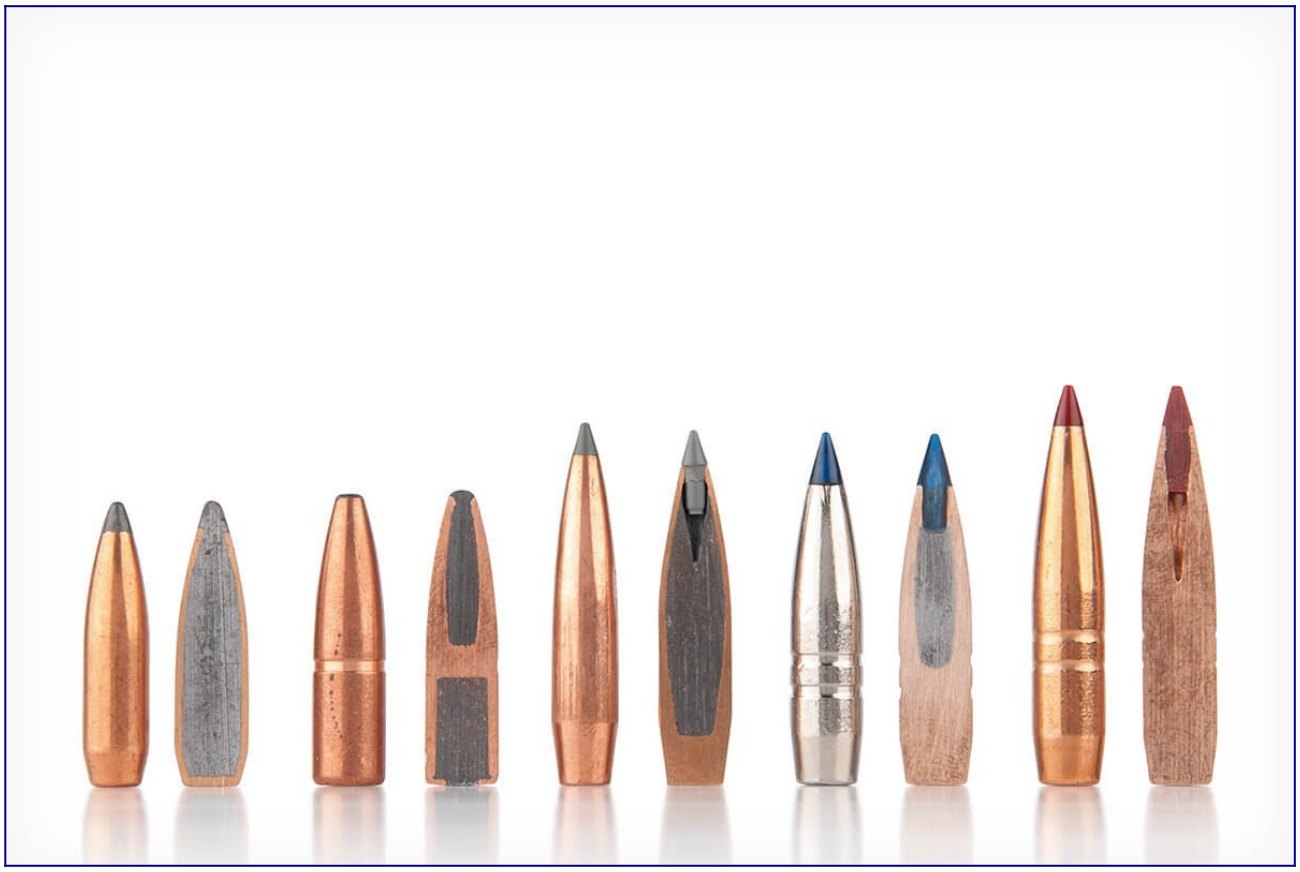
# Bullet Performance Limits in Expansion and Velocity

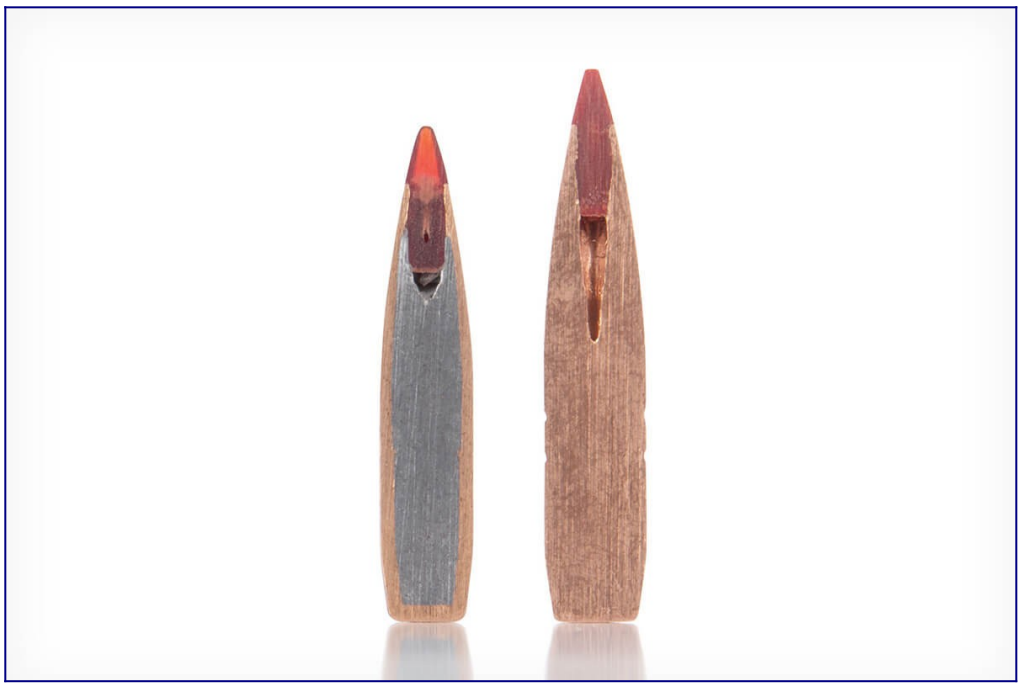
**Curious about bullet expansion and velocity? Here are the facts, straight from a ballistic genius.**



