



**VIRGINIA DEPARTMENT OF FORENSIC SCIENCE**  
**EVIDENCE HANDLING & LABORATORY**  
**CAPABILITIES GUIDE**

**FIREARMS & TOOLMARKS**

**Contact Information**

If you have any questions concerning the Firearms & Toolmarks examination capabilities or evidence handling procedures, please call the Training Section or the Firearms & Toolmarks Section at the Forensic Laboratory that services your area.

<b><u>Laboratory</u></b>	<b><u>Section Contact</u></b>	<b><u>Phone Number</u></b>
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## **OVERVIEW**

The primary role of the firearms examiner is the examination of firearms and ammunition components in an attempt to associate a particular firearm as having fired particular ammunition components, through microscopic comparison.

### **CAPABILITIES AND SERVICES**

#### **Mechanical Condition of Firearms**

Each firearm that is submitted to the Firearms Section is examined to determine whether it is in normal mechanical operating condition and is test fired, when possible. This examination includes the operability of the safety features, physical characteristics of the firearm and determination of manufacturer, model and serial number. Also, capability of full automatic fire is determined.

#### **National Integrated Ballistics Information Network (NIBIN)**

DFS has a formal agreement with the ATF to enter ballistic information into NIBIN and exchange information. Digital images of the markings on fired cartridge/shotshell cases recovered from a crime scene or test fires from submitted semiautomatic pistols and semiautomatic, slide-action, and bolt-action and lever-action rifles and shotguns are acquired and searched against a database. The Department's NIBIN system is set up to search specimens submitted at all four of the DFS laboratories. Other state or regional NIBIN databases can be searched on a case by case basis if the criminal event involves multiple jurisdictions outside of Virginia. If a potential association is found, a Certificate of Analysis or letter will be issued to the affected agencies requesting the evidence be resubmitted if a confirmation of the association is needed to support any agency's investigation.

#### **Identification of Firearm Parts**

Firearm parts found at a crime scene may be identified as to:

- a. The type of firearm from which they originated
- b. Whether the part came from a firearm submitted as evidence (Fracture Match)

#### **Identification of Brand**

Bullets, wad components, cartridge cases and shotshell cases recovered at a scene or from a body may be identified by brand.

#### **Possible Brand and Caliber of Firearm**

By determining the class characteristics (caliber, number of lands and grooves, direction of twist and their dimensions, breechface and/or firing pin shapes, other various markings) exhibited on fired ammunition components (bullets, cartridge cases, shotshell cases), the firearms examiner may be able to provide information concerning the brand and type of firearm in which the

component was fired. This may be particularly useful when no firearm has been recovered.

### **Bullet Identification to a Particular Firearm**

When a rifled firearm is manufactured and through its use, unique microscopic markings (striae) are left on the inner surface of the barrel. When the firearm is fired, these striae are imparted on the bullet. These striae are individual to a particular firearm.

When a firearm is submitted to the laboratory for comparison, the examiner test fires the firearm and uses a comparison microscope to compare the striae of the test fired bullet to those present on the evidence bullet, if the evidence bullet is suitable for comparison. By this microscopic comparison of the markings on both bullets, the examiner can determine if the evidence bullet was fired from the submitted firearm. The following conclusions may be reached:

- a. The bullet was identified as having been fired from the firearm.
- b. The bullet was eliminated as having been fired from the firearm.
- c. It is not possible to identify or eliminate the bullet as having been fired from the firearm.

### **Firearm Not Recovered**

Bullets and cartridge cases/shotshell cases recovered from the same or different incidents can be compared to determine if they were fired from/in the same firearm.

### **Bullet Fragments**

The firearms examiner may be able to provide the same type of information from a bullet fragment as that of a whole bullet. A bullet fragment can be identified as having been fired from a particular firearm if sufficient marks are present. The quantity and quality of these marks are determined by microscopic examination. All bullet fragments should be collected and submitted to the laboratory.

