What is the Discipline of Firearm & Toolmark Examination?

- An empirical (based on observation) comparative analysis that can determine if a striated or impressed mark was produced by a particular tool.

What is a Tool & How are they Made?

The harder of two objects that comes into forceful contact with one another, resulting in the softer object being marked.

What is a Toolmark?

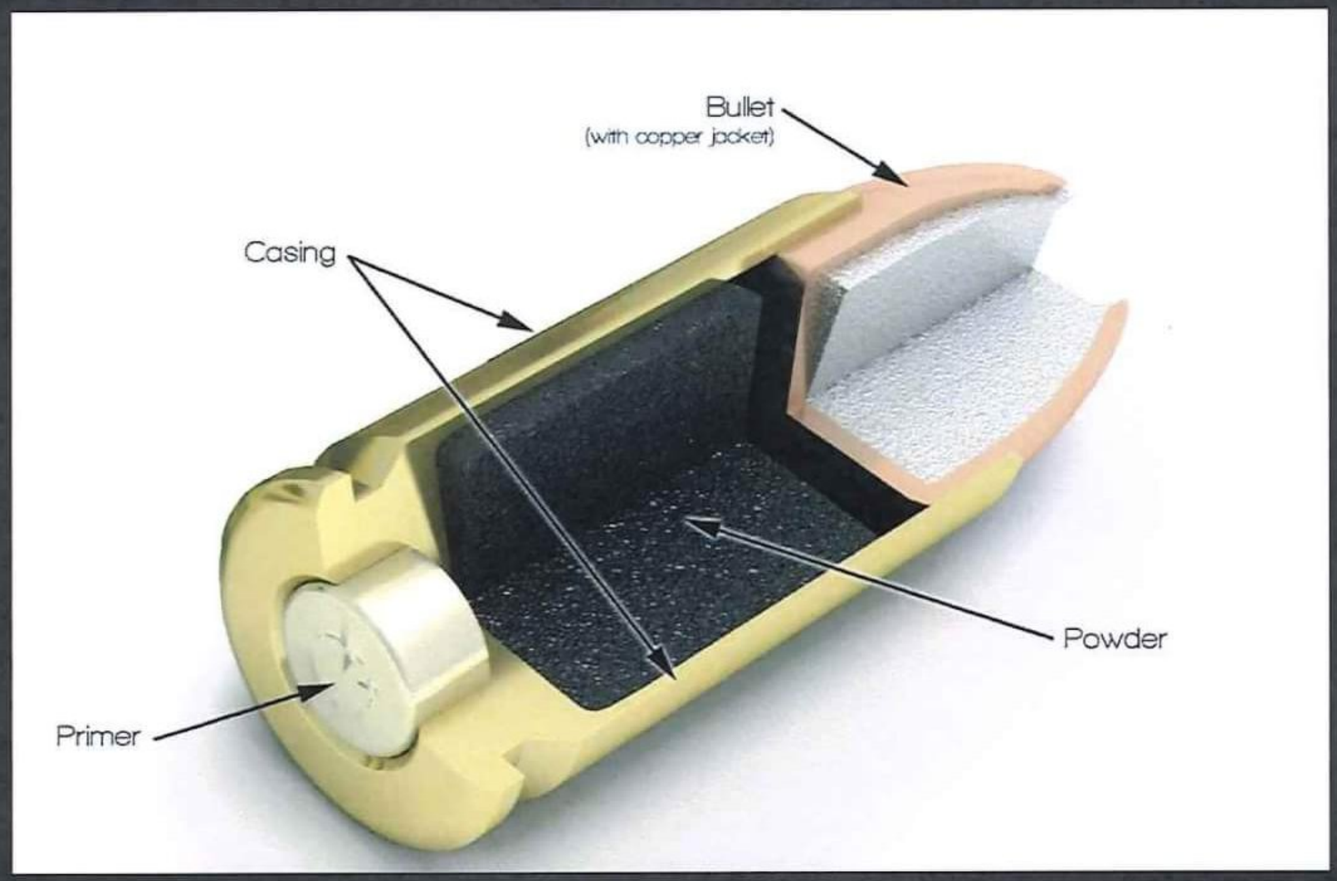
Features imparted on an object by the contact and force exerted from a tool.