(Photo by Joseph von Benedikt)

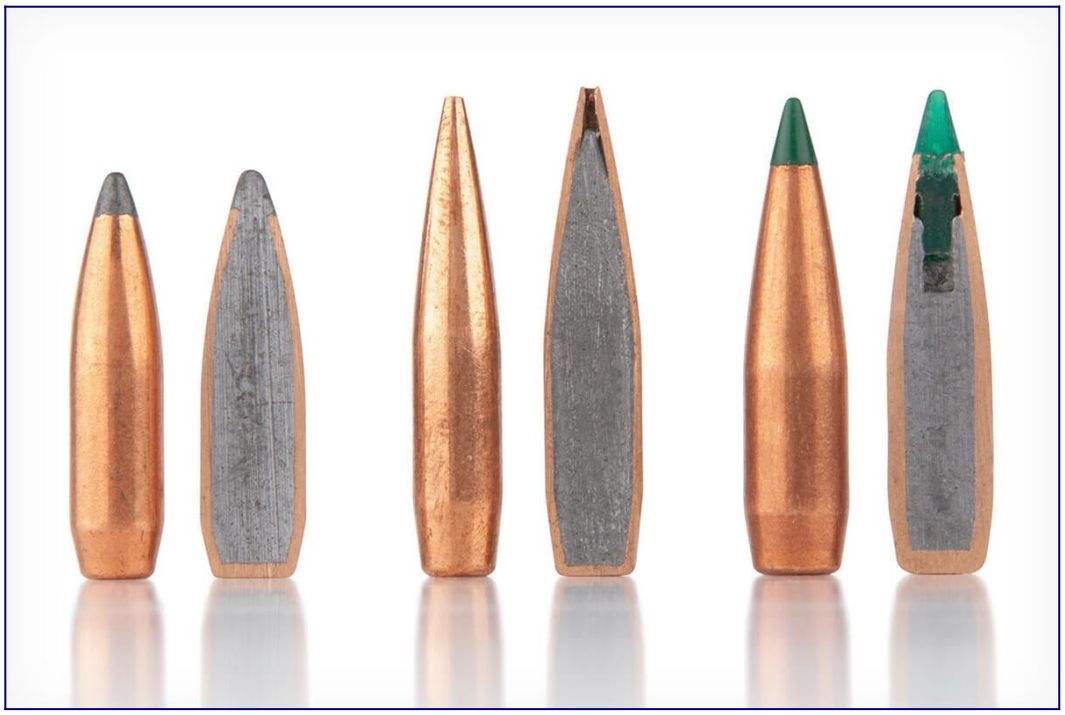
February 08, 2023 By Dave Emary

We’re hearing more and more about hunting at what can only be considered extreme ranges. It’s fairly easy to select an optic and rifle that are capable of providing the performance necessary to shoot at these ranges. There’s a number of off-the-shelf loads that provide the accuracy performance necessary to shoot at these ranges.

