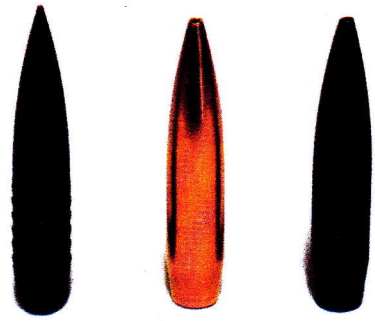
Reloading new-generation projectiles

by Steve Hurt



Three 6.5mm target bullets, including a slightly longer new-generation GS Custom 119-grain SP bullet with an SSIP of 754psi, left; a copper colored 'traditional' Sierra Match King 142-grain bullet with an SSIP of 3626psi; and the same Sierra, moly coated by Steve Hurt, with an SSIP of 2393psi. Note the irregularities in the meplat (bullet tip) on the traditional projectiles; serious competitors will often trim these projectiles to an even face, while some go so far as to reduce the meplat further by 'pointing' them using the Whidden Pointing System.

It's hard for us to imagine today just what a paradigm shift moving away from cast lead and black powder cartridges to jacketed projectile, cordite and smokeless cartridges must have been for the shooters of the late 1800s. Indeed, it was not an overnight event. Shooters of that time could easily recall their fathers and grandfathers using muzzleloading arms just a couple of decades before and were only just coming to terms with the rapidly developing cartridge concept. It took a number of landmark military events to cement the future of cartridge technology for the next 110 years or so.

Discussions by others in this magazine have proposed and explored a number of experimental technologies, some of which may hold some promise, while a great many others have already fallen by the wayside. However, one issue that constantly confronts shooters today, and isn't going away any time soon, is the use of new-generation brass and copper projectiles. Like our forebears of the late 1800s, it appears that many shooters, and particularly reloaders, aren't quite sure how to relate to these bullets, relying heavily on current understanding. This after all, is the only point of reference anyone has at any time.

At this stage, it must be made clear that this article is skewed toward modern, high-pressure rifle projectiles and cartridges. It might surprise many rifle shooters to find out that there is still a lot of straight lead/lead alloy projectiles used in handguns even today, but this is generally confined to target application, rather than hunting or military on any broad scale.

This discussion is not about the questionable issues of environmental influence using different materials, or the impact on hunters of possibly ingesting lead from their harvest. It's about understanding the different performance characteristics of swaged jacketed lead projectiles and brass/copper bullets. These differences can get a reloader into all sorts of bother if not clearly understood.

Setting aside for the moment the different terminal requirements of target shooters and hunters, let's take a look at the current product platform, before we explore the new generation. Generally speaking, what we might currently call 'traditional' projectiles are swaged and jacketed. The core is essentially lead or a lead alloy, and the jacket is usually gilding metal, made up of 90 to 95 per cent copper, with the balance mostly zinc. Occasionally, you may find a 'pure' copper jacket, but this is not common.

Jackets are pressed out of sheet gilding metal material and placed in a press multiple times, until the disk eventually looks like a cup of the desired shape and size. A lead plug, cut from precision extruded lead wire, is inserted into the cup, and the whole thing placed into a press again to form the final bullet shape.

While this has been oversimplified (jackets are often annealed at certain stages) and the lead core for hunting bullets may have their cores soldered to their jackets to meet terminal performance objectives, this is essentially the process. Most conventional bullets are made this way, regardless of shape or configuration, whether they are partitioned, tipped, hollow-points or 'solids', or for target, military or hunting application. Occasionally, military bullets will have 'soft' iron cores (such as the 7.62x39mm) as opposed to lead, but the process is basically the same.

The qualities of traditional lead core bullets may vary based on shape, design, bearing surface and materials used, but the internal pressures required are confined to a surprisingly, relatively narrow shot start initiation pressure (SSIP) band. SSIP is the pressure required to alleviate the cartridge of its projectile and complete the engraving process of the bullet in conforming to the newly swaged state imposed by the barrel throat. Note that this is bullet and barrel throat dependent, independent of but married to the pressures involved in any particular cartridge or load.

