Firearm and Toolmark Overview

The **Firearm and Toolmark discipline** is a versatile, well-equipped unit offering a number of services that can be useful to investigators.

Firearm and Toolmark Examiners are dedicated to providing reliable scientific support to all law enforcement personnel. Services are provided at both the investigation and trial-preparation stages of criminal cases involving the use of a firearm or other tool. By examining the evidence submitted, Firearm and Toolmark Examiners may be able to:

- Determine whether a bullet was, or was not fired from a particular firearm
- Determine whether a cartridge case was, or was not fired from a particular firearm
- Determine the type of firearm from which a bullet or cartridge case was fired when a firearm is not submitted
- Determine the operability of a firearm
- Determine whether a tool found in a suspect's possession was, or was not used to cut, scrape, pry, or pinch evidence material seized from a crime scene*
- Determine the original serial number of a firearm or other metal object whose serial number has been obliterated
- Determine if gunpowder is present on a victim's clothing or other evidence**
- Determine a distance range from the muzzle of the firearm to the target at the time the firearm was fired**

Tools found at the scene of a crime that cannot be associated with a suspect **will not be examined.*

***No muzzle-to-target distance tests can be performed without the firearm that was involved in the shooting.*

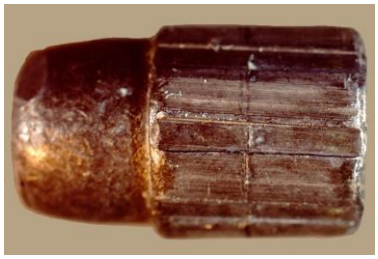
Note: It cannot be determined "how long" it has been since a firearm was fired.

Other examinations not specifically listed above may be performed on a case by case basis. Please contact Firearms section personnel if you have any questions regarding additional examinations that can be performed on the evidence that is being submitted to that laboratory.

Firearms Analysis

Basics of Firearms Comparisons

Rifling is a series of spiral grooves cut or impressed into the barrel of handguns and rifles. The raised portions of the rifling are known as lands and the recessed portions are known as grooves. The purpose of rifling is to impart a rapid spin on the bullet as it passes through the barrel. This spin helps to improve accuracy and distance by reducing the bullet's tendency to tumble during flight.



As the bullet travels down the barrel of the firearm, the rifling of the harder barrel engraves or imparts the rifling onto the bearing surface of the softer bullet. The bullet now bears the same general rifling characteristics as the gun from which it was fired.

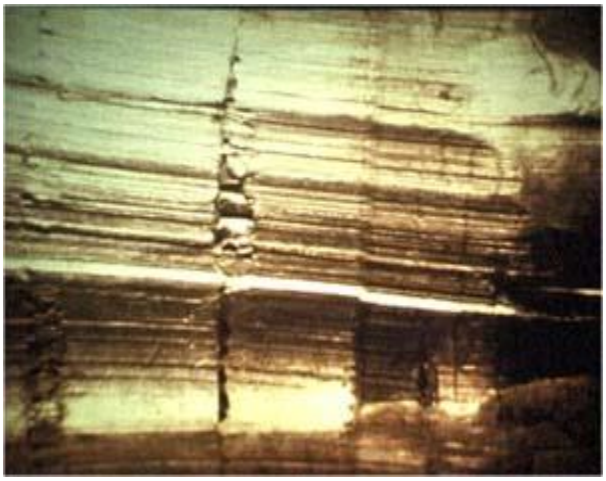
Since rifling characteristics can differ from one firearm manufacturer to another, forensic firearm examiners can determine the type of firearm that fired a particular bullet by examining the impressions of the lands and grooves on the bullet. They examine the width, the number, and the direction of the twist of the lands and grooves. For example, a 9mm pistol made by one manufacturer might have a barrel with 6 lands and grooves that twist to the right and another manufacturer's 9mm might have 6 lands and grooves that twist to the left. In addition, the width of the lands and grooves may differ.

Because each barrel will have imperfections left by the manufacturing process that will leave unique marks on a bullet, firearm examiners can determine whether a bullet recovered from a crime scene or victim was fired from a firearm taken from a suspect.

Comparison Process

The first step in the **Comparison Process** is to test fire the firearm into a water tank in the lab.

Bullets



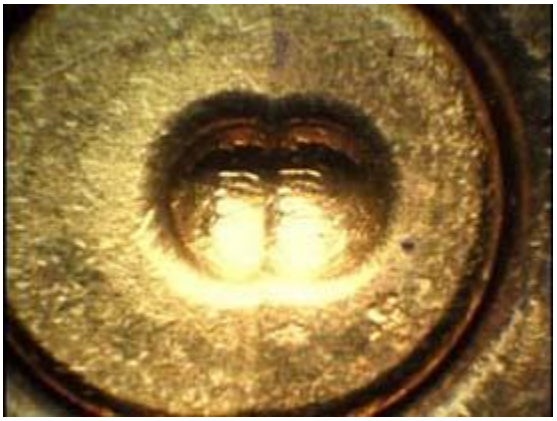
The second step involves using a comparison microscope to compare the test bullet to the bullet recovered from the victim or crime scene.