Two types

-Impressed Toolmarks

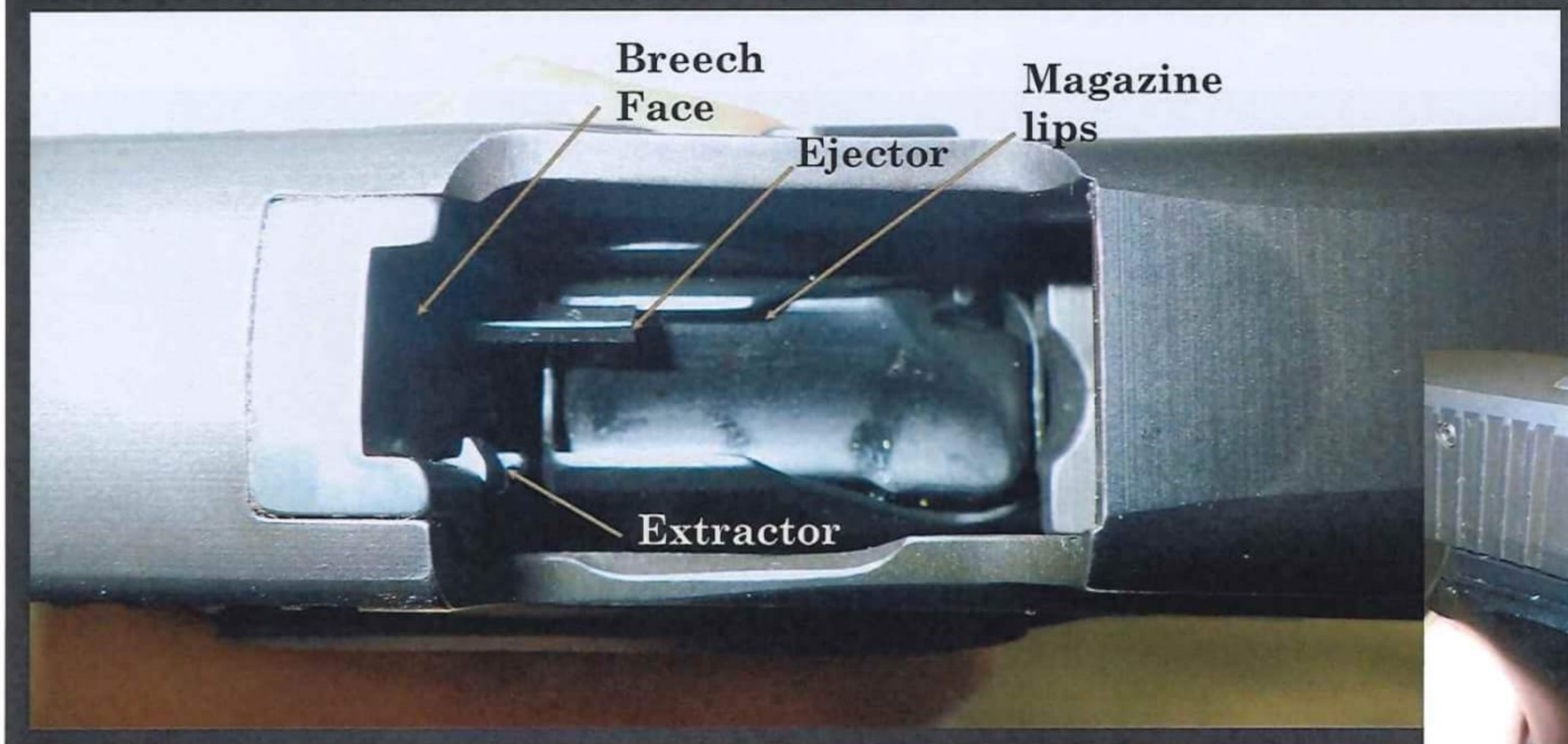
-Striated Toolmarks

Parts of a Cartridge



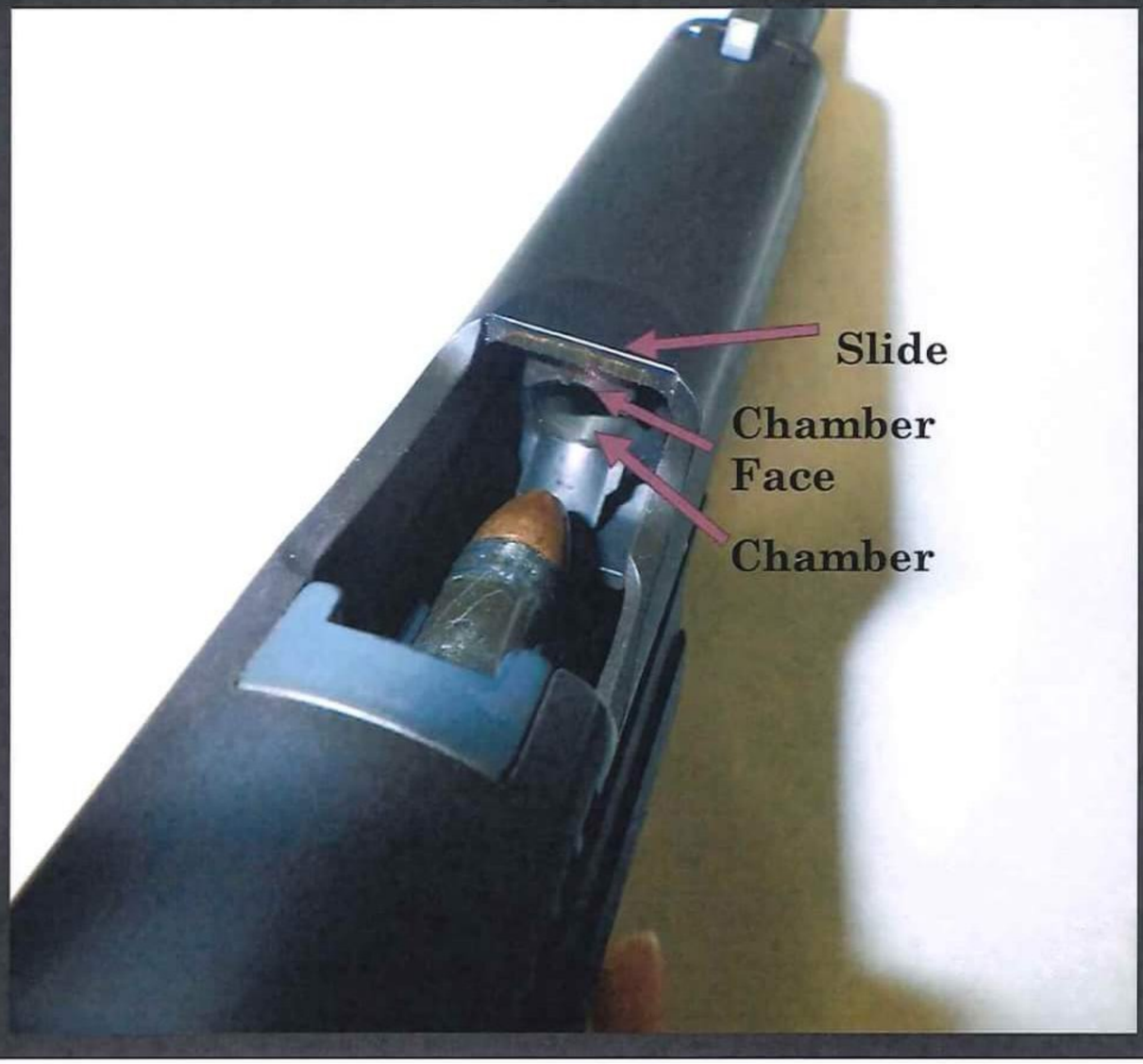
Parts of a Firearm

Parts Inside the Firearm



Side View

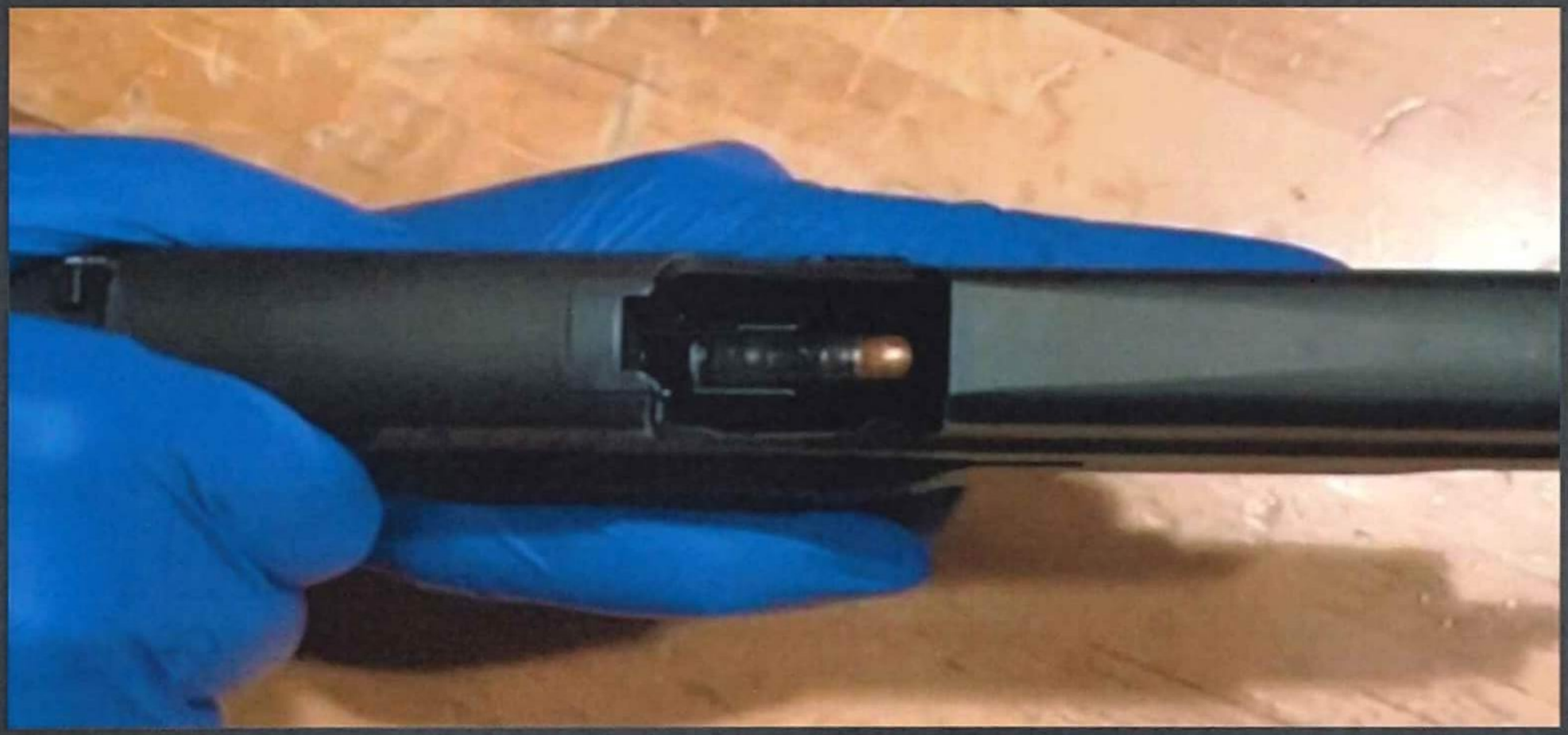
Parts Inside the Firearm



Cycling a Cartridge

Cycling a Cartridge

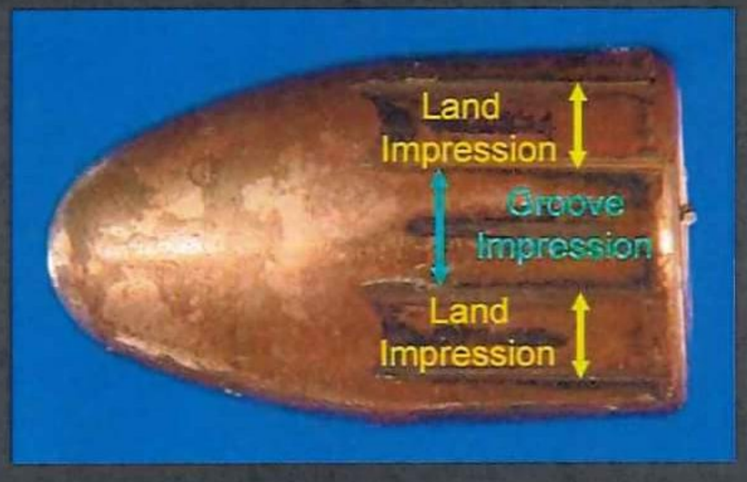
Cycling a cartridge



Cycling a Cartridge

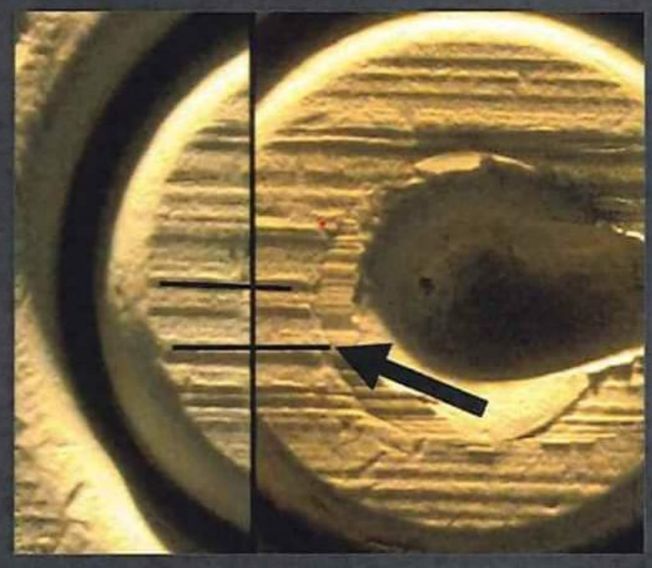
Class Characteristics

- General and/or measurable features of a specimen which indicate a restricted group source. They result from design factors, and are therefore determined prior to manufacture.



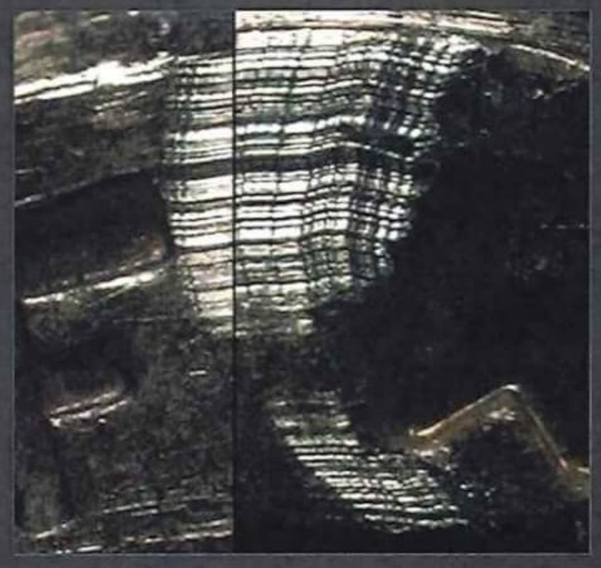
Subclass Characteristics

- Features that may be produced during manufacture that are consistent among some items fabricated by the same tool at the same time. These are not determined prior to manufacture and are more restrictive than class characteristics.



Individual Characteristics