The SSIP of traditional projectiles is usually in the 3200 to 3800psi range and nearly all loading manuals assume this, with the better ones specifying these details more precisely. Although often rubbery, loading manual guidelines are a starting point when approached conservatively. The more prescriptive (eg, nominating the particular projectiles, primers and temperature at which loads were developed), the more likely they are to be reasonably precise and accurate.

New-generation bullets are a completely different product altogether. Made from solid, pure copper, or a copper alloy (brass

of various specifications), these projectiles are almost universally produced on computer numerical controlled (CNC) lathes, although some are swaged in extremely high-pressure presses. As most would now know, state-of-the-art CNC is capable of producing extreme precision to unbelievably fine tolerances in a repetitive way that was unimaginable not so long ago. The challenge with this process is that each projectile has to be made one at a time, making it a slow procedure. Since time is money, this inevitably makes them more expensive to produce.

Copper, brass (in its various forms) and lead have very different qualities in terms of material density, hardness and ductility, which translate directly into different behaviours in the barrel, in flight and on impact. Not surprisingly, these projectiles must therefore make use of very different bullet shapes, designs and loading practices.

Unlike lead or lead-core bullets, neither copper nor brass bullets are as easily swaged in a barrel, which means that design measures are required to ensure pressures don't rise unexpectedly or dramatically. Those familiar with the evolution of the Barnes-X product will have noticed over the years that pressure relieving bands, dry lubricant coatings and ballistic-tips have all been added in an attempt to address this and other issues, as a direct result of using various forms of copper alloy material.

Bullet	SSIP	Powder	Load (grains)	Primer	Pressure at 38C (psi)	Powder burned %	Case Capacity (%)	Velocity (fps)
GS Custom HV 130-grain	754	ADI2219	45	Federal 215	59,386	100	95.7	3073
Woodleigh PP 150-grain	3626	ADI2206H	46*	Federal 210	56,920	98.7	96.6	2850
Barnes TSX 130-grain	4351	Varget/ ADI2208	47.5**	Federal 210	55,809	96.1	104.8	2968 compressed load

Notes:
All loads and pressures used are calculated using QuickLoad. They were tested in a .308 Winchester with a barrel length of 22" (559mm), barrel twist of one in 12" (305mm) and cartridge overall length of 2.8" (71.12mm). The maximum CIP pressure standard is 60,191psi. Do not assume that they will be appropriate for your rifle; they are tabled solely for the purposes of demonstration and explanation.
***ADI lists 45.5 grains of ADI2206H as maximum for a 150-grain traditional projectile such as the Woodleigh, but does not specify what temperature or which projectile was used in testing.**
****Barnes TSX load recommendations drawn from www.barnesbullets.com**
Due to differences in the density of lead and copper/brass, 130-grain copper/brass projectiles have a similar displacement and therefore powder capacity influence as a 150-grain traditional projectile, hence the comparison. All three of these projectiles are well suited to a one in 12" twist barrel.

According to the QuickLoad program and as shown in the accompanying table, the SSIPs for the Barnes-X product in its various guises has a range that starts at around 4351psi for the TSX and TTSX BT bullets, 5802psi for the XLC BT, and a whopping 6527psi for 'old'-style X BT. That is an enormous range and almost twice that of conventional bullets at the top end of the spectrum. Reading the websites and QuickLoad library of other brass bullet manufacturers suggests that their products also fall into a similar SSIP range, but it is rare to see this quantified among the newer players.

New-generation projectiles can be banded or grooved and this has a big influence on the SSIP range. North Fork bullets are a banded copper bullet with a bonded lead core nose and an SSIP similar to the lower end for traditional bullets, while the GS

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Custom product is a banded, pure copper hollow-point bullet with an SSIP of just 754psi, according to QuickLoad. Clearly, new-generation bullets operate over a very much broader SSIP range, so whatever your understanding is about one bullet, it is obviously foolish to transpose it onto another bullet when developing a load or projecting expectations on any other form of bullet performance.

So what is the difference between a banded and a grooved bullet? Put simply, both principