WESCO MAGAZINE

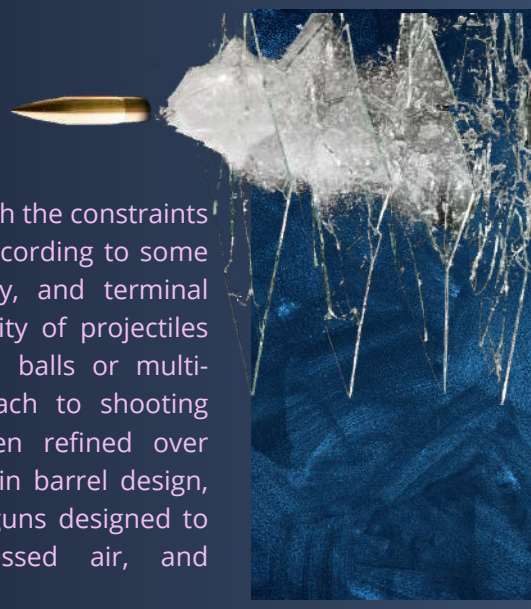
Excuse the pun !

Decoding Impact:

"The Critical Role of TERMINAL BALLISTICS in Forensic Science"

Terminal ballistics is a sub-field of ballistics concerned with the behaviour and effects of a projectile when it hits and transfers its energy to a target.

Bullet design (as well as the velocity of impact) largely determines the effectiveness of penetration.
The concept of terminal ballistics can be applied to any projectile striking a target. Much of the topic specifically regards the effects of small arms fire striking live targets, and a projectile's ability to incapacitate or eliminate a target.
Common factors include bullet weight, composition, velocity, and shape.



Class of projectile

Projectiles are primarily designed for compatibility with the constraints of the device used to launch them, and secondarily according to some balance of logistical practicality, practicable accuracy, and terminal effect. Prior to the development of rifling, the majority of projectiles purpose-built for shooting consisted of fitted round balls or multi-projectile shot loads. In modern times, this approach to shooting persists, along with other methods that have been refined over centuries in unique settings. In addition to advances in barrel design, means of propulsion have also diversified, including guns designed to use black powder, smokeless powder, compressed air, and electromagnetic force."

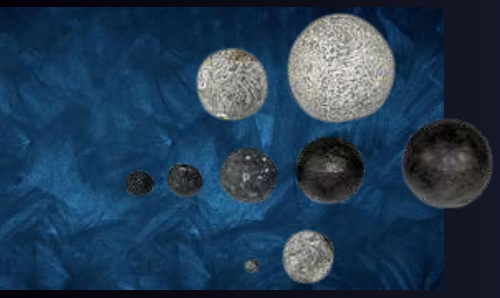
Ammunition and its components can be categorized in various ways. Among other factors, it may be classified according to the shape, weight, and dimensions of a projectile or cartridge, the customary charge of powder, velocity, intended purpose, and recommended applications. Though some projectiles and ammunition are designed specifically for target shooting, the minimal powder charges necessary to propel a metal projectile down the length of a barrel can still be potentially lethal and should be treated as such.

Conventional forms of projectiles:

- **Round Ball** - Spherical in shape prior to loading, used in smooth or rifled barrels.
- **Shot** - multi-projectile load, typically spherical or semi-spherical, best used in smoothbores.
- **Slug** - A nose heavy design that uses air drag from a light hollowed base or wad to aid stability.
- **Pellet** - (Specific) A self-sealing, non-spherical projectile, typically designed to obturate with a rear skirt.
- **Bullet** - (Specific) A semi-cylindrical projectile, often with a frontal nose, stabilized gyroscopically from rotation.