The photo on the left shows the split screen image the scientist sees using the comparison microscope. The right side of the photo shows the test bullet fired from the suspect's firearm into the water tank, and on the left side, the bullet recovered from the crime scene. The marks or striations on each bullet match, indicating that the two bullets were fired from the same firearm.

Cartridge Cases

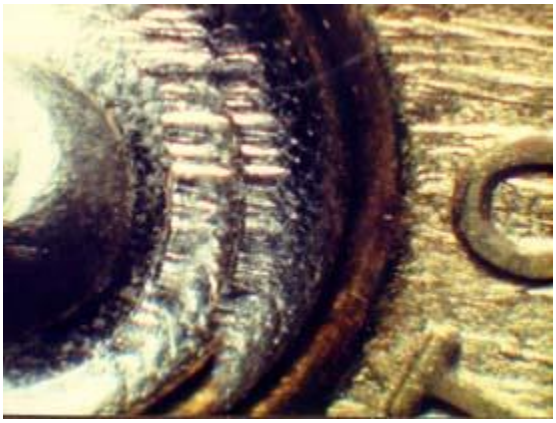
A firearm will also leave unique marks on cartridge cases. Cartridge cases left at crime scenes can link a suspect's firearm to the crime.

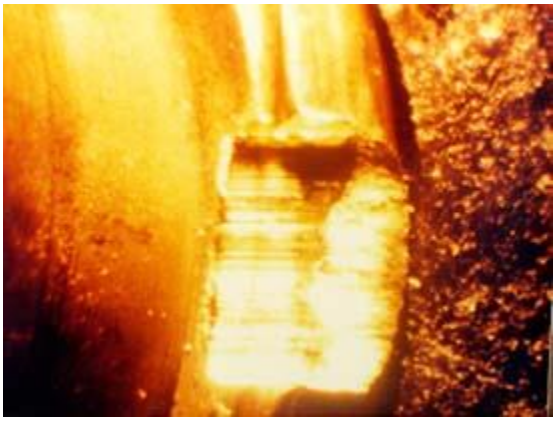
The following photographs of split screen images from a comparison microscope show three different types of markings left on cartridge cases that firearm examiners can use in determining if the cartridge cases were fired from the same firearm.



Firing pin impressions - When a firearm's trigger is pulled, the firing pin is forced into the primer cup located at the rear center of the cartridge.

Breech face marks- These marks come from the area surrounding the firing pin of the firearm. After the cartridge powder is ignited by the firing pin striking the primer cup, tremendous pressure is exerted in the chamber of the firearm, forcing the back of the cartridge case against the breech face of the firearm.





Extractor marks - After a semi-automatic pistol has been fired, an extractor pulls the cartridge from the chamber and ejects it from the pistol.

IBIS/NIBIN

The Integrated Ballistics Identification System (IBIS) is used to associate evidence in previously unsolved crimes. IBIS is a highly technical, computerized image analysis system that records striated images from bullets and cartridge cases and compares them to a national database of images called the National Integrated Ballistic Information Network (NIBIN). The GBI Firearms section only has the capability to enter cartridge cases for search against the NIBIN database.

Cartridge cases recovered from crime scenes are imaged into the system and searched to find associations with other evidence in the database or from test fires from firearms that are submitted to the laboratory for testing that meet entry criteria.

The images from the test fires and evidence are compared automatically against the database. These images can be compared in a matter of minutes, an impossible task for a firearms examiner using conventional procedures. The images are correlated by the system and given a score as to a possible association. The results of this correlation are called NIBIN leads.

The firearms examiner makes a final determination by conducting a microscopic examination of the evidence generating the NIBIN Lead. If an association is confirmed, it becomes a NIBIN Hit. When a Hit has occurred, the involved law enforcement agencies are notified and they can then take the appropriate investigative and legal actions.

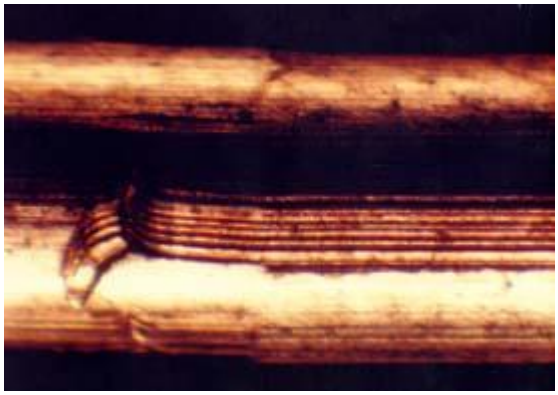
Evidence cartridge cases and test fires remain in the system to be searched indefinitely on an ongoing basis as new images are added. The database searches cartridge cases from scenes before and after the incident date, and test fires from submitted firearms only before the date of collection by the agency. If it is known by the agency that the firearm will leave law enforcement custody after test firing (ex. return to owner or sold to the public) please communicate this to the laboratory as this can be noted in the system and search criteria adjusted to continue searching the database after leaving agency custody. The images from the test fires and evidence are correlated automatically against the database for the NIBIN region encompassing the host site. Manual searches outside the region can be performed at the request of the submitting agency.