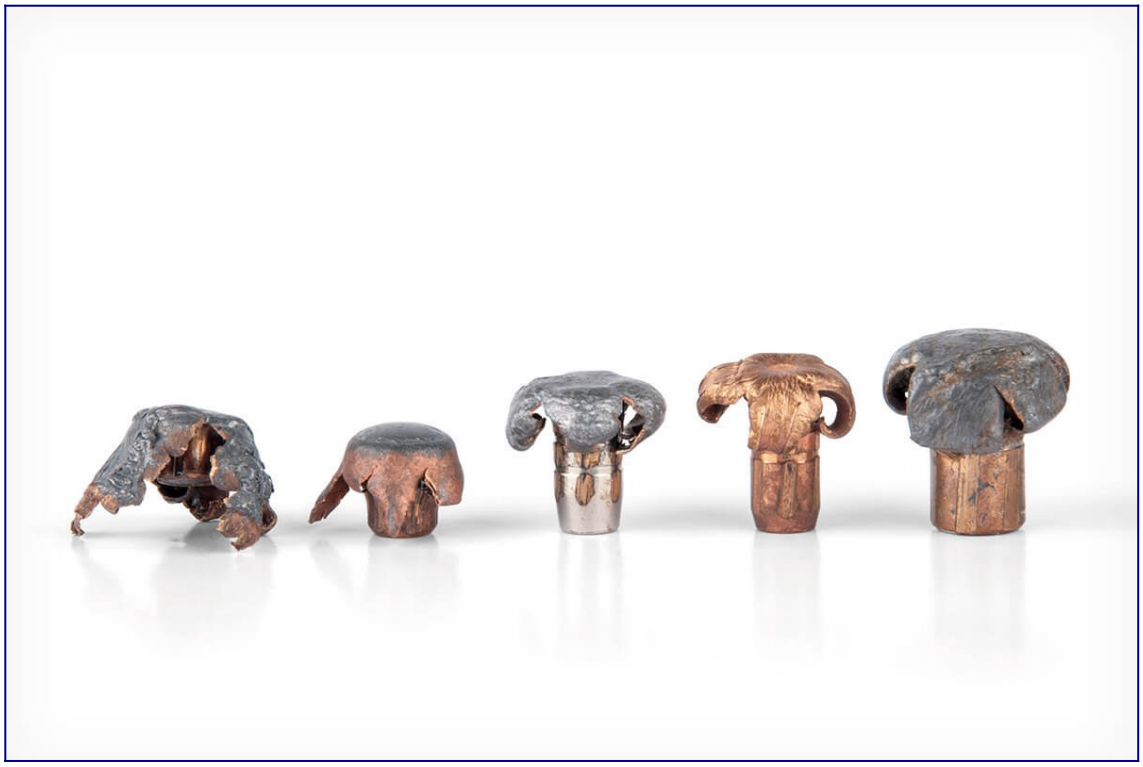


But what are the real-world performance limits of bullets and their ability to expand and provide ethical kills at extended ranges? There has been some marketing done to show the expansion performance at extended ranges of specialty bullets, but little information is available on many other types of bullets. Following is a discussion of a number of different bullet types and what their performance limits are. This information is based on years of bullet testing in ordnance gelatin, and in many of the bullet designs, corresponding field-testing experience to compare to the gelatin testing. I will add at this point that the results obtained in ordnance gelatin generally closely match up with performance on game. In this article, I will only discuss rifle bullets that are designed to expand on soft tissue.

## Expanding Designs

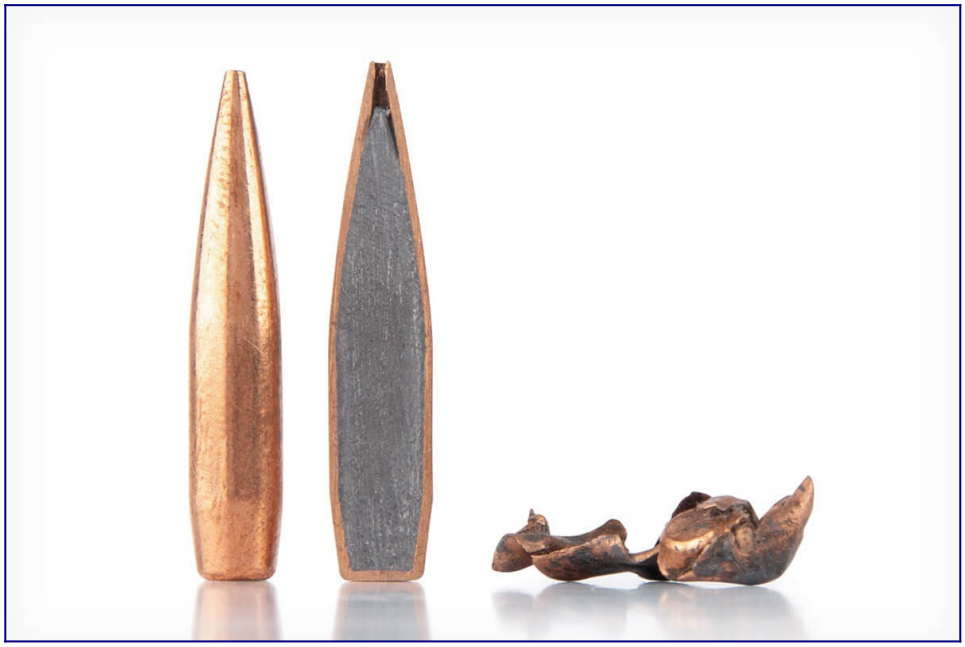


Expanding designs can be separated into two general types: jacketed or monolithic bullets. Jacketed bullets are constructed of a metal jacket/sleeve and a soft core. The most common metal used for jackets is gilding metal copper alloy. A lead core is pressed/swaged into the jacket, and then the bullet shape we recognize is formed. Two subsets of jacketed bullets are the bonded bullet and partition. Solid or monolithic bullets are just like they sound; they are made from a monolithic slug of metal, almost always copper or gilding metal.



There are three main types of expanding jacketed bullets: hollowpoint (HP), soft point (SP), and partition. Within most of these types, there are features that improve performance such as polymer tips, boattails, etc. Many manufacturers have trademarked features meant to provide performance improvement. An example of this would be the Hornady InterLock.