### **Cartridges**

If the cartridge has been cycled (loaded, extracted and ejected) through the action of a bolt-action, lever-action, slide-action or autoloading firearm, the markings left by this process may be associated with a particular firearm. In some cases markings left on cartridges may be associated to a particular magazine. If these types of marks are present on cartridges, it may also be possible to associate them to cartridge cases, if no firearm has been recovered.

### **Cartridge Cases**

Generally, there are five surfaces of a firearm that may leave identifiable marks on various areas of a cartridge case: breechface, firing pin, extractor, ejector and chamber. Generally, if a fired cartridge case can only be identified to a particular firearm by the extractor and/or ejector mark(s), this only identifies the cartridge case as having been extracted and/or ejected (i.e., cycled) in a particular firearm.

### **Shotshells**

These may be associated to a firearm in the same manner as cartridges. The gauge may be determined and the brand of the components may be characterized.

### **Shotshell Cases**

These may be identified in the same manner as a fired cartridge case. In addition, the components that may have been commercially loaded into the shotshell may be identified.

### **Shotshell Components**

Recovered wad material and/or projectiles may be identified as to gauge, type, and/or brand of commercial manufacture.

### **Saboted Ammunition**

A sabot is a plastic enclosure around a bullet/projectile that allows a smaller diameter and lighter weight projectile to be fired. The Remington Accelerator™ cartridge and sabot slugs (for shotguns) are two examples of this type of ammunition. When sabot ammunition is used, the microscopic markings from the barrel will be imparted onto the sabot rather than the bullet. This means the bullet/slug cannot be identified with the firearm that fired it, but it may be possible to identify the sabot.

### **Distance (Proximity) Determination**

The approximate distance the muzzle of a firearm was from an object at the time of firing may be determined by examining clothing or other materials for the presence of gunshot residues. This should not to be confused with primer residue as discussed under [Trace Evidence – Primer Residue](#). Gunshot residues are discharged from the firearm in the form of burnt, partially burnt and un-burnt gunpowder particles, vaporous lead and particulate metals. When packaging objects thought to contain gunshot residues, use packaging techniques that protect the surface and minimize possible cross contamination.

The firearm and all ammunition components associated with the firearm should be submitted along with the object to allow for a thorough examination for approximate distance. With the exception of contact shots, near contact shots or maximum distance determination, the elements needed to perform valid muzzle-to-target distance determinations include:

- Firearm
- Fired cartridge/shotshell case(s) or projectile that can be identified to the firearm
- Appropriate ammunition (at least one evidence cartridge of same brand, load, and caliber as the item identified to the firearm)
- Questioned pattern

In the absence of the elements listed above, clothing and other objects may be evaluated for the presence of gunshot residues on a case-by-case basis (consult with a Firearm Section supervisor prior to submission).

Pellet patterns can also be examined for distance determination based on the rate of pellet spread over a given distance for a particular weapon and ammunition.

## Donations of Firearms or Ammunition

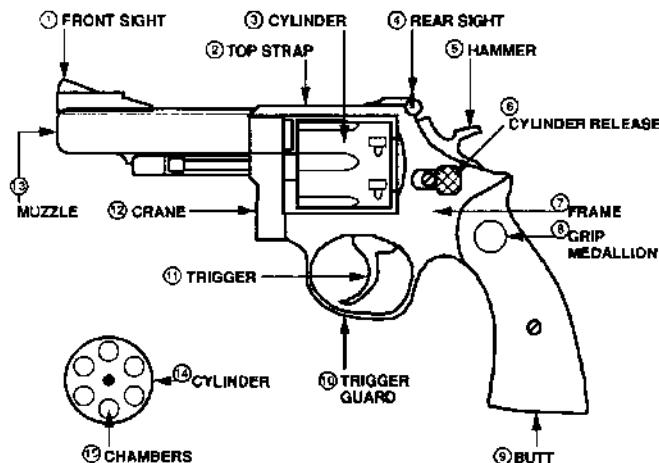
DFS may accept firearm or ammunition donations from police departments and sheriff's offices for scientific purposes as part of the firearm or ammunition reference collection once the criminal case is complete and the owner of the firearm is legally unable to retain the firearm or no longer wishes to keep it.