Toolmark Examination

The Firearm and Toolmark discipline receives tools suspected of being associated with a crime scene. Cutting, pinching, prying, and striking tools are all examined by this discipline. Great care must be taken by the officer to protect the marking surfaces on the tool. If the entire tool cannot be wrapped, the tool's marking

surface should be protected using whatever materials are available to the officer. It should be understood that tools found at the crime scene that cannot link a person to the scene will not be examined. Materials recovered from the crime scene that are suspected of being marked by the recovered tool should be carefully removed from the scene so that the marks are not disrupted. Any cuts made by the officer to remove the suspect areas should be clearly marked so as not to be confused with the suspect areas. Each item should be packaged separately and submitted to the laboratory.

Tools also leave unique marks that can provide important clues in linking a suspect to a crime. The photo on the right is a split screen comparison of copper wires cut by a wire cutter found in the possession of a burglary suspect. The test cut on the right matches the evidence cut from the crime scene on the left.



A maul recovered from a burglary suspect is compared against the indentation left in the victim's doorjamb.

The maul fits the indentation perfectly, providing local investigators with evidence to charge the suspect in the burglary.

Evidence Submissions

The following are general requirements for officers and other law enforcement personnel in collecting and submitting evidence for Firearm and Toolmark analysis. As in all cases, common sense should be used when attempting to protect the integrity of evidence.

Firearms

Firearms should be collected carefully so that no parts of the firearm are damaged. Officers should make sure that nothing comes in contact with either the inside of the barrel or the breech face, which is where the head of the cartridge rests before firing. All firearms must be unloaded prior to submission to the laboratory. If a firearm cannot be unloaded prior to submission to the laboratory, you **must** notify DOFS personnel for instructions **prior to submitting the firearm.** Insure that the container is clearly labeled 'LOADED FIREARM'. Loaded firearms must be hand delivered to laboratory staff – **do not** leave in the lock box.

Firearms Recovered From Water

Firearms removed from ***fresh*** water **must** be placed in the same water for submission to the laboratory. Small lunch coolers work very well for handguns. In the event that a rifle or shotgun is removed from a lake or pond but can't fit into a container, the firearm should be sprayed heavily with WD-40 or other lubricant and taken to the laboratory as soon as possible. The slightest bit of rust to the inside of the barrel will alter the individual characteristics necessary to make identification. If the firearm is removed from the water, it must be oiled, making sure that the inside of the barrel is sprayed or filled with oil. This will slow the oxidation process. Firearms removed from ***salt*** water should be rinsed, heavily oiled and brought to the crime laboratory. Heavily bloodstained firearms should be packaged in boxes with a biohazard label.

Protecting the Firearm from Damage

Do not insert foreign objects into any part of the firearm such as the barrel or ejection port. In the event the firearm will be dusted for fingerprints or super glued, block both ends of the barrel gently with tape. This will prevent residue from building up inside of the barrel. Do not dry fire or work the action of any firearm that is to be submitted to the crime lab. Leaving empty cartridge cases in the chamber of a revolver when submitted might assist the examiner in determining from which chamber the round was fired.

Bullets, Cartridge Cases and Cartridges

When bullets and cartridge cases are submitted for analysis, they should be individually packaged in their own canister, envelope, or other small container. Bullets (especially lead) should be lightly wrapped in tissue or cotton so that the bullet surface will be protected from possible damage.

- Do not mark or engrave any surface on a bullet or cartridge case as this may damage individual characteristics. If evidence must be marked, mark the container itself.
- Do not let any metal object such as forceps, knives or screwdrivers come into contact with a bullet. Metal objects will scratch the surface and alter the markings used for identification.
- Numerous cartridge cases recovered from the same area may be packaged together in one container to save time and supplies.
- Be sure to collect any wads or pellets in cases involving a shotgun. Under certain circumstances a wad can be matched to the barrel of a shotgun, especially if it has a sawed-off barrel.
- Film canisters or pillboxes make excellent containers for packaging bullets and cartridge cases.

Clothing

Clothing submitted to the laboratory to be checked for gunpowder should be packaged in a paper bag or box. Do not package wet or bloody clothes until they have air-dried. Wet clothes will mold, making them difficult to examine. Inform the firearms examiner of how the layers of clothing were worn in order to assist in determining the path of the bullet. This information should be written on the evidence bag or the submission form. The Firearms discipline also performs muzzle-to-target distance determinations. In order to perform this service, the firearm identified and any ammunition collected in connection with the shooting must also be submitted. If no firearm has been seized, the examination will be limited to a search for gunpowder or a gunpowder pattern.