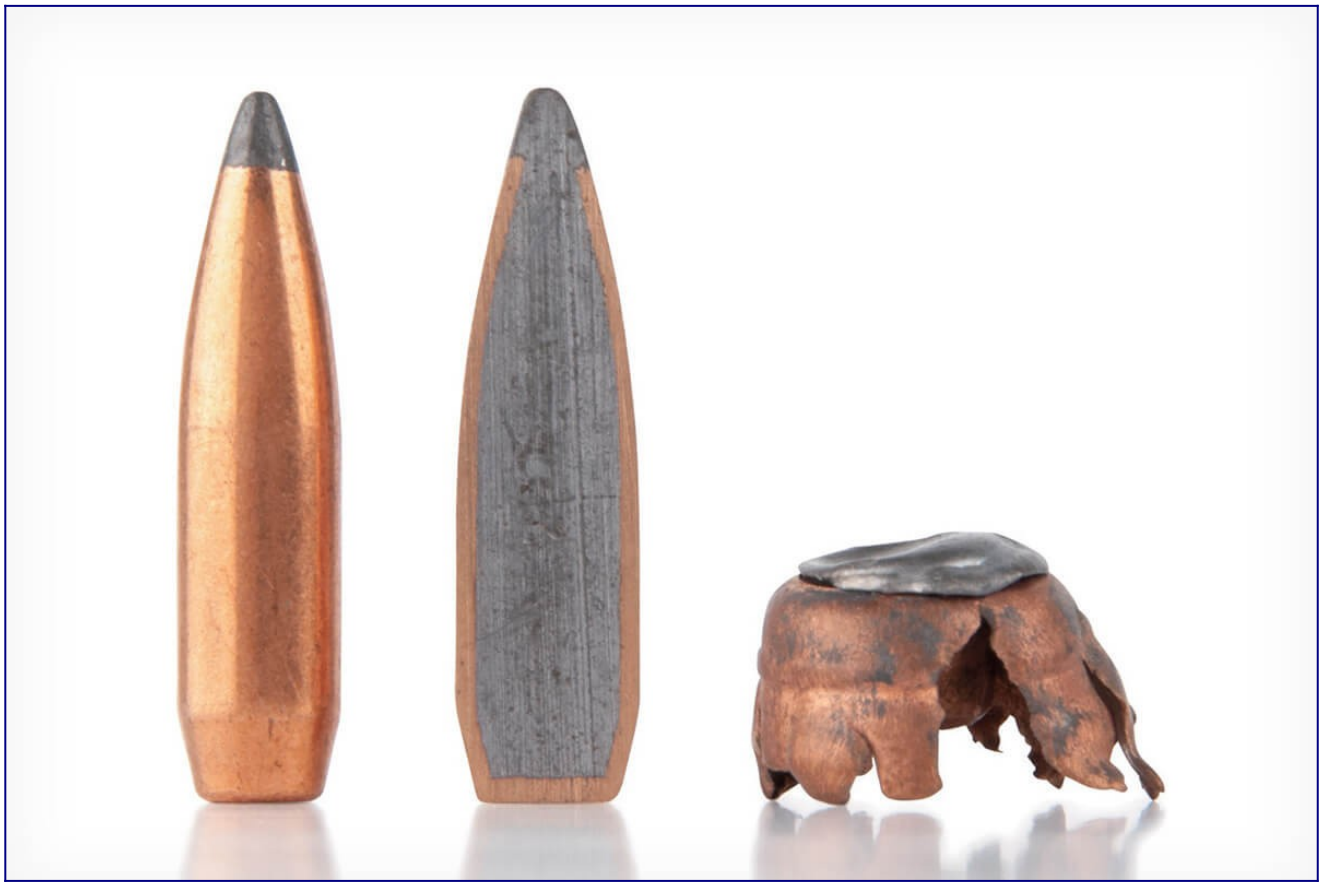
## Hollowpoint (HP)



See Photo Gallery

The very front of the nose of HP bullets contains no core material — it's hollow. This type of bullet has a fairly thin jacket. The HP does several things for the bullet. The hollow cavity in the nose moves the center of gravity of the bullet to the rear, providing some accuracy advantages at short to medium ranges. No core material in the nose allows the point or meplat of the bullet to be formed to a smaller point. This allows improvement in the ballistic coefficient (BC) of the bullet over a SP. If the point is not brought to an extremely sharp point and left slightly open, it can provide rapid expansion as well as relatively low-velocity expansion. HPs with very small points don't expand and either completely penetrate like a full metal jacket (FMJ) or tumble at some point along the path through the target. These sharply-pointed HP bullets provide very unpredictable terminal performance. Lastly, because of the metal nose, HP bullets are not affected by flattening of the nose during recoil while in the magazine, unlike SP and some polymer tip bullets. This prevents changes in downrange trajectory and terminal performance. Applications for HP designs are match or target shooting and varmint hunting. I know there are those out there that will disagree with me, but I do not consider HP bullets a legitimate big-game hunting bullet, especially at long ranges, because they do not expand and provide very unpredictable terminal performance.

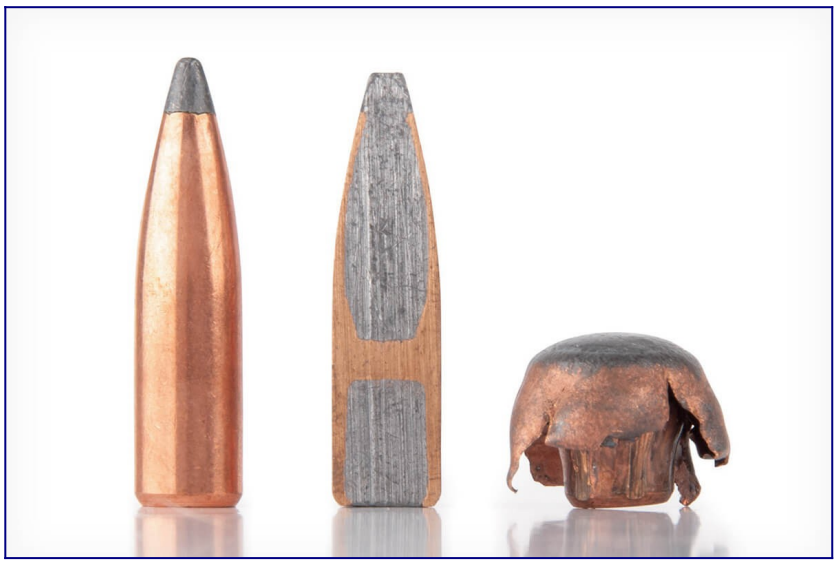
## Softpoint (SP)