Contact the appropriate Firearm Section supervisor prior to submitting a donation.

## FIREARMS NOMENCLATURE & DEFINITIONS

### HANDGUNS

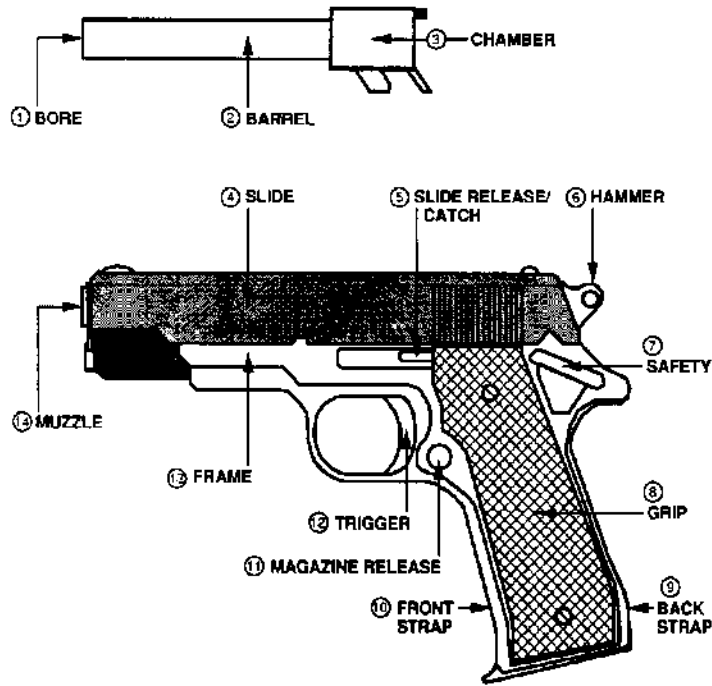
**Revolvers** A firearm, usually a handgun, with a cylinder having several chambers so arranged as to rotate around an axis and can be discharged successively by the same firing mechanism



**Pistol** A repeating firearm requiring a separate pull of the trigger for each shot fired, and which uses the energy of discharge to perform a portion of the operating or firing cycle.

**Magazine** A container for cartridges which has a spring and follower. The magazine serves to provide a new cartridge for loading into the chamber of the firearm during the firing cycle.

**Clip** A detachable metal frame or box, generally disposable, which contains cartridges and serves to facilitate the loading of an internal magazine. *Not to be confused with a magazine.*



## SHOULDER GUNS

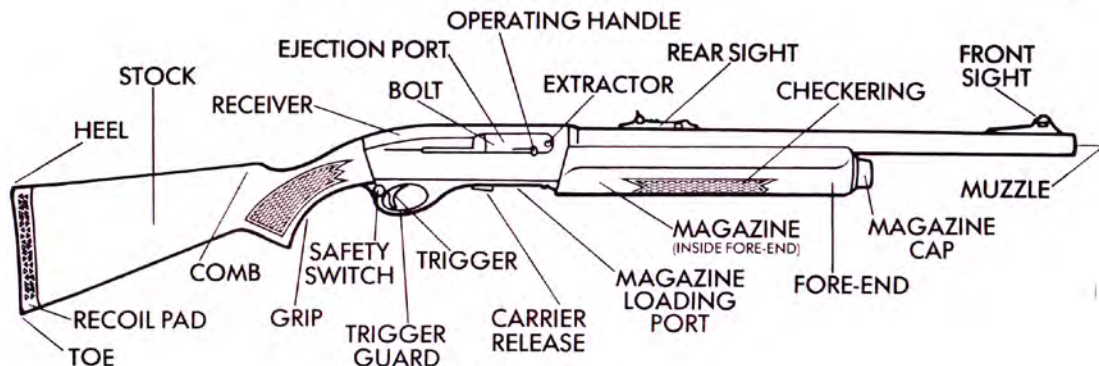
### Rifle

A firearm having rifling in the bore and designed to be fired from the shoulder.