- Marks or features produced by the random imperfections or irregularities of tool surfaces. These characteristics can also be imparted inside a firearm due to use, abuse, or corrosion.



Class, Subclass, Individual

- Training
- Research
- Manufacturing Process
- Direct Observation
- Indirect Observation
- Scope Magnification
- ****More than one area

Examination Process

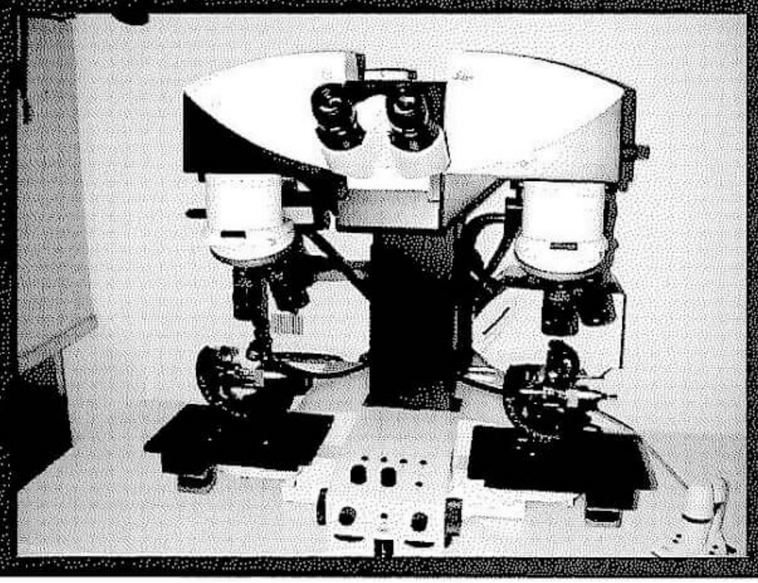
- Level 1 Analysis
- Assess the condition of the evidence as received
  - Biological material
  - Rust/Corrosion/Dirt/Debris
  - Is anything broken or missing?

Examination Process

- Level 1 Analysis-Continuation
- Assess class characteristics present on evidence
  - Caliber
  - Shapes of marks such as firing pin, ejector mark, extractor mark, breech face marks
  - Spatial relationships of marks like ejectors and extractors
  - Widths of lands and grooves for bullets
  - Width of the base of a bullet
  - Weight of bullets
  - Twist of rifling

Examination Process

- Level 2 Analysis-
- Test fire submitted firearms with appropriate ammunition
- Assess items for comparative value using a comparison microscope



