Ballistics

Come in and get your notebooks out. We have notes today!
History of Gunpowder and Firearms

- The Chinese invented gunpowder over a thousand years ago.
- Muzzle-loading matchlocks used wicks to ignite the gunpowder.
- The cartridge and breech loading followed.
- Rifling provided greater accuracy.
- Revolver, semi-automatic, and automatic handguns were developed.
Different Types of Firearms

* Semiautomatic 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.

* Revolver
  A firearm with a cylinder having several chambers so arranged as to rotate around an axis and be discharged successively by the same firing mechanism.*
  Double Action - A mechanism in which a single pull of the trigger cocks and release the hammer.
Firearm Nomenclature

- Slide
- Barrel
- Extractor
- Trigger
- Hammer
- Safety
Firearm Nomenclature

- Cylinder
- Trigger
- Hammer
- Barrel
- Breechface
- Firing Pin
Firearm Nomenclature

Breech face
Ejector
Firing Pin Aperture
Extractor
Basic Operation

1. Pull the trigger and the firing pin of the firearm hits the base of the cartridge, igniting the primer powder mixture.

2. The tiny explosion—not much more than a spark—of the primer powder mixture on the anvil delivers a spark through the flash hole to the main gunpowder supply.

3. The main gunpowder supply ignites, and the pressure of the explosion pushes the bullet from the casing and into the barrel of the firearm. The amount of gunpowder and the mass of the projectile in a cartridge determines the speed of the bullet.

4. The bullet follows the lands and grooves pattern of the barrel and begins its spiral before it leaves the barrel.

DID YOU KNOW: Shotgun shells are measured in gauge. The 10-gauge, 12-gauge, 16-gauge, or 20-gauge refers to the number of round lead balls per pound of load in the shot. The larger the gauge number, the smaller the inside diameter of the barrel would be. A 12-gauge shotgun will propel fewer (but larger-sized) lead shot than a 20-gauge shotgun.
Each barrel has four class characteristics

1. Caliber (bore diameter: .357, .22, .45)
2. Number of lands and grooves
3. Direction of twist
4. Width of the lands and grooves
Class Characteristics - Measured

• All class characteristics are measurable

  • Caliber
  • Number of lands and grooves
  • Width of the lands and grooves
  • Direction of twist
Individual Characteristics

• If we look beyond the lands and grooves under a microscope, we can also see microscopic scratches called striations.

• These microscopic scratches are a by-product of the manufacturing process and are totally unique to a particular firearm making them individualistic.

Real Striation Comparison under a microscope
**Figure 17-11.** Depending on the firearm and cartridge used, the fire pin mark appears on the rim or the center of the spent cartridge.

**Figure 17-12.** Breech marks come in various forms, sometimes as parallel lines, circular lines, or stippled at the bottom of the cartridge casings.

- **Center-fire impression comparison.**
- **Circular breech mark pattern.**
- **Rim-fire impression comparison.**
- **Stippled breech mark pattern.**
Gunshot Residue

Particles of unburned powder and traces of smoke are the residues of gunshots. They can leave a trace on the hand, arm, face, hair, or clothing of the shooter. They can also leave a trace on the victim.
Gunshot Residue

Chemical testing often can detect residue even if removal is attempted.

The distance from the victim to the shooter can be determined by examination of the residue pattern on the victim.
Entrance Wounds

- Are generally smaller than the size of the bullet, because the skin is somewhat elastic and stretches when a bullet enters the body
- If clothing is penetrated first, fibers may be embedded in the wound pointing in the direction of penetration
- GSR is usually found only on entrance wounds
- If the muzzle is in contact with the skin, the hot gases released from the muzzle flash may burn the skin
Exit Wounds

- Are usually larger, because as the bullet moves through the body, it may collect and carry body tissue and bone with it.
- Because bullets do not travel smoothly through a victim’s body, a larger, more irregular exit wound may occur.
- Sometimes bullets do not exit.
- High-speed bullets are more likely to pass through the body.
- Lower caliber bullets, such as a .22, tend to lodge within the body.
• Two reference points are needed to define the trajectory.

• Investigators can figure the shooter discharged the firearm somewhere along that line.

\[
\begin{align*}
\text{Distance to window} & = \text{Distance to shooter (a)} \\
23.9 \text{ inches} & = a \\
23.5 \text{ inches} & = 720 \text{ inches} \\
\end{align*}
\]

\[
\begin{align*}
a &= 732.3 \text{ inches} \\
\text{Hypotenuse} &= \text{distance to the shooter} \\
a &= \text{distance to the building} \\
b &= \text{height of the shooter from the horizon, not from the ground} \\
\text{Hypotenuse}^2 &= (a)^2 + (b)^2 \\
(732.3 \text{ in})^2 &= (720 \text{ in})^2 + b^2 \\
536,300 \text{ in}^2 &= 518,400 \text{ in}^2 + b^2 \\
536,300 \text{ in}^2 - 518,400 \text{ in}^2 &= b^2 \\
17,900 \text{ in}^2 &= b^2 \\
b &= 133 \text{ in} \sim 11 \text{ ft}
\end{align*}
\]

If the building is 60 feet away, then the shooter was about 11 feet higher than the height of the bullet hole in the seat, which was at 4 feet. This height of about 15 feet off the ground (11 ft plus 4 feet) predicts that the shooter was on the second floor.
A car’s seat has been shot through the car’s window. The bullet hole is located four feet above the ground. The nearest building is 60 feet away along the horizon. If the trajectory angle is found to be 10°, from the horizon, at what height was the bullet fired?

Using the law of Tangents

- Law of Tangents!

\[
\tan \text{ of Trajectory Angle} = \frac{\text{height}}{\text{distance}}
\]

- \( \tan 10^\circ = \frac{\text{height}}{60 \text{ ft.}} \)

\[ \frac{.176}{1} = \frac{\text{height}}{60 \text{ ft.}} \]

height = 10.56 ft. = 11 ft.

The bullet was fired 15 ft. above the ground.