### Shotgun

Generally, a smooth bore shoulder firearm designed to fire a shotshell containing numerous pellets or sometimes a single projectile (slug). Shotguns can also be equipped with a rifled barrel.

### Semiautomatic Rifle or Shotgun Schematic



## AMMUNITION COMPONENTS

<b><u>Bullet</u></b>	A non-spherical projectile designed for use in a rifled barrel.
<b><u>Cartridge</u></b>	A single unit of ammunition consisting of the cartridge case, which contains a primer, propellant, and the bullet or projectiles.
<b><u>Cartridge Case</u></b>	The metallic container, which is no longer filled with the components that originally comprised the cartridge.
<b><u>Shotshell</u></b>	A single unit of ammunition consisting of the shotshell case, which contains a primer, propellant, and one or more projectiles.
<b><u>Shotshell Case</u></b>	The shotshell container, which may be plastic or paper, which is no longer filled with the components that originally comprise a shotshell.
<b><u>Shotshell Wad</u></b>	The components of a shotshell, which typically separate the powder and projectiles, and are used to adjust the volume of the contents of the shotshell. Wads are made of a variety of material types (e.g., circular cardboard, fiber or felt disks, plastic one-piece or multi-piece shot cup and/or shot columns).
<b><u>Slug</u></b>	A term applied to a single projectile loaded into shotshells.
<b><u>Shot</u></b>	Pellets ranging in size, normally loaded into shotshells. (Note: there are several cartridges currently available for handguns that contain pellet loads)

## COLLECTION GUIDELINES

**\*\*PLEASE REFER TO THE RECOMMENDED SAFETY PROCEDURES FOR FIREARM SUBMISSION UNDER [EVIDENCE SUBMISSION](#)\*\***

**ITEM** - Firearms (handgun or shoulder gun)

**METHOD** - All firearms to be submitted to the laboratory should be made safe. Unload firearms after properly documenting the cylinder in revolvers or the chamber and magazine in pistols, rifles and shotguns. Consider recovery of DNA, trace evidence or latent prints do not process in field). Package firearms in a rigid container, seal, mark container and indicate condition of firearm on container as **LOADED** or **UNLOADED**. Firearms submitted for DNA or trace evidence must be sealed with tape over all edges and any openings (such as holes in the box) prior to submission (see example under [Evidence Submission](#)).

**DISCUSSION** - Safety is the first consideration, therefore, firearms should be unloaded

prior to delivery to the laboratory. If this is not possible, call the Firearms Section prior to submission and make sure the packaging material is marked **LOADED FIREARM**. Packaging material may rub latent prints and destroy evidence, therefore, it is important to package in a manner so the gun contacts the packaging material as little as possible. Documenting the cylinder in a revolver may help determine the sequence of events and aid in scene reconstruction. It is requested that you do not package guns in plastic.

**ITEM – Firearms found in water**

**METHOD –** Place the firearm in a container of the same water and immediately submit the item.

**DISCUSSION -** When a firearm is found in water, leaving the firearm in the same water will slow the rusting process.

**ITEM – Bullets, shot pellets, slugs and shotshell wads**

**METHOD -** Recover using rubber tipped forceps or gloves, so as not to contaminate or add trace or other biological evidence. Place in a plastic zip lock bag. Package projectiles separately, clearly label and seal properly. Do not mark evidence with item numbers, initials, date or other information. Place the necessary information on the packaging. Bullets, etc. collected in the emergency room should be washed off with water (not disinfectants) and air dried before packaging. Body fluids may destroy some microscopic markings.

**DISCUSSION -** Handling these items with your fingers may add additional trace or biological evidence. Bullets, etc. should be handled as if biohazards are present and in a manner to protect any trace evidence, such as fibers, paint or DNA that may be present. The chain of custody can be maintained by marking the packaging material.