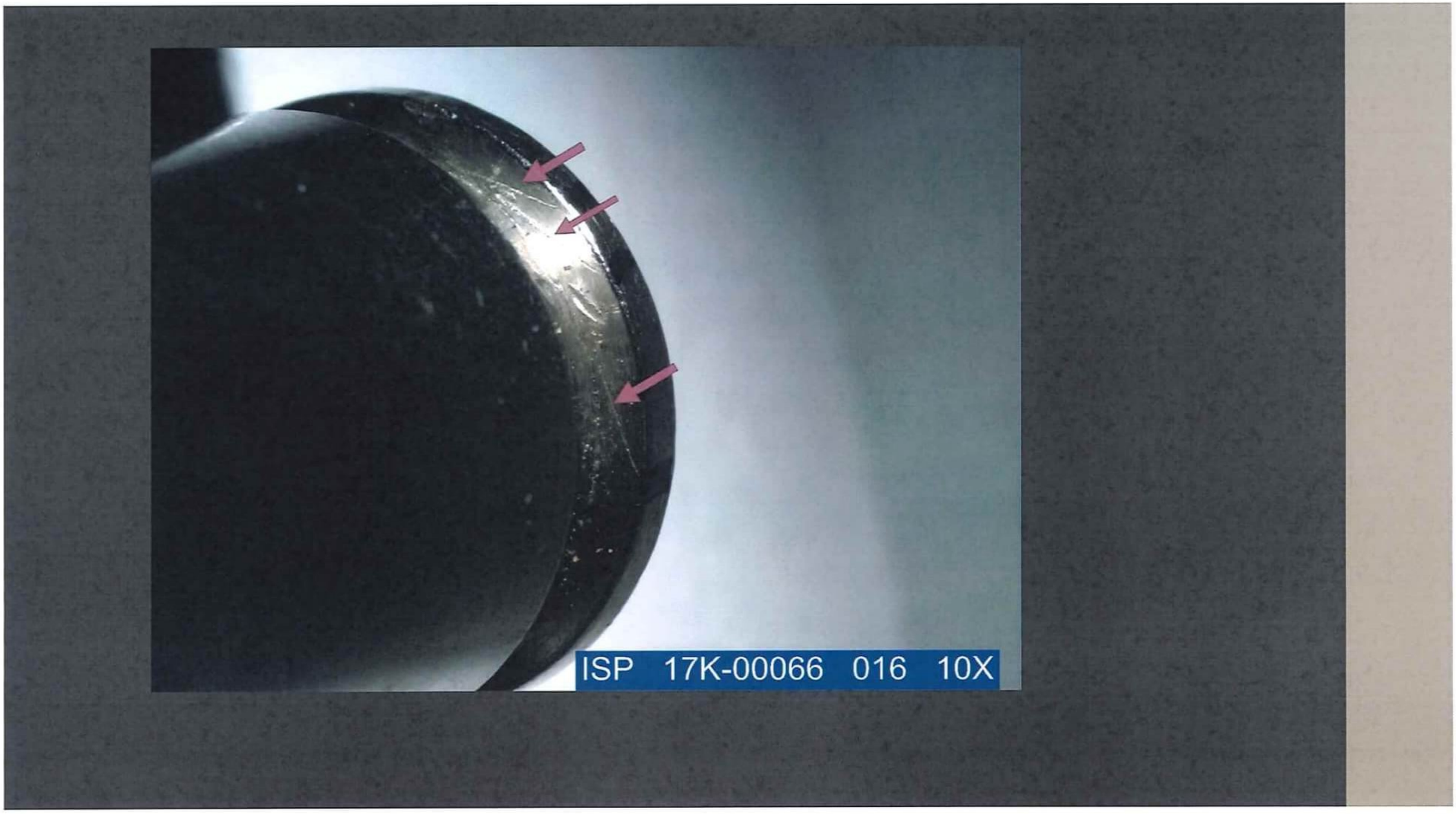
Examination Process

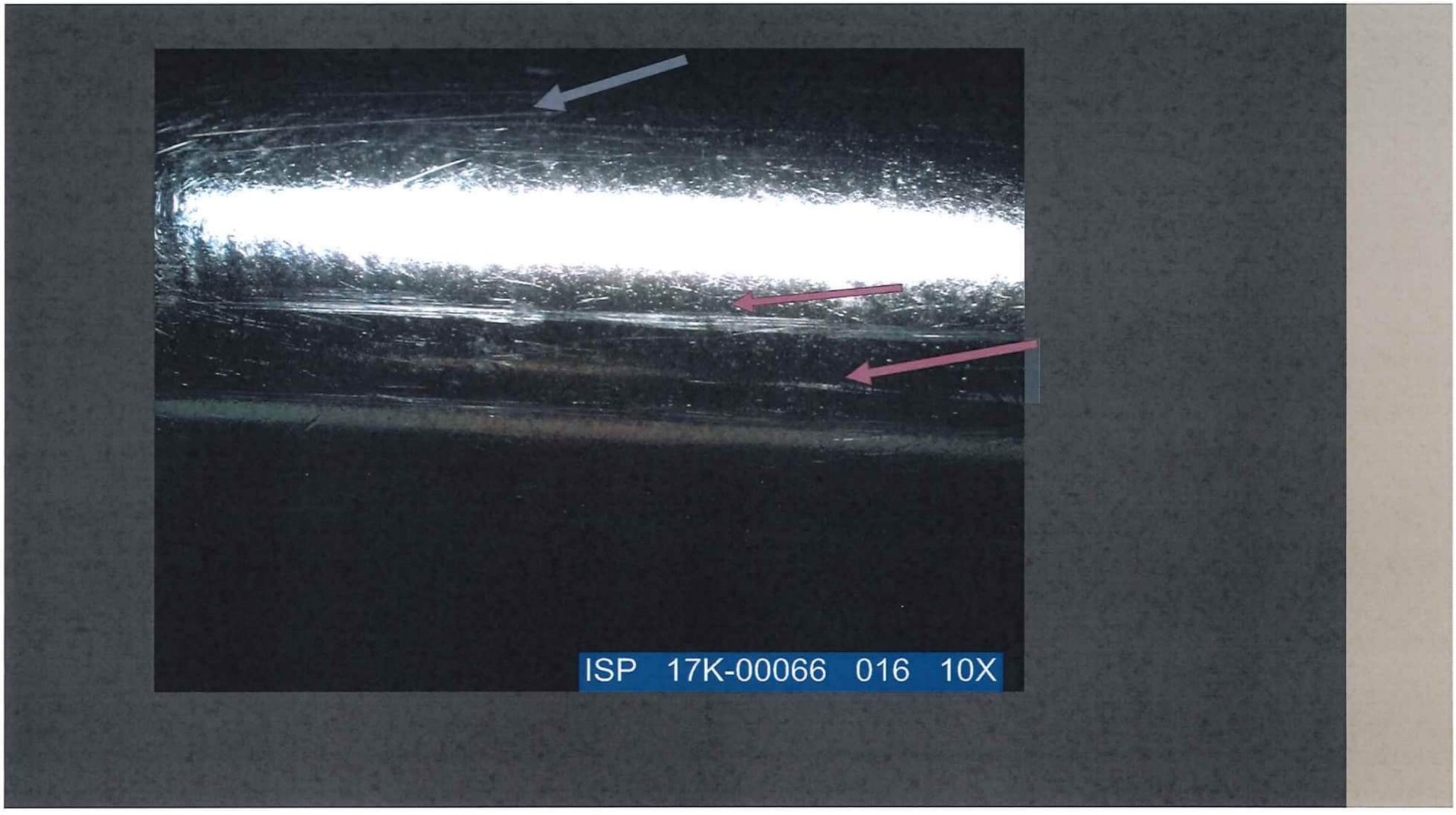
- Level 2 Analysis Continued
- Draw conclusions based on level 1 analysis and level 2 analysis
- Conclusions
  - Identification
  - Inconclusive
  - Exclusion

Submission 1 - Request 0003 17K-00066

- Item 016 - 1 Winchester 40 S&W cartridge
- Item 024 - Glock Model 22, 40 S&W caliber pistol, serial number NR668 US
  - 1 magazine
  - Magazine containing 15 Federal 40 S&W caliber cartridges


ISP 17K-00066 016 10X


ISP 17K-00066 016 10X


ISP 17K-00066 016 10X

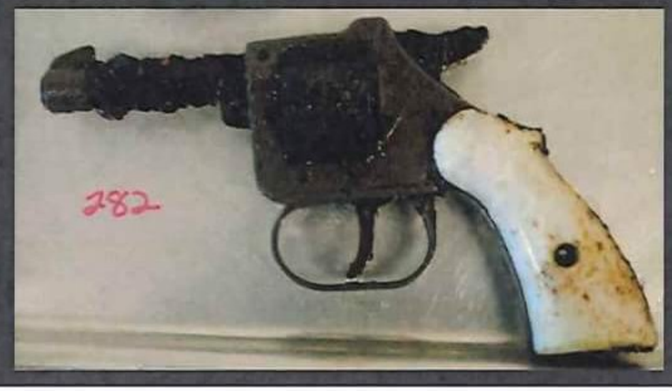
Submission 2 - Request 0004

- Item 090 - Smith & Wesson, Model M&P40, 40 S&W caliber semiautomatic pistol, serial number DWS1872
  - 1 magazine
- Item 101 - Sig Sauer, Model P239, 40 S&W caliber semiautomatic pistol, serial number SA4-50895
  - 1 magazine
- Item 106 - Sealed brown paper bag containing 5 sealed manila envelopes each containing a cycled cartridge (items 106A, 106B, 106C, 106D, and 106E)




