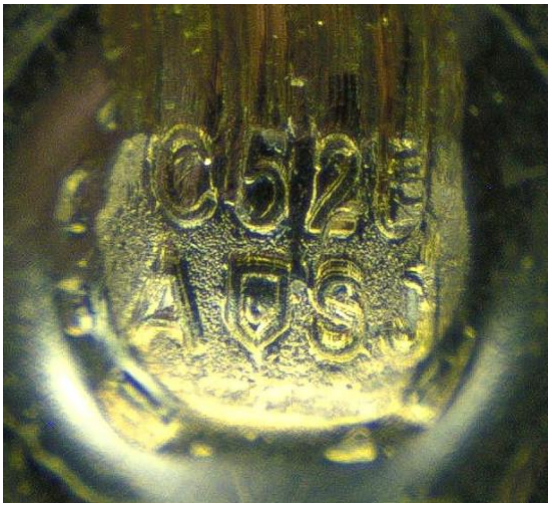
Item 7: Close-up Flipped Horizontally

Glock 9mm Gen 5: Leeds LCF3 with polarization filter

Item 8: Overall



Item 8: Close-up



Item 8: Close-up Flipped Horizontally

Glock 9mm Gen 5: Leeds LCF3 with polarization filter

Item 9: Overall

Item 9: Close-up

Item 9: Close-up Flipped Horizontally

Glock 9mm Gen 5: Leeds LCF3 with polarization filter

Item 10: Overall

Item 10: Close-up

Item 10: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

Item 1: Overall

Item 1: Close-up

Item 1: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

Item 2: Overall

Item 2: Close-up

Item 2: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

Item 3: Overall

Item 3: Close-up

Item 3: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

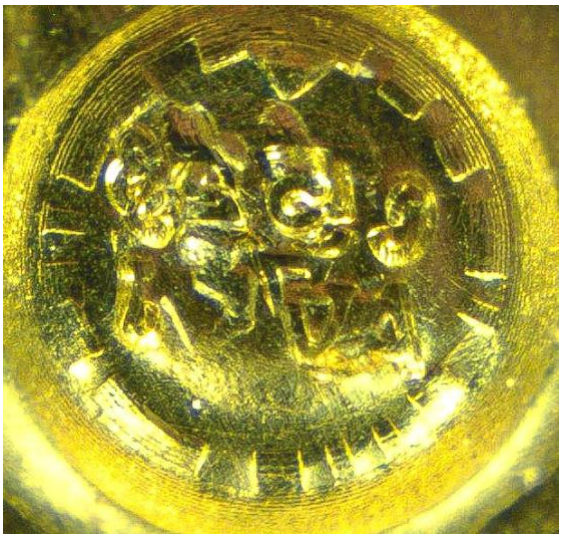
Item 4: Overall

Item 4: Close-up

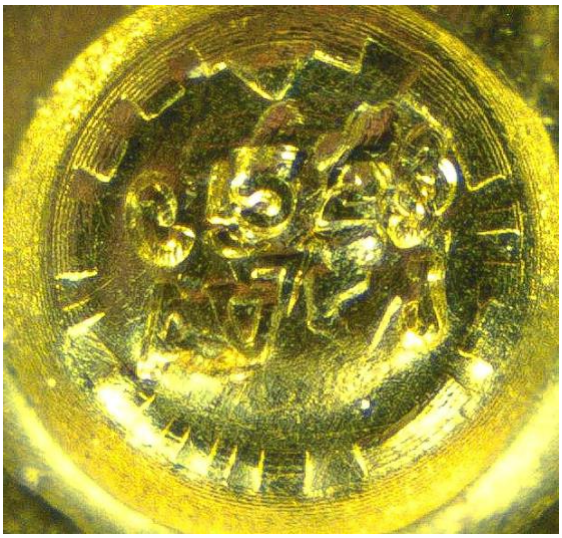
Item 4: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

Item 5: Overall



Item 5: Close-up



Item 5: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

Item 6: Overall

Item 6: Close-up

Item 6: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

Item 7: Overall

Item 7: Close-up

Item 7: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

Item 8: Overall

Item 8: Close-up

Item 8: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

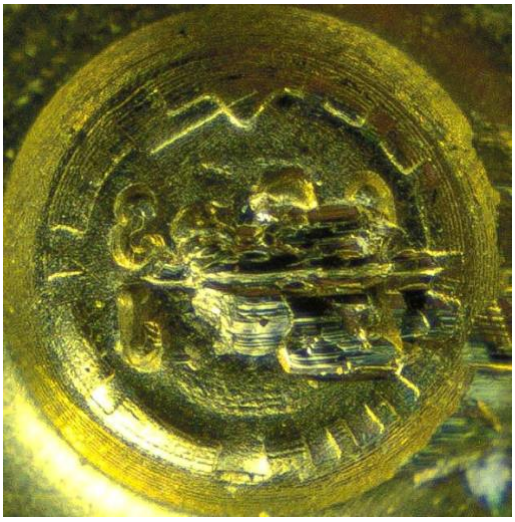
Item 9: Overall

Item 9: Close-up

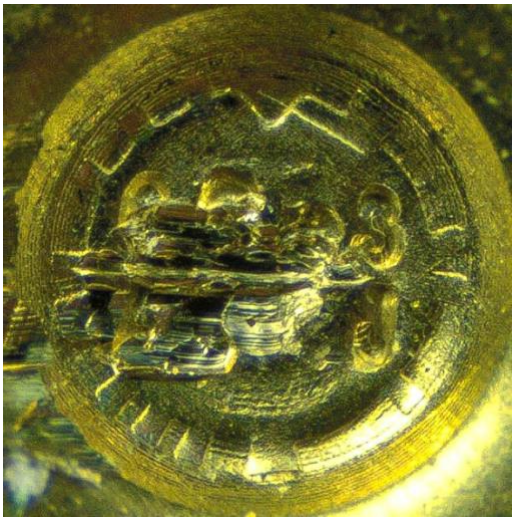
Item 9: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

Item 10: Overall



Item 10: Close-up



Item 10: Close-up Flipped Horizontally

Smith and Wesson Model 1911 .45 Cal, 1991 Version: Leeds LCF3 with polarization filter

Left: TacLabs Stencil demonstrating the engraved microstamp and surrounding proprietary gear code.

Right: Overlay of one item from the .45 cal Model 1911 with the stencil to show the transfer of the gear code to the primer. Full transfer of the gear code would aid in the identification of the alphanumeric microstamp.