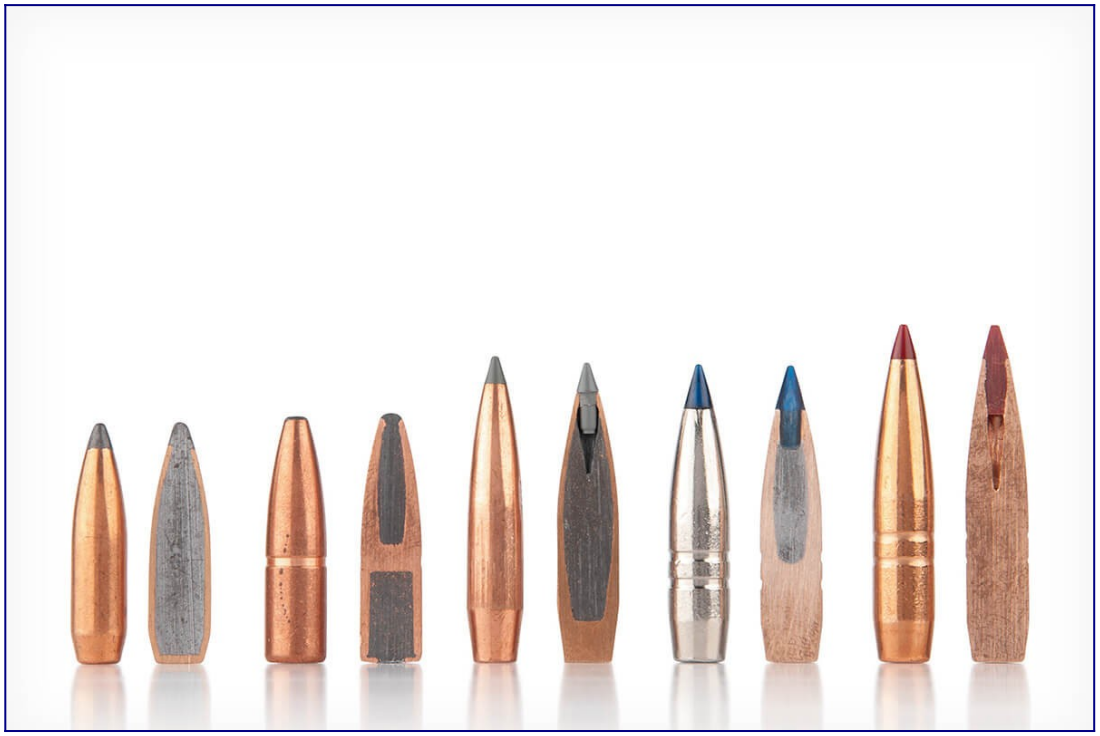
SP bullets are the oldest of the expanding designs and have been around since the late 1800s. They are made by forming a metal jacket and pressing a lead core into the jacket. The nose is formed, and a small amount of lead core is squeezed out the top of the jacket and shaped to a rounded point. When a SP bullet impacts a target, the exposed lead begins to crush and mushroom, forcing open the jacket and causing the bullet to expand. In essence, SP bullets were the first tipped projectiles. SP bullets aren't flashy but are still around because they are effective. SP bullets can be very

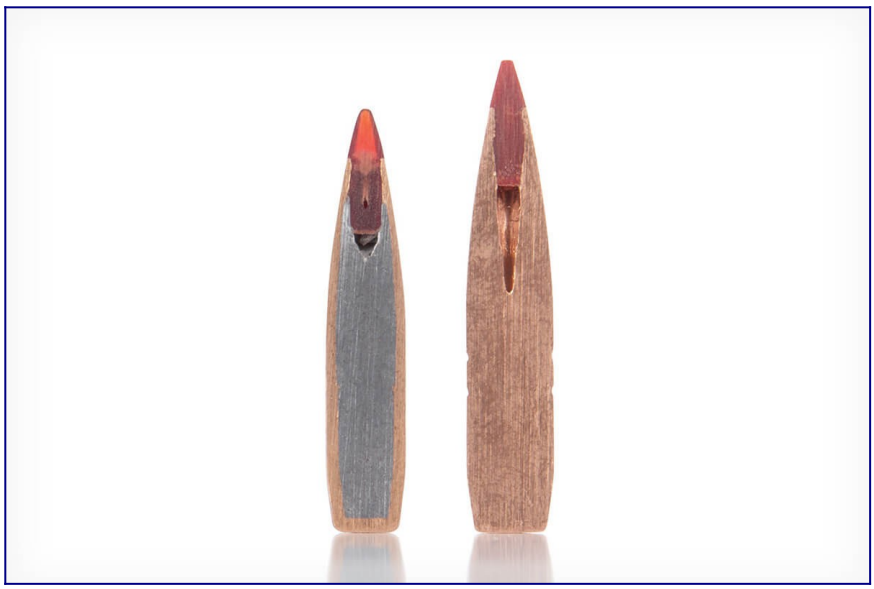
accurate, have effective terminal performance within moderate ranges, and are usually the lowest cost hunting bullet. Non-bonded SP bullets can have jacket core separation from time to time, which reduces their terminal performance slightly. In my experience, SP bullets will expand reliably down to about 2,000 fps or slightly less impact velocity. If you are the casual hunter and only hunt at moderate ranges of 250 to 400 yards, a SP bullet will get the job done and cost less.