Submission 3 - Request 0006

- Items 273, 280, 281, and 282 all sealed plastic bags containing water containing unidentified firearms
- Item 276 an envelope containing suspected pieces of a firearm



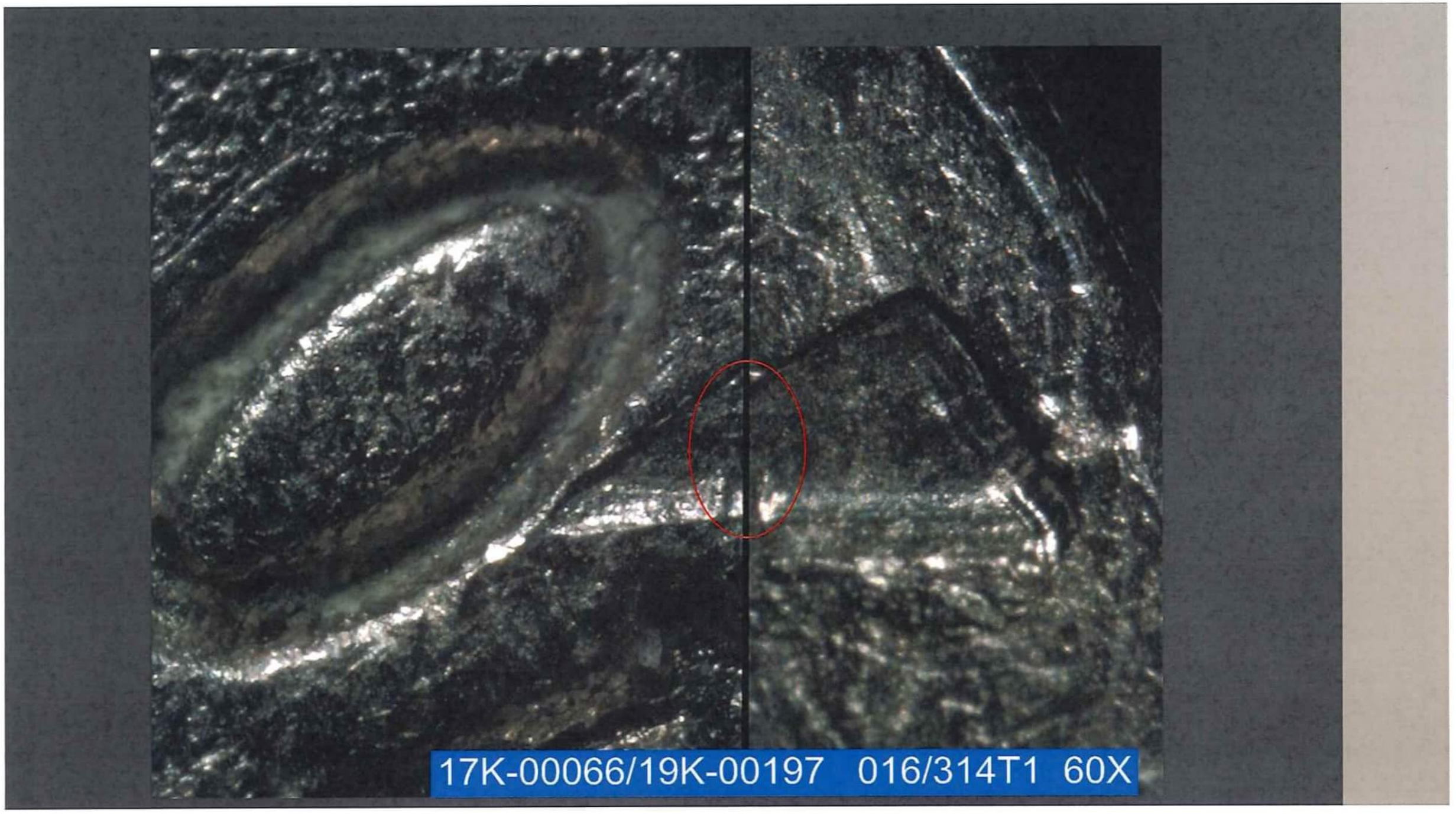
Submission 4 - Request 0008/0025

- Item 314 - Sig Sauer, Model P226, 40 S&W caliber pistol, serial number U 625 627
- Item 315 – 1 Winchester 40 S&W Cartridge
- Item 316 – 1 Blazer 40 S&W Cartridge
- Item 317 – 2 magazines, 1 magazine containing 8 cartridges and another magazine containing 9 cartridges (all Blazer 40 S&W cartridges)


17K-00066/19K-00197 016/314T1 60X


17K-00066/19K-00197 016/314T1 60X


17K-00066/19K-00197 016/314T1 40X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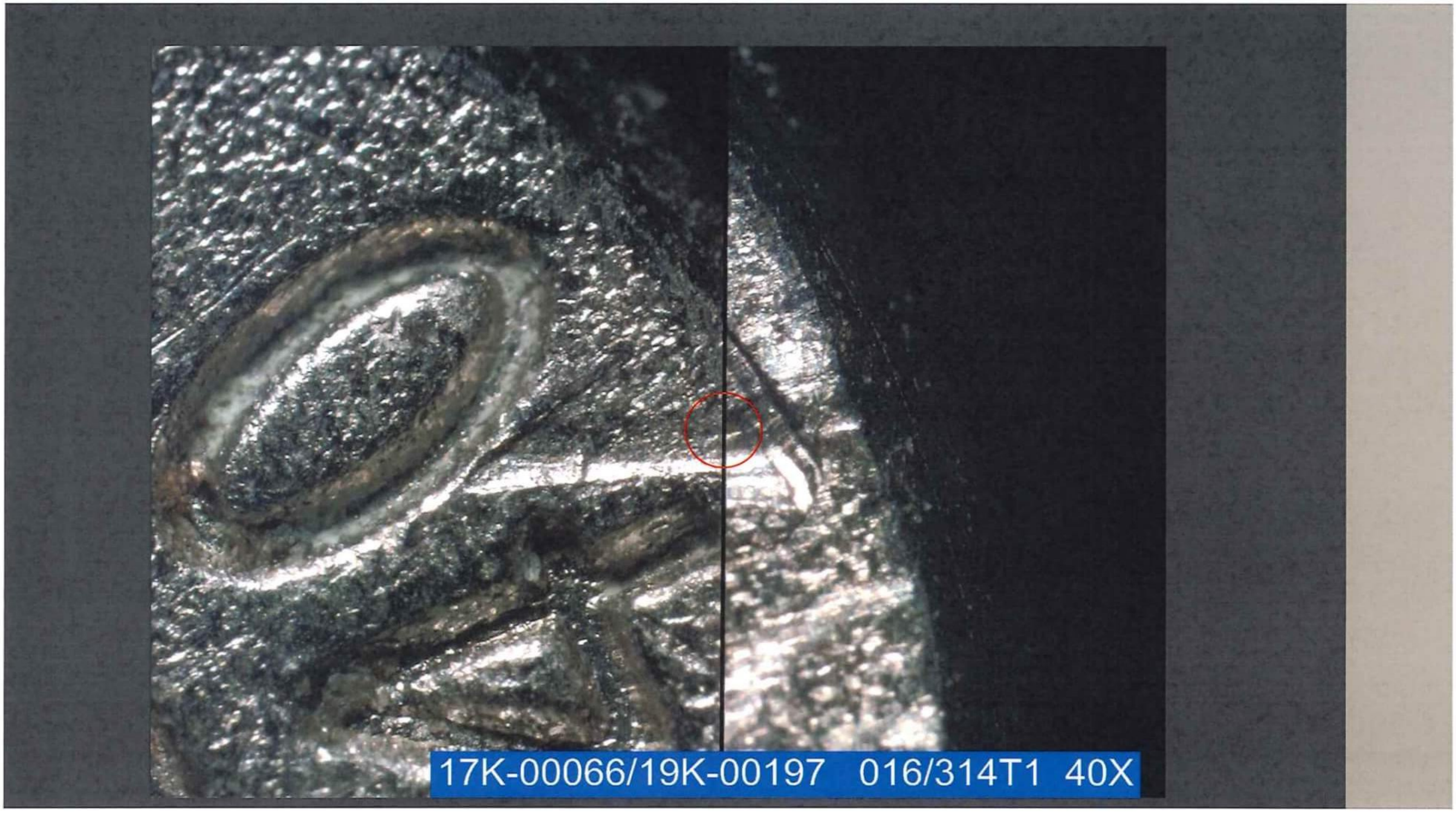
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17K-00066/19K-00197 016/314T1 60X

