UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-
OFFICE OF THE DIRECTOR

August 12, 2026

The Honorable Brian Babin
Chairman
Committee on Science, Space, and Technology
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

Thank you for your letter regarding the feasibility of firearm microstamping technology. NIST has not conducted independent research in this area, nor does the agency currently have an active workstream on this topic. Establishing a robust scientific validation across real-world conditions would require substantial resources. Our response offers a synthesis of published data from state agencies, academic institutions, forensic science professionals, and advocacy groups. NIST's goal in this response is to provide the Committee with a comprehensive summary of the best available evidence in the field.

Microstamping involves using a laser to engrave a unique microscopic identifier (microstamp) onto one or more firearm components, such as the firing pin or breech face. A microstamp can include an array of alphanumeric characters, geometric shapes, and/or barcodes. When fired, the gun imprints this microstamp onto the cartridge case before it is ejected from the firearm. For example, when a microstamped firing pin strikes the primer or cartridge rim during discharge, it transfers the unique microscopic identifier directly onto the cartridge case. The goal is to allow law enforcement to link expended cartridge cases found at crime scenes to a specific firearm make, model, and serial number through a database, even if the gun itself is not recovered.

There is significant disagreement regarding the viability of this technology. While state-led viability studies in California (CA) and New Jersey (NJ) have concluded that the technology is viable, significant concerns persist. Key areas of disagreement or concern include the long-term durability of the microstamps after repeat firings under various maintenance conditions, the dependence of mark transfer fidelity on the firearm-ammunition combination, the need to test a broader range of firearm-ammunition combinations, the high susceptibility to deliberate tampering, and the substantial costs associated with manufacturing mandates and necessary database management.

Research indicates that microstamped codes can persist on the firing pin through repeated firing, with studies observing legible transfers after as many as 2,500 rounds [1]. However, researchers found that legibility is inconsistent and that transfer rates vary by firearm and ammunition type [1, 4, 12, 13].

The Association of Firearm and Tool Mark Examiners (AFTE) and the New York State (NYS) Firearms Technical Working Group (TWG) note that firing pins naturally wear over time [2, 5]. Furthermore, firearms produce residues such as propellant (gunpowder) and primer particles that

can accumulate in the microscopic engravings, potentially obscuring the code [1, 5, 13].

Researchers observed that legibility is also significantly influenced by both firearm model, including firing pin shape, and the type of ammunition being used. The inventors of the microstamping technology recommend optimization of the microstamp for each firearm model [4, 10, 12]. The composition and hardness of the primer material also affect legibility [1, 4, 13]. The presence of lacquer sealants on some ammunition can degrade the transfer quality [4, 12]. Application of microstamping to firearms that use rimfire ammunition is considered more challenging, as the harder material of the cartridge rim causes lower quality impressions and lower durability of the microstamp [1, 11, 13]. Manufacturer branding on the primer surface of the ammunition may also impact microstamp visibility by obscuring or preventing the code transfer [1, 13].

Studies showed that firing pin motion, such as repeated strikes and drag, during discharge, can significantly impact the readability of microstamps [1, 4, 11, 12, 13]. For example, when the firing pin strikes the primer multiple times, it can create overlapping or blurred impressions.

The following approaches to address microstamp legibility concerns have been proposed by microstamping proponents:

- replacing stereo microscopy with high-resolution Scanning Electron Microscopy (SEM);
- creating redundant microstamp features, such as a binary "gear code" and radial bar code surrounding the alphanumeric characters on the nose of the firing pin;
- adding additional microstamps on other firearm surfaces, such as the breechface; and
- reconstructing the full microstamp code from partial microstamp impressions on multiple cartridge cases retrieved from a crime scene, assuming they were fired from the same firearm [10,12].

Furthermore, they mention that while a partial microstamp does not provide a link to a specific firearm; it may still have forensic utility, similar to the value of a partial license plate number [10, 12].

While it is technically possible to microstamp internal surfaces other than the firing pin, such as the breech face, ejector, or extractor, the efficacy of these approaches has not yet been demonstrated. There is concern about the transfer and persistence of microstamps that impact areas of the cartridge case that are harder than the primer [5, 11]. We are not aware of any published reports describing results obtained for microstamps on surfaces other than the firing pin.

It is technologically feasible to engrave microstamps into firearm components, including firing pins, using laser technology, but the economic feasibility is a point of debate. Todd Lizotte, the co-inventor of the technology and head of TACLABS, estimates the cost of implementation at $3 to $10 per firearm when produced in high-volume batches of over 2,500 units [6, 7].

In contrast, industry representatives argue that introducing microstamping into the existing workflow would disrupt high-speed manufacturing processes, eliminate the mass production of interchangeable parts, and could raise consumer costs by over $200 per firearm [8, 9, 14, 15, 16].

They cite the total cost of manufacturing adjustments, serialized part matching, and quality control as the drivers for this increase.

