Bullet and Cartridge Comparison

As a bullet passes through the barrel of a gun, the barrel leaves distinct markings on the bullet. So if a bullet is found at the scene of a crime and another test fired from a suspect's gun show the same markings, the suspect is linked to the crime.

The Gun Barrel
The gun barrel is produced from a solid bar of steel that has been hollowed out by drilling. The drill marks left on the barrel's inner surface are randomly irregular and unique to each barrel.

The next step is to create spiral grooves. This is known as rifling. The surfaces of the original bore remaining between the grooves are called lands.

interior of firearm barrel diameter is caliber
As the bullet travels through the barrel, it engages rifling grooves; these grooves guide the bullet through the barrel giving it a rapid spin.

The diameter of the bore is the caliber, and they are recorded in hundredth of an inch or in mm. For example, .22 caliber or 9 mm. The caliber number isn't exact. Example - a .38 caliber weapon may actually have a bore diameter that ranges from 0.345 to 0.365

**Rifling Methods**

Every firearms manufacturer chooses a rifling process best suited to meet the production standard and requirements of the product. Once the choice is made, the class characteristics of the barrel will remain consistent; each will have the same lands and grooves, with the approximate width and direction of twist.
For example, .32-caliber Smith & Wesson revolvers have 5 lands and grooves twisting to the right.

On the other hand, Colt .32-caliber revolver exhibit 6 lands and grooves twisting to the left.

Although these class characteristics permit the examiners to distinguish one type or brand name of weapon from another, they do not impart individual characteristics.
If you would to cut a barrel open lengthwise, a careful examination of the interior would reveal striations. These striations are impressed into the metal as the negatives of minute imperfections found the rifling cutter's surface. The random distribution and irregularities of these markings are impossible to duplicate exactly in two barrels.

No two rifled barrels even those manufactured in succession, have identical striation markings.

Comparing Bullet Markings

As the bullet passes through the barrel, its surface is impressed with rifle markings of the barrel. The bullet emerges from the barrel carrying the impressions of the bore's interior surface; these impressions reflect both the class and individual characteristics of the barrel.
Because there is no practical way of making a direct comparison between the markings on the fired bullet and those found within the barrel, the examiner must obtain test bullet's fired through the suspects barrel for comparison. To prevent damage to the test bullet's markings and to facilitate the bullet recovery, test firings are normally made into a recovery box filled with cotton or into a water tank.

filled with ballistic fiber

data tank
Any differences in these class characteristics immediately eliminate the possibility that both bullets traveled through the same barrel.

If both bullets carry the same class characteristics, the analyst must begin to match the striated markings on both bullets. This is done with a comparison microscope.
Considerations in Bullet Comparison

Unfortunately, the firearms examiner rarely encounters a perfect match all around the bullet's periphery. The presence of grit and rust can alter the markings on the bullets fired through the same barrel. More commonly, recovered evidence bullets may become so mutilated and distorted on impact as to yield only a small area with intact markings.

Frequently, the firearms examiner receives a spent bullet without an accompanying suspect weapon and is asked to determine the caliber and possible make of the weapon. If a bullet appears not to have lost its metal, its weight may be one factor in determining its caliber.
Example-
A bullet that has five lands and grooves and twist to the right could not come from a weapon manufactured by Colt because Colts don't have these class characteristics. Colts have 6 lands and grooves and twist to the left.

FBI maintains a record known as General Rifling Characteristics File. This file has lands and grooves width dimensions for known weapons.
Unlike rifled firearms, a shotgun has a smooth barrel. So the projectiles passing through the barrel don't have any markings that can relate it back to the gun.

Shotguns fire small lead balls or pellets contained within a shotgun shell. A paper or plastic wad pushes the pellets through the barrel on ignition of the cartridge's powder charge. By weighing and measuring the diameter of the shot recovered at the crime scene, the examiner can usually determine the size of the shot used in the shell. The size and shape of the recover wad may also reveal the gauge of the shotgun used and, in some instances may indicate the manufacturer of the fired shell.

Gauge - diameter of the shotgun barrel

- Higher the gauge, the smaller the diameter
  - Example: a 12-gauge shotgun has a bore diameter of 0.730"
  - A 16-gauge shotgun has a 0.670" diameter
  - Exception: .410-gauge shotgun has a barrel of 0.41"
GAUGE SIZES

<table>
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<th>GAUGE</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>28</th>
<th>410*</th>
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<tbody>
<tr>
<td>Diameter in inches</td>
<td>.780</td>
<td>.727</td>
<td>.670</td>
<td>.617</td>
<td>.550</td>
<td>.410</td>
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* Shot comes in a variety of sizes. See chart below.
* Wad: The one piece AA wad is designed to produce more consistent patterns by protecting the shot and ensuring reliable powder combustion.
* Powder: Winchester now end improved powders burn cleanly and consistently for more uniform patterns and velocities.
* Primer: Shotshell primers are designed for quick, sure ignition.

* is named by its bore size, not by its gauge. ** Gauges are shown at 70% scale.
Cartridge Cases

The act of pulling the trigger releases the weapon's firing pin, causing it to strike the primer, which in turn ignites the powder. The expanding gasses generated by the gunpowder propel the bullet forward through the barrel at the same time as pushing the cartridge case or shell back with equal force against the breechface.

As the bullet is marked by its passage through the barrel, the shell is also impressed with markings by its contact with the metal surfaces of the weapon's firing and loading mechanisms. These markings can be reproduced in test firings for comparisons.
The shape of the firing pin is impressed into the soft metal of the primer on the cartridge case, revealing minute distortions of the firing pin. The breechface is also impressed on the cartridge case. The breechface also has striations that become highly distinctive. Other markings that may appear on a shell as a result of metal-to-metal contact are caused by the extractor and ejector mechanism.

Mechanism in a firearm by which a cartridge of a fired case is withdrawn from the chamber

Firing pin, breechface, extractor, and ejector marks may also be impressed on shells fired by a shotgun

The mechanism of a firearm that throws the cartridge or fired case from the firearm