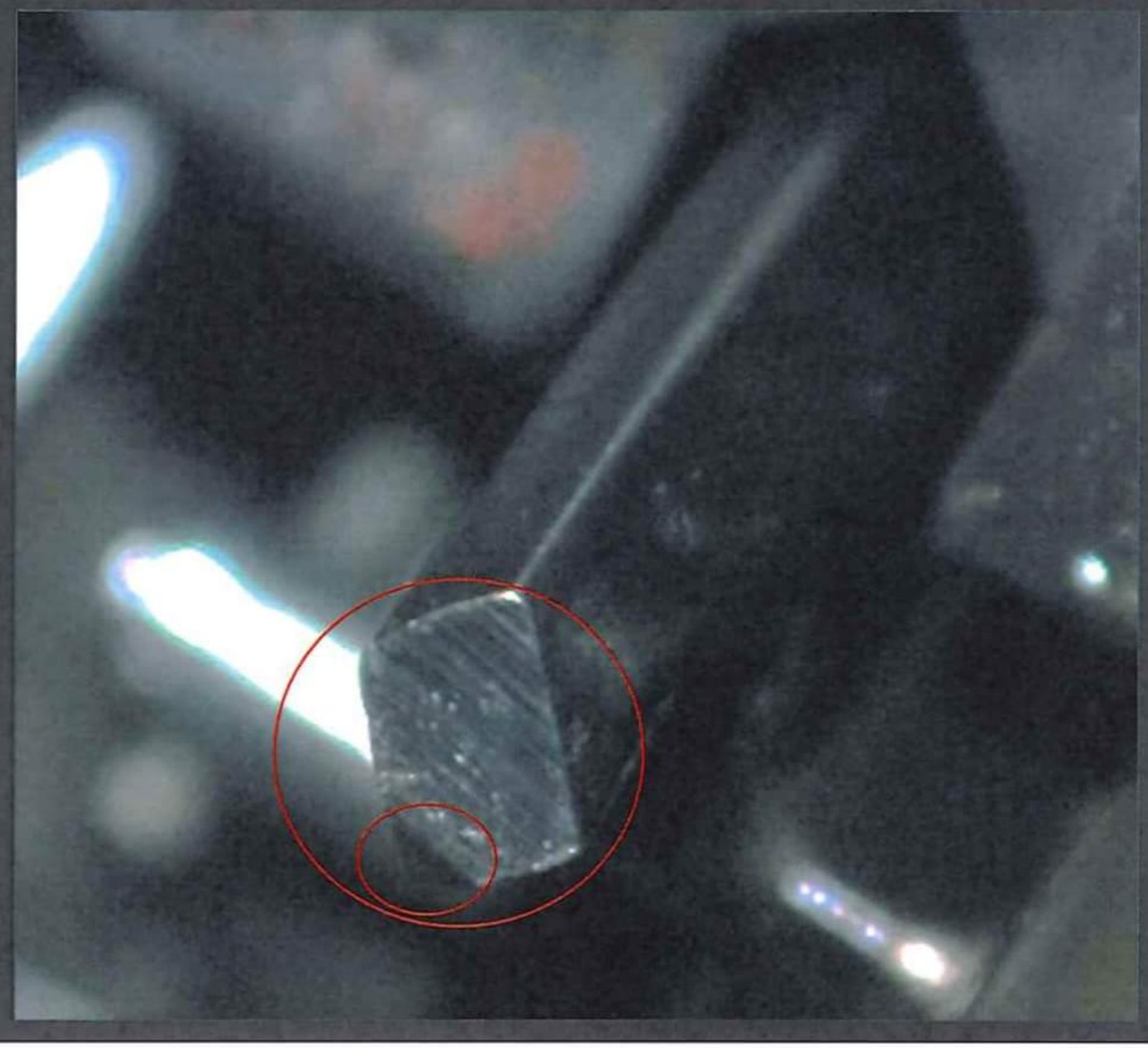

17K-00066/19K-00197 016/314T1 60X


17K-00066/19K-00197 016/314T1 40X


17K-00066/19K-00197 016/314T1 60X


17K-00066/19K-00197 016/314T1 40X

Ejector from Firearm-Item 314



A Study of Consecutively Manufactured Chisels

By: Stephanie J. Eckerman, Minnesota Bureau of Criminal Apprehension Forensic Science Laboratory, St. Paul, MN

Key Words: Chisels, Consecutive Manufacture, Subclass Characteristics, Toolmarks, Tools

ABSTRACT

Consecutively manufactured (consecutively finished – refer to article) chisels/pry tools were studied to determine whether or not the tools are capable of producing individual and identifying characteristics. Toolmarks were examined from one set of three consecutively ground chisels of one type, and from three sets of three consecutively manufactured or ground chisels of another type, with each set representing a different stage in the manufacturing process. Results showed that each ground chisel produced individual and identifying characteristics, and that there was no carry-over of features due to the finishing process between consecutively finished tools. Consecutively forged and trimmed tools did possess similar features prior to a grinding step.

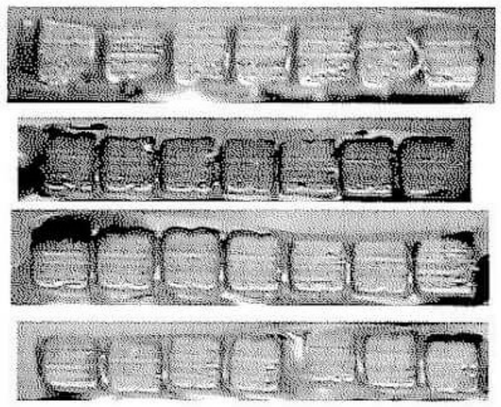
9mm Smith & Wesson Ejectors

A Technical Report By Evan Thompson and Rick Wyant, Washington State Patrol Crime Laboratory, Marysville, Washington

Key Word: Ejectors, class characteristics, family and individual characteristics

ABSTRACT

While attending a Smith & Wesson semiautomatic pistol armorer's school, an eyeloop examination of twenty-eight factory new ejectors revealed what appeared to be a number of both class and family characteristics.



The Microsil casts revealed heavy striations that carried over from ejector to ejector, along with fine individual characteristics which were substantially different. A call

331-0852] revealed that the ejectors are stamped from bar stock and that the face of each ejector, which comes into contact with the rim of the cartridge case upon ejection, is **ground** to a specific angle to ensure proper ejection. As some of you may recall, Mr. Ziaenzio taught


17K-00066/19K-00197 016/314T2 60X

Manufacturing of SIG Sauer 9 x 19 mm Pistols

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1. School of Science and Technology, Nottingham Trent University, Nottingham NG11 8NS, UK.
2. Electron Science Research Institute (ESRI), Edith Cowan University, Joondalup WA 6104, Western Australia, Australia.
3. Department of Applied Science, Security and Resilience, Cranfield Defence and Security, Cranfield University, Shrivenham, Swindon, Wiltshire SN6 8LA, UK.