## Partition

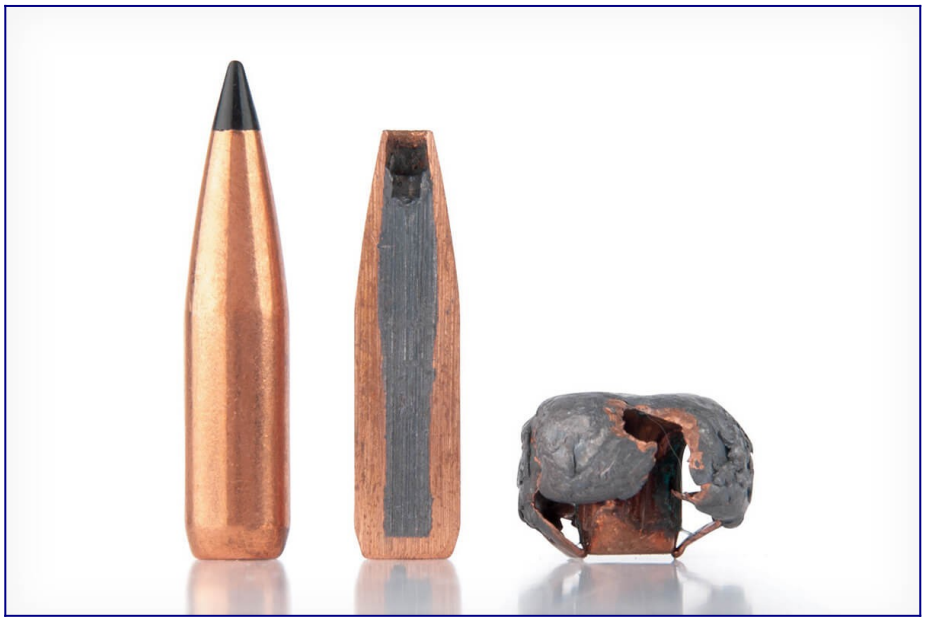


Partition-type jacketed bullets were developed by John Nosler Sr. in the late 1940s. They are really a subset of SP bullets. This design starts as a cylindrical billet of copper and is formed from both ends, so the jacket has a solid bulkhead in the middle of the bullet. A lead core is pressed into both ends of the jacket, and the nose is formed like a conventional SP design. This bullet set the standard for a tough, deep penetrating, improved weight retention design over a traditional SP bullet. They feature consistent retention and consistent penetration. They can be a little difficult to get top accuracy out of at times and are usually a little more expensive because they are more difficult to make. They will provide reliable expansion down to 2,000 fps or slightly less.





## Bonded



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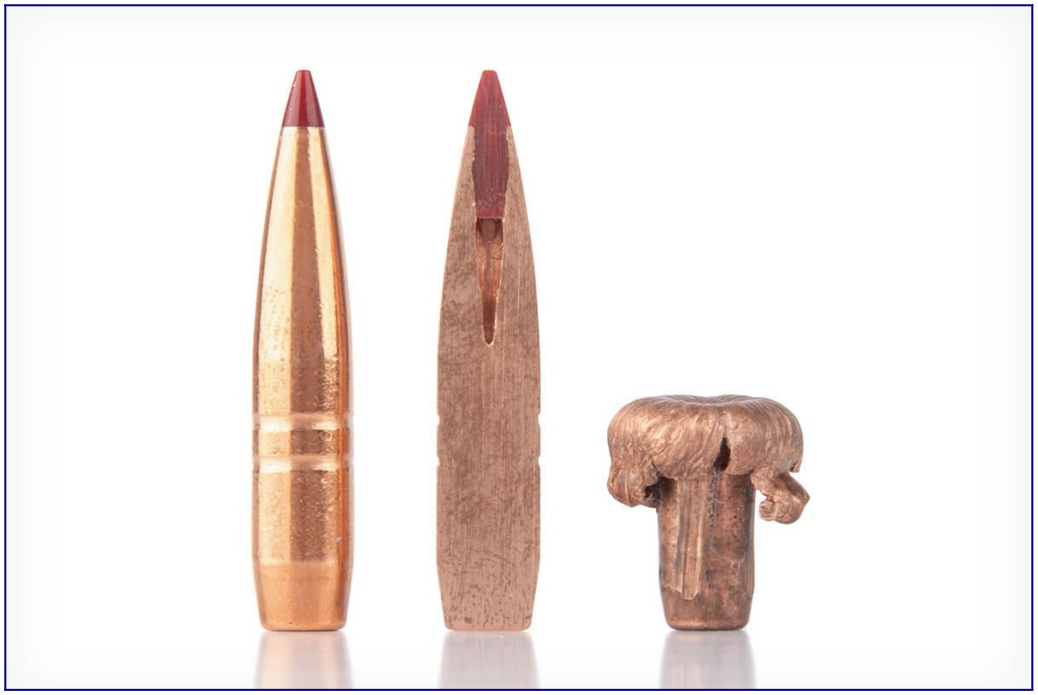
Bonding is usually a heat process where the lead core is bonded to the jacket. The jacket and core cannot separate but react and expand as one. This results in a tough bullet that has high weight retention, typically better than 90 percent. Depending on the design, they also typically have very deep penetration but not to the extent that solids do. The heat used in the bonding process anneals the jacket back to a relatively soft condition, and the jacket has to be made thicker to achieve the required strength. Bonded bullets have soft, pure lead cores because alloyed leads will not bond. Bonded bullets are an obvious choice when you're after deep penetration and extremely reliable terminal performance. Bonded bullets tend to be not as accurate as non-bonded bullets because of the thicker jacket. I have never seen one that did not produce "hunting" accuracy. Bonded bullets will usually expand to somewhat lower velocities than a SP bullet because of the soft, pure-lead cores. They will typically expand down to about 1,800 to 1,900 fps.