The forensic utility of microstamping depends on the firearm's ability to successfully transfer a unique microstamped code to a cartridge case and an examiner's ability to read the code and search a database that links the microscopic identifier to the firearm's make, model, and serial number. When the microstamp contains a (redundant) geometric "gear code" or "bar code" pattern, in addition to alphanumeric characters, the examiner may also have to interpret and decode the geometric pattern [12]. Studies report variability in the ability of participants to correctly interpret microstamped features transferred to the cartridge case through visual analysis [1, 4].

While microstamping has shown promise in a small number of initial studies, e.g., [1, 4], no large-scale independent (blind) studies have been conducted to establish validity and error rates across a wide range of firearm model and ammunition combinations [1, 2, 5]. Furthermore, the studies are limited to subjective evaluations involving a small number of observers, firearms, and firing pins, and rely exclusively on one manufacturer to produce the microstamps on the firing pin. These limitations currently preclude reliable estimates for error rates under real-world conditions. Studies showed lower microstamp recovery rates for rimfire or lacquered ammunition [1, 4, 11, 12, 13].

Forensic science organizations and industry groups have voiced concerns about the technology's inconsistent performance across different firearms and ammunition types. Furthermore, they argue that existing firearm and toolmark identification techniques provide a reliable and proven methodology for linking cartridge cases found at different crime scenes or for linking a cartridge case to a confiscated firearm [2, 5, 9, 13]. The National Integrated Ballistic Information Network (NIBIN) was built for this purpose. There are additional concerns that microstamping may obscure some of the features used in traditional forensic firearm identification, such as the random, distinctive marks created by the tools used to manufacture the gun components.

While a Scanning Electron Microscope (SEM) improves microstamped code recovery rates compared to stereo microscopy [12], some codes remain illegible even under high magnification due to phenomena such as multiple firing pin strikes and firing pin drag. The NYS TWG and AFTE note that most publicly funded forensic science laboratories lack SEMs for firearms examination, and that acquiring them is cost-prohibitive [2, 5]. Furthermore, using the same SEM for both microstamp imaging and gunshot residue analysis would risk massive cross-contamination [2, 5].

The technology is highly susceptible to deliberate circumvention. Microstamps on firing pins can be defaced or obliterated with basic household tools such as a sharpening stone, hammer, or small file [1, 11, 13]. The research demonstrated that the firearm remained fully operational after removing the microstamp. Furthermore, because firing pins are replaceable parts, a user could easily swap a microstamped pin for an unmarked aftermarket version [2, 5, 9]. It is important to note that replacing a firing pin can be part of routine maintenance or accommodate an owner's preference. No realistic mechanical mitigation strategy currently exists to address these modifications, and critics argue this vulnerability undermines the technology's effectiveness as a

crime-solving tool [2, 9, 14, 15, 16].

There are significant differences in available cost estimations. While Mr. Lizotte cites low per-unit costs ($3 to $10) [6], industry groups claim that the total cost of manufacturing adjustments and matching serialized parts would be substantial [8, 9,14, 15, 16]. For the technology to trace a weapon, a secure database must be established to link a unique microstamp code to a firearm make, model, and serial number [2, 5, 15].

The exact cost of a national database is unknown. As a baseline, the NYS TWG highlighted the NY Combined Ballistic Identification System (CoBIS), a searchable ballistics image database of cartridge cases fired from firearms legally sold in New York; that program cost $30 million over 11 years before being defunded due to limited efficacy [5, 9].

Beyond broader reliability concerns, forensic science practitioners and industry stakeholders maintain that microstamping is easily circumvented through manual tampering and is cost-prohibitive due to significant manufacturing and administrative burdens.

Additionally, some industry representatives view microstamping mandates as a "de facto ban" on modern firearms, citing manufacturers' unwillingness to reconfigure their manufacturing processes [15, 16]. When the state of California implemented its requirement, the number of approved handgun models on the state's roster dropped by approximately 50% as manufacturers chose not to introduce new, microstamp-compliant models [15, 16, 19].

Further concerns point to government research that shows that "criminals do not typically obtain firearms through retail sources, opting instead to acquire firearms through theft, 'Off the street/underground market,' or 'from a family member or friend, or as a gift'" [15, 21]. Therefore, efforts to trace back to the original purchaser may not lead directly to the perpetrator, limiting their investigative value [2, 8, 9,15, 21].

Critics question the logistics of managing millions of unique identifiers across a complex supply chain to ensure no codes are duplicated. For example, AFTE states that "if vendors supplying firing pins to handgun manufacturers were required to laser engrave firing pins, they would have to ensure that there was no duplication of the code with other vendors" [2].

Forensic science and industry organizations also express concern that microstamping may destroy useful toolmarks used in traditional forensic firearm identification [2, 9]. Experts caution that "[t]he use of microstamping could greatly impede the abilities of a firearm and toolmark examiner and could result in less conclusive determinations that lead to more ambiguity in a criminal case." [2]

If you have any further questions, please contact the NIST Congressional and Legislative Affairs Office at NISTCLA@nist.gov.

Sincerely,

Craig S. Burkhardt, J.D.
Deputy Under Secretary of Commerce for Standards and Technology &
Deputy Director, National Institute of Standards and Technology

cc: The Honorable Zoe Lofgren
Ranking Member
Committee on Science, Space, and Technology

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