** Present address: Faculty of Sciences, Staffordshire University, Stoke-on-Trent, ST4 2DE, UK*

Keywords: 9 x 19 mm, electrochemical, hammer forged, manufacturing, rifling, SIG Sauer

ABSTRACT

This article details the manufacturing processes and assembly of 9 x 19 mm calibre SIG Sauer duty, sporting and limited edition pistols produced at the factory in Eckernförde, Germany.

The principal manufacturing focus for this paper is SIG Sauer barrel production, as two methods of rifling are utilized in their pistols; electrochemical rifling and cold hammer forged rifling. However, pistol slide and frame manufacturing is also discussed, as well as assembly, proofing and test firing of firearms before sale.

one material feed point. During the milling process, the first steel piece is cut off and turned away with cutting head 1, while the second piece is produced at the same time with cutting head 2. The third barrel is then made by cutting head 1 and so on. The machine operates automatically and uses computer aided manufacture (CAM). This process drills the internal barrel bore and chamber, contours the outside of the barrel, breech block with locking and camming surfaces (Figure 1) as well as crowning the muzzle. The use of two cutting heads is particularly noteworthy for any firearm examiner undertaking toolmark comparison and investigation utilizing consecutive barrel manufacture, or when investigating potential sub-class characteristics. Another aspect to highlight is that there are six CNC milling machines located at the factory that are all used for barrel manufacturing, and a variable number may be running at any one time to produce one batch of pistol barrels. The number used depends on the size of the batch. At the end of this stage there is no rifling inside the barrel bore.

The rifling is then imparted using an ECR machine, which can rifle one barrel at a time and takes about 15 seconds. The electrode (Figure 2) is held vertically at the base of the machine and the barrel (anode) is held vertically above the electrode (cathode). The barrel is then lowered on to the electrode while a voltage is applied and the electrode rotates at the specified rate, stripping the metal away forming the grooves. The barrels milled from one (or more) CNC milling machine(s) will have been grouped together and will not be separated into barrels cut with each of the machines or individual cutting heads. This means that consecutively produced barrels (at the end of production) are highly unlikely to have been produced sequentially from one tool/cutting head. However, SIG Sauer does ensure that all machines producing the batch are equipped with tools that are made from the same tool-batch. This is to try to ensure that there are no differences in the barrel tolerances.

After an internal polishing step, the barrel is hardened in two areas (shown as discoloured areas on Figure 3) where forceful contact will be made between the barrel and other pistol components upon firing the weapon:

1. On the top, front section of the barrel breech block, which hits the front of the slide's ejection port during lock-up;

2. The barrel locking lug beneath the breech block, which causes the barrel to move downwards after firing and the slide remain open after the last round in the magazine has been fired.

The hardness of these areas is tested in order to ensure that they are within tolerance. If the hardness does not meet the requirements, the inductive hardening process can be repeated, numerous times if necessary, without affecting the quality of the steel, and can be programmed to increase or reduce hardness.

A robot then polishes the external surfaces of the barrel and moves the barrel into a laser machine, which engraves the serial number onto the barrel. However, due to the use of two cutting heads in each CNC machine for drilling and milling the barrels, and the potential for multiple machines to be used to manufacture one batch of barrels, a firearm examiner cannot rely on the assumption that consecutive serial numbers indicate consecutively manufactured barrels. This issue has been highlighted previously and is summarised by Bonfanti and De Kinder [11].

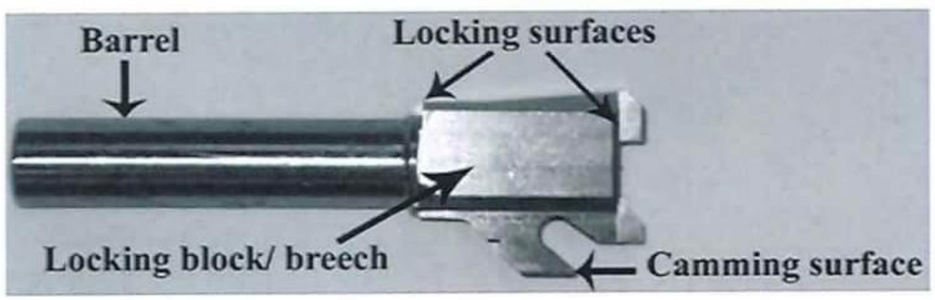
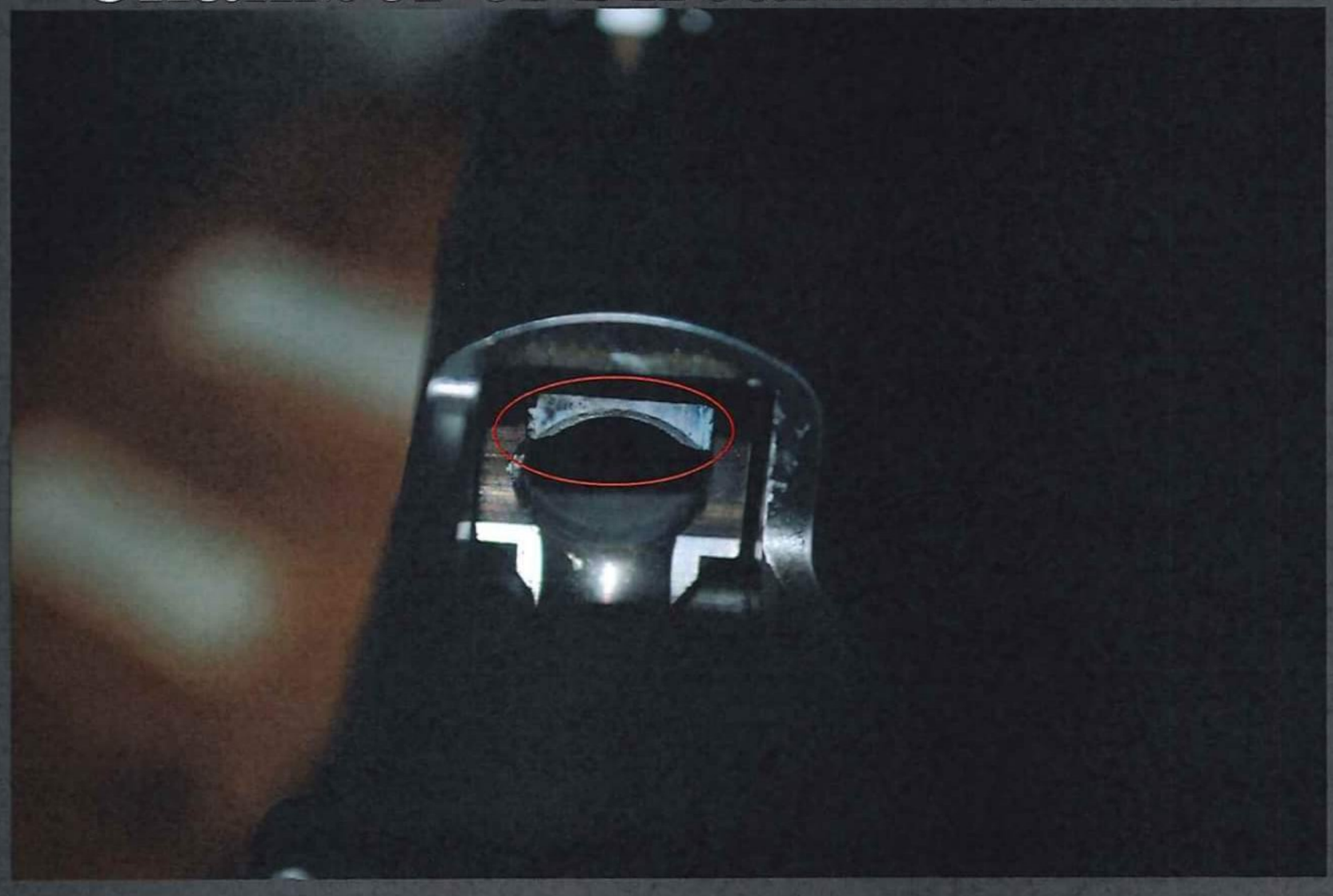