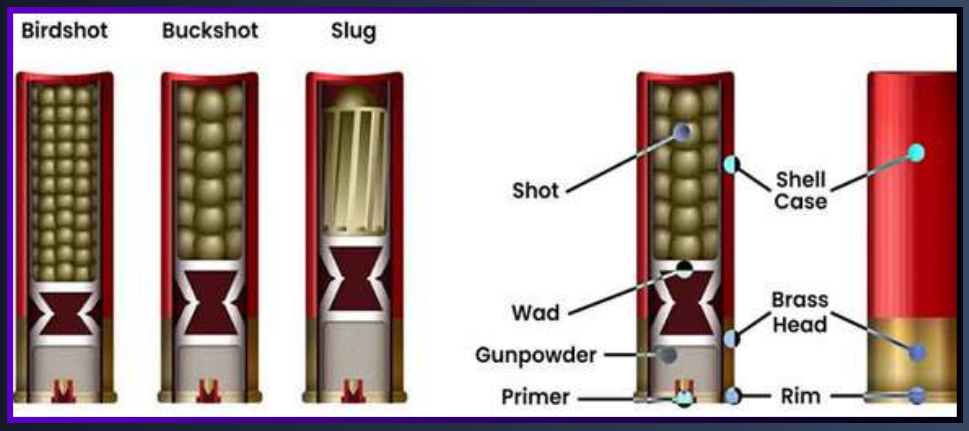
For short-range target shooting, typically on ranges up to 50 meters (55 yards) with low-powered ammunition like a .22 long rifle, aerodynamics is relatively unimportant, and velocities are low compared to those attained by full-powered ammunition. As long as a bullet's weight is balanced, it will not tumble; its shape is thus unimportant for aerodynamics. For shooting at paper targets, bullets that punch a perfect hole through the target—called wadcutters—are preferred. They have a very flat front, often with a relatively sharp edge along the perimeter, which punches out a hole equal to or almost equal to its diameter, enabling unambiguous scoring of the target. Since cutting the edge of a target ring results in a higher score, accuracy to within fractions of an inch is desirable.

Round Ball



Round shot from the 16th century Mary Rose English warship, showing both stone and iron balls.

Shot and Slug

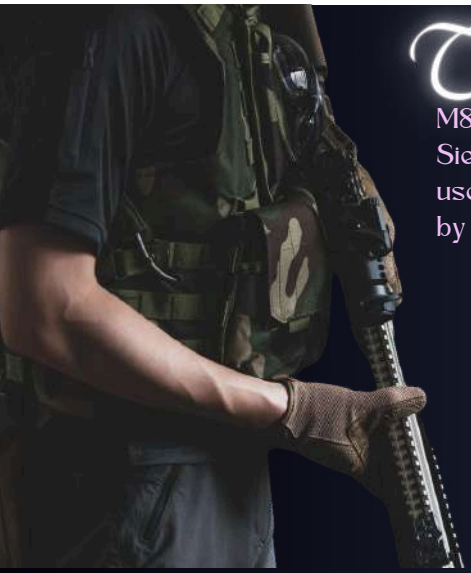


Bullet

Pellet

Magazine-fed pistols tend not to reliably feed wadcutters because of their angular shape. To address this, the semi-wadcutter is often used. The semi-wadcutter consists of a conical section that comes to a smaller flat point, with a thin, sharp shoulder at the base of the cone. The flat point punches a hole, and the shoulder opens it up cleanly. For steel targets, the goal is to provide enough force to knock over the target while minimizing damage to it. A soft lead bullet, jacketed hollow-point bullet, or soft-point bullet will flatten out on impact (if the velocity at impact is sufficient to cause deformation), spreading the impact over a larger area of the target. This allows more total force to be applied without damaging the steel target.

There are also specialized bullets designed for use in long-range precision target shooting with high-powered rifles. The designs vary somewhat from manufacturer to manufacturer. Research in the 1950s by the U.S. Air Force discovered that bullets are more stable in flight for longer distances and more resistant to crosswinds if the center of gravity is biased toward the rear of the center of pressure. The MatchKing bullet is an open-tip match design with a tiny aperture in the jacket at the point of the bullet and a hollow air space under the point, whereas previous conventional bullets had a lead core that extended all the way to the point.