**ITEM - Cartridge, cartridge case, shotshell, shotshell case**

**METHOD -** Recover using rubber tip forceps or gloves so as not to obliterate fingerprints, or damage trace evidence. Cartridges, cartridge cases, shotshells and shotshell cases may be placed in a plastic evidence bag. Properly label and seal the container. Never mark the head stamp area or other portions of the cartridge, cartridge case, shotshell or shotshell case. In incidents where the use of sabot ammunition is suspected, the investigator should be aware that the sabot may have separated from the projectile (bullet or slug).

**DISCUSSION -** Handling these evidence items may destroy fingerprint evidence. The marks in the head stamp area and other portions are used in the laboratory comparison and identification process. Ammunition found at the scene or in the suspect's house may be helpful in the comparison process. The sabot bears the identifying marks (the bullet/slug in this instance does not).



**ITEM** - Clothing for distance (proximity) determination exams

**METHOD** - Completely air dry the clothing. Place clothing item flatly onto a clean piece of butcher paper sufficiently larger than the item itself. Place additional paper inside article of clothing to separate the layers. Place another piece of paper that is slightly smaller than the first, but still covers the entire item, over the item and roll or fold it over onto itself so no openings are exposed. Properly label and seal the container ([Clothing in Paper Baffles](#)). Also, please submit the autopsy report from the Office of the Chief Medical Examiner, the police report, room size, constraints, witness/suspect statements, and any information that may be pertinent to the investigation.

**DISCUSSION** - This packaging approach ensures that the area of the clothing bearing the gunshot residue will not come in contact with other areas of the garment. This is also a good procedure for bloody garments. Plastic will cause the biological material on the clothing to deteriorate, even if it is thoroughly air dried.

## **Toolmarks Overview**

Toolmark Identification is a discipline of forensic science which has as its primary function to determine if a toolmark was produced by a particular tool. Toolmark cases may involve any type of criminal activity, ranging from burglary to homicide. Toolmarks may be encountered on many varied surfaces including wood and metal, therefore, all cases and many surfaces should be considered for potential toolmarks.

The examination of toolmarks involves an attempt to associate a particular toolmark with a particular tool through microscopic comparison. Toolmark examinations also include identification of objects which forcibly contacted each other, were joined together under pressure for a period of time and then removed from contact or were originally a single item before being broken or cut apart.

### **TOOLMARKS NOMENCLATURE & DEFINITIONS**

<b><u>Tool</u></b>	An object used to gain mechanical advantage; the harder of two objects which when brought into contact with each other, results in the softer one being marked.
<b><u>Toolmark</u></b>	A mark produced on a softer receiving surface by a harder object.
<b><u>Cast</u></b>	The reproduction of a toolmark or the surface of a tool using a molding material such as silicone rubber, Mikrosil™, Forensic Sil™, Kerr Permlastic™ or other suitable material.

## **CAPABILITIES AND SERVICES**

### **Examination of the Toolmark Prior to the Recovery of a Suspect Tool**

The laboratory can provide information to the investigating officers through the examination of the toolmark. The possible determinations are as follows:

1. Type of tool used (class characteristics)
2. Size of tool used (class characteristics)
3. Unusual features of tool (class and/or individual characteristics)
4. Action employed by tool in its operation
5. Most importantly, examination can determine if the toolmark is of value for identification purposes

### **Examination of the Suspect Tool with a Toolmark**

The tool will be examined for foreign deposits such as paint or metal for comparison against the marked object. This trace evidence may help to associate the tool with the marked surface; however, the trace evidence in these circumstances usually provides class characteristic evidence.