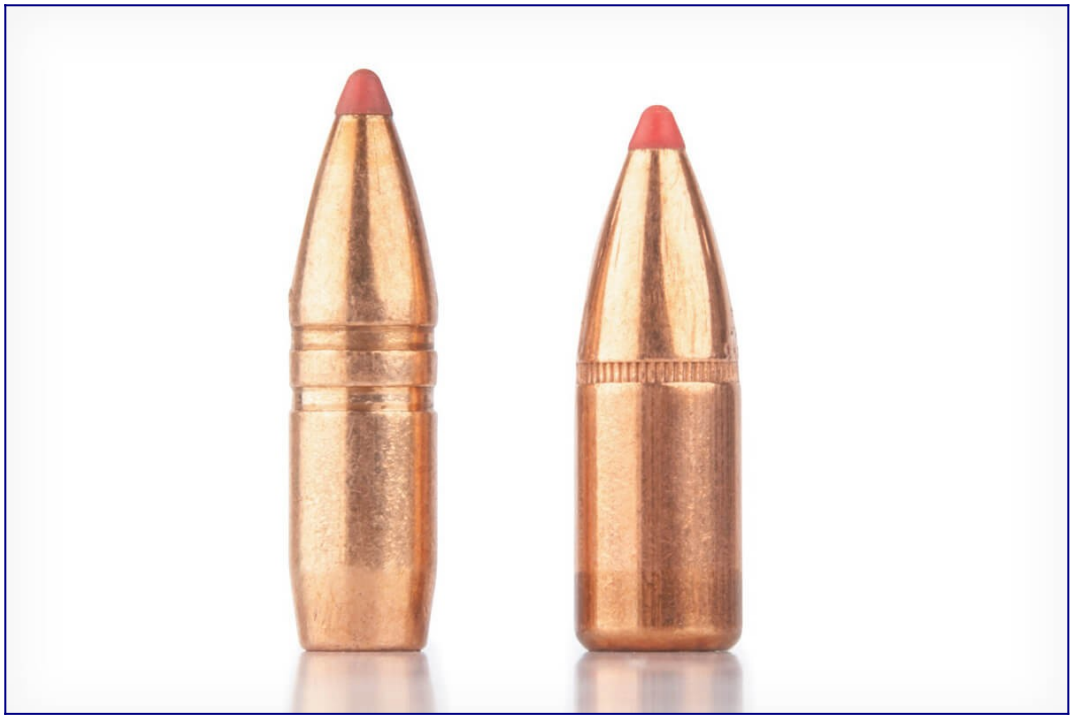
## Monolithic (Mono)



Monolithic (mono) bullets are made from a solid cylinder of a copper alloy. Mono bullets have a cavity formed in the nose similar to a HP or contain a polymer tip in the nose. Mono bullets were developed by Randy Brooks while CEO of Barnes Bullets and are designed to be controlled expansion bullets for hunting. Mono bullets meant for hunting, such as the Barnes TSX and TTSX, Federal Trophy Copper, Hornady GMX/CX, Nosler E-Tip, and Winchester XP Copper have all garnered a reputation as effective hunting bullets with nearly 100 percent retained weight and very deep penetration.

A rule of thumb I like to use for mono bullets when people complain they are too light is to remind them that they lose no weight when penetrating and will act like a jacketed bullet that weighs up to 30 percent heavier than the mono bullet. A given weight mono bullet will perform like a much heavier lead core bullet. A .30-caliber, 150-grain solid will perform terminally about like a 190-grain lead core bullet that's going to lose 30 to 35 percent of its weight while penetrating. Mono bullets are typically pricey because they are all copper, and copper is more expensive than lead. Mono bullets can be a little difficult to get to shoot as accurately as other bullet types, but solids always produce "hunting" accuracy. In my experience, most of the solids will expand reliably to 400 and 500 yards. The tipped ones will give about 100 yards of additional expansion effectiveness.