The U.S. military now issues ammunition to snipers that use bullets of this type. M852 Match and MII8LR ammunition are issued, for the 7.62×51mm chamber: both use Sierra MatchKing bullets: for 5.56×45mm those U.S. Navy and U.S. Marine snipers who use accurized M16-type rifles are issued the Mk 262 Mod 0 cartridge developed jointly by Black Hills Ammunition and Crane Naval Surface Warfare Center.

For ultra-long-range precision target shooting with high-powered rifles and military sniping, radically designed very-low-drag (VLD) bullets are available that are generally produced out of rods of mono-metal alloys on CNC lathes. The driving force behind these projectiles is the wish to enhance the practical maximum effective range beyond normal standards. To achieve this, the bullets have to be very long and normal cartridge overall lengths often have to be exceeded. Common rifling twist rates also often have to be tightened to stabilize very long projectiles. Such commercially non-existent cartridges are termed "wildcats". The use of a wildcat-based (ultra) long-range cartridge demands the use of a custom or customized rifle with an appropriately cut chamber and a fast-twist bore.

Maximum penetration

For use against armoured targets, or large, tough game animals, penetration is the most important consideration. Focusing the largest amount of kinetic energy and projectile mass on the smallest possible area of the target provides the greatest penetration. Bullets for maximum penetration are designed to resist deformation on impact and usually are made of lead that is covered in a copper, brass, or mild steel jacket (some are even solid copper or bronze alloy). The jacket completely covers the front of the bullet, although often the rear is left with exposed lead (this is a manufacturing consideration: the jacket is formed first, and the lead is swaged in from the rear). For penetrating substances significantly harder than jacketed lead, the lead core is supplemented with or replaced with a harder material, such as hardened steel.

Military armour-piercing small arms ammunition is made from a copper-jacketed steel core; the steel resists deformation better than the usual soft lead core leading to greater penetration. The current NATO 5.56mm SS109 (M855) bullet uses a steel-tipped lead core to improve penetration, the steel tip providing resistance to deformation for armour piercing, and the heavier lead core (25% heavier than the previous bullet, the M193) providing increased sectional density for better penetration in soft targets. For larger, higher-velocity calibers, such as tank guns, hardness is of secondary importance to density, and are normally sub-caliber projectiles made from tungsten carbide, tungsten hard alloy, or depleted uranium fired in a light aluminum or magnesium alloy (or carbon fiber in some cases) sabot.

Many modern tank guns are smoothbore, not rifled because practical rifling twists can only stabilize projectiles, such as an Armour-Piercing Capped Ballistic Cap (APCBC), with a length-to-diameter ratio of up to about 5:1 and also because the rifling adds friction, reducing the velocity and thus total force it is possible to achieve. To get the maximum force on the smallest area, modern anti-tank rounds have aspect ratios of 10:1 or more. Since these cannot be stabilized by rifling, they are built instead like large darts, with fins providing the stabilizing force instead of rifling. These subcaliber rounds, called Armor-Piercing Fin-Stabilized Discarding Sabot (APFSDS) are held in place in the bore by sabots. The sabot is a light material that transfers the pressure of the charge to the penetrator, then is discarded when the round leaves the barrel.

To be Continued in the next edition of Wesco Magazine...

Article written by Wessie van der Westhuizen.
the CEO and founder of Wesco Forensic Services, is a distinguished expert in the field of forensics, particularly known for his extensive knowledge of terminal ballistics. With a career dedicated to advancing forensic science, Wessie has played a pivotal role in understanding how projectiles behave upon impact, contributing significantly to crime scene investigations and the pursuit of justice. His innovative approaches and deep insights have established him as a leader in the industry. We extend our sincere thanks to Wessie for sharing his invaluable expertise and shedding light on this critical aspect of forensic science.