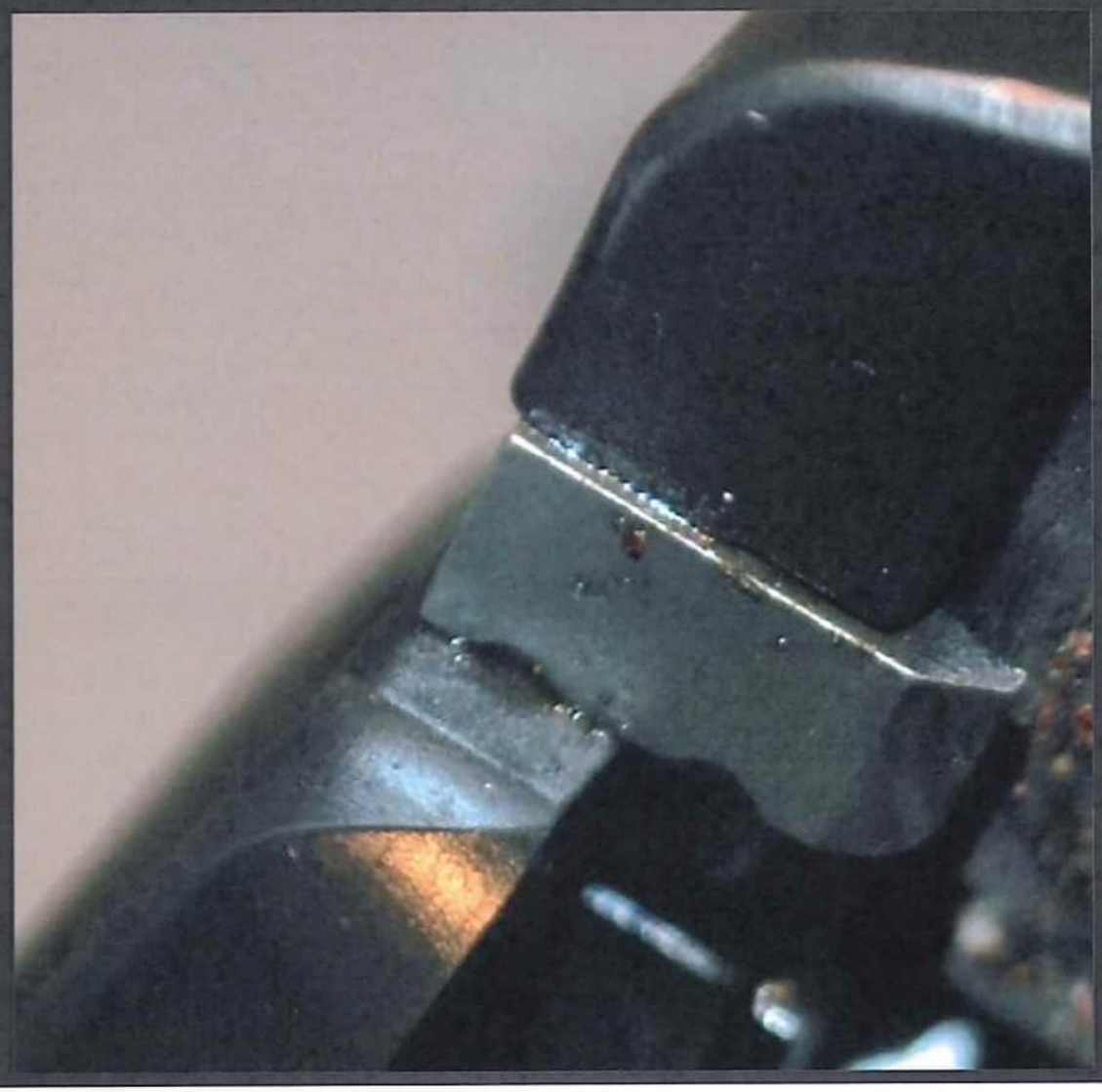
Figure 1: Annotated image of a 9 mm Luger SIG Sauer P250 barrel after CNC milling stage.

Chamber of Firearm-Item 314




17K-00066/19K-00197 016/314T1 60X

Extractor of Firearm-Item 314



An Evaluation of the Individuality of the Two Types of Remington 870 Extractors – Metal Injection Molded vs. Milled

By: Samantha Berghorn, Onondaga County Center for Forensic Sciences, Syracuse, NY

Keywords: extractor, metal injection molding, milled, MIM, Remington 870

ABSTRACT

Remington 870 shotguns possess different types of extractors depending on whether it is a commercial or law enforcement variant. The commercial 870 shotguns are equipped with a metal injection molded extractor whereas the law enforcement versions have a milled extractor. Six extractors of each type were examined and compared to determine if there was any carryover of class or individual markings within a type or between the two types. Although some similarities existed between each extractor within each type, each extractor was still able to be differentiated from one another and the extractor marks were all able to be identified back to their corresponding extractor.

The Identification of Consecutively Manufactured Extractors

By: Technical Sergeant Dennis J. Lyons, Firearm and Toolmark Examiner, New York State Police, Albany, N.Y.

Key Words: Cartridge case, consecutive manufacture, criteria, extractor, identification, known non-match, semi-automatic pistol, striated toolmark, sub-class characteristics.

ABSTRACT

Caspian Arms, Ltd. produced ten consecutively manufactured extractors for use in a Colt, Model 1911A1 semi-automatic pistol. These extractors were used in the same semi-automatic pistol to produce samples of known and unknown cartridge casings. A group of firearm and toolmark examiners were given test sets of these cartridge casings to attempt to make the correct associations between the known and unknown casings. Each examiner was to receive 12 unknown casings in addition to standards for the ten consecutively manufactured extractors, with each known having at least one unknown associated with it. This study showed that when a proper scientific approach is applied the correct identifications could be made and the extractors could be distinguished from each other regardless of the fact that they were consecutively manufactured.

Firearm and Tool Mark Identification: The Scientific Reliability and Validity of the AFTE Theory of Identification Discussed Within the Framework of a Study of Ten Consecutively Manufactured Extractors

By: Ronald G. Nichols, Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives Forensic Science Laboratory, Walnut Creek, CA

Keywords: consecutive matching striations, firearms and tool marks identification, identification criteria, subclass characteristics, scientific reliability and validity

ABSTRACT

Since the advent of DNA technology, there has been increased scrutiny of the scientific reliability and validity of identification disciplines. Unfortunately, in the case of firearm and tool mark identification, there has not been one document that comprehensively discusses this issue with regard to the AFTE Theory of Identification, even though there have been numerous studies that have been performed to investigate the scientific validity and reliability of the theory and its underlying premises. This article will collate the relevant studies performed in this quest in an effort to bring together the many variables that have been examined to determine if the theory remains valid. An example of which would be varying methods of tool manufacture. In addition, within this article will be a study performed utilizing ten consecutively manufactured extractors. It has been determined through this further work and review that substantial support validating the AFTE Theory of Identification exists and that its scientific validity and reliability can be more than adequately defended.

Manufacturing of this firearm

- How a Sig Sauer pistol is made
- Slide/Frame/Barrel
- https://youtu.be/gAhcU_NfYQA?si=vWOiaHmTexGivaDC

- Assembly
- https://youtu.be/Xj8V2LtVFaQ?si=lfZGV_E_dtGpWoC7