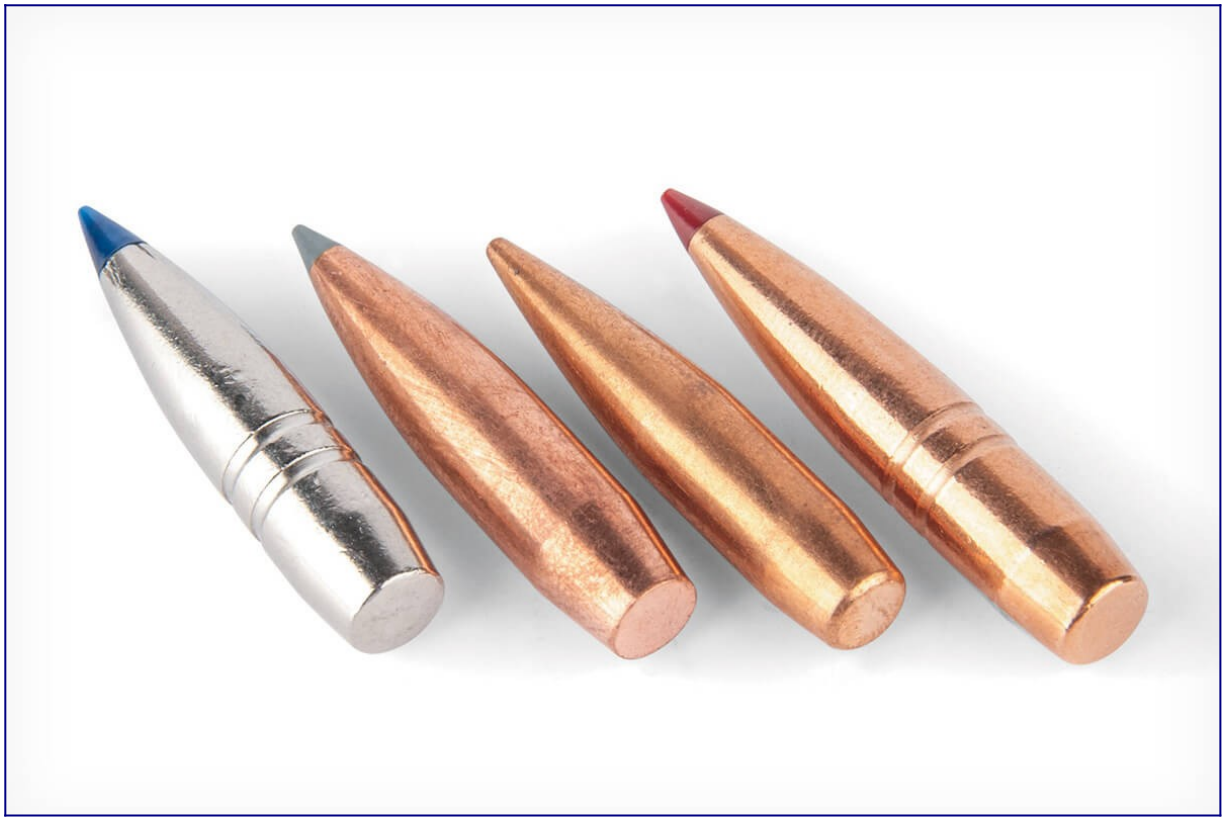
## Tipped



Now let’s discuss tipped bullets. Tipped bullets were developed by Nosler and introduced in 1989. The tip does a number of things to enhance bullet performance. First, they have a much smaller point diameter on the nose that improves the BC, retained velocity, and trajectory. As a result of being a molded polymer tip, the shape of the nose is extremely uniform from bullet to bullet and lot to lot. This improves consistency. Lastly, a properly constructed tipped bullet will have a gap between the shank and core that allows the tip to set back into the jacket when it impacts. This ensures rapid and reliable expansion. The combination of having higher retained velocity than a SP and a better mechanism for initiating expansion results in expansion at lower velocities and greater range. Tipped bullets will expand reliably down to velocities of about 1,800 fps. New bullet designs such as the Hornady ELD-X and Federal Terminal Ascent have extended this expansion velocity down to the 1,500-fps range. These two bullets, with their very high BCs and terminal performance to very low velocities, will produce effective terminal performance from 800 to 1,000 yards.

There is an interesting subset of tipped bullets. The Hornady LEVERevolution (LE) and Monoflex (MFX) bullets use a resilient, flexible polymer tip. The tips were designed to allow the use of a pointed bullet in a tubular magazine because the tips flatten in the magazine tube to prevent primer detonation but restore to their original shape when loaded in the chamber. The soft tips also aid terminal performance because they generate expansion to lower velocities. The Hornady LE and MFX bullets will give useful expansion down to about 1,700 fps retained velocity. This dramatically increases the effective range of common lever-action cartridges to ranges of about 300 to 350 yards in some cases.

## Boattails



Boattails have been rather misrepresented over the years. A boattail is a bullet feature that lowers the drag of the bullet, but it only does this effectively below a certain velocity range. Generally speaking, a boattail does not have a lot of effect until the bullet has slowed down below about 2,000 fps. The boattail also must be at least half a bullet diameter long and an angle of 8 degrees or less to have much effect. Many of the bullets you see with a very short or steep-angled boattail have virtually no aerodynamic advantage over a flat base. These do nothing more than make seating the bullet easier. If you are a traditional hunter that never shoots beyond 250 to 300 yards, a boattail bullet gains you very little. For long-range shooting beyond 500 yards, a properly designed boattail has an increasingly bigger effect on trajectory and retained velocity as the bullet slows down.

After reading this, hopefully you have some insight into the differences between styles of bullets on the market. You should be able to make an informed decision on what bullet type would best meet your needs and avoid spending money trying things you don’t need.