After the examination for foreign materials, class characteristics are compared to establish consistency. Finally, several test marks are made with the suspect tool, and microscopic comparisons of the test against the questioned toolmark are made. Three possible conclusions may be reached:

1. That the tool produced the toolmark
2. That the tool did not produce the toolmark
3. That there are not sufficient corresponding individual characteristics between the known and the unknown to determine if the tool did or did not produce the mark

## **PRESSURE OR CONTACT EXAMINATIONS**

These examinations may make it possible to associate any two objects that were in contact momentarily or for more extended time

## **COLLECTION GUIDELINES**

### **ITEM - Toolmarks**

**METHOD** - If the object bearing the toolmark is reasonably mobile, bring the entire object to the laboratory. Protect the toolmark area by covering it carefully with paper; however, always consider latent fingerprints, trace evidence, paint, etc. when packaging. If the object is particularly large or is completely immobile, the toolmark area may be cut out (depending on the situation, e.g., security considerations and damage to property) or cast using a suitable casting material. Package the toolmark cast in a rigid container (such as a pill box), properly seal and label. Include mid-range or orientation photographs, sketches and reports.

DO NOT place suspect tool into toolmark as it could destroy markings or transfer trace evidence.

**DISCUSSION** - The actual toolmark is preferred over a cast of the toolmark; therefore, the microscopic marks need to be protected to provide the best possible results. Submission of photographs, sketches and reports may help the examiner determine the action of the tool.

### **ITEM - Tools**

**METHOD** - Do not submit a tool for toolmark comparison until it can be associated with a suspect (e.g., it was seized from the suspect's possession/property or it has been associated to that suspect through forensic evidence). If fingerprints are a consideration, package in a manner to immobilize the item and/or to reduce the contact with the packaging material. Do not place any identifying marks on the tool.

Package in a manner to protect the working end of the tool (e.g., on a screwdriver place a paper fold over the tip). After the working end has been protected, place in a rigid container.

**DISCUSSION** - Fingerprints can associate a suspect with the tool. Wrapping the working end of the tool will protect the microscopic characteristics of the tool as well as trace evidence.

### **ITEM - Drill**

**METHOD** - Consider fingerprints, protect the drill bit, and recover any drill shavings on the tool or in the tool box. Package shavings in a rigid container and cushion with tissue. Seal and label properly.

**DISCUSSION** - Although microscopic markings on drill bits change with use, drill shavings found on the tool or in the tool box may have been produced during the same time frame as those recovered at the scene. The rigid container will help protect this fragile evidence.

**ITEM - Drill Shavings (Scene)**

**METHOD** - Packaging same as drill shavings from the drill

**SPECIALIZED TOOLMARK EXAMINATIONS****Fracture Match**

Fracture match examinations are conducted to associate items such as broken bolts, automobile ornaments, tips of knives and screwdriver blades with objects from which they were broken.

**COLLECTION GUIDELINES**

**ITEM** - Items to be examined for fracture match (examples: broken tools, glass, vehicle parts )

**METHOD** - Package in a manner that will protect the edges of the items to be fracture matched. For example, when submitting glass, wrap and package each piece separately and clearly label and seal. In the request clearly indicate which items should be compared. For fragile items such as paint, a rigid container cushioned with tissue is probably best.

**DISCUSSION** - The edge will contain the areas to be fracture matched. If these areas are damaged it may prevent any possibility of a successful match.

**Serial Number Restorations**

Serial numbers provide a means of identifying and tracing items of equipment, vehicles, guns and other products using this form of identification. The numbers or letters are **usually** stamped into a metal surface. Serial numbers can be obliterated using several different techniques, such as scraping, grinding, punching or filing. Frequently the damage is limited to the surface with the intention to make the number unreadable. Often the stamping methods deform the metal below the surface and allow for the recovery of the serial number. Procedures performed in the laboratory may enable the examiner to restore and document the number.

**COLLECTION GUIDELINES**

**ITEM** - Obliterated Serial Numbers

**METHOD** - Protect the area needing restoration. Do not attempt to restore the number in the field.

**DISCUSSION** - The first attempt to restore the number is the most productive and further attempts will likely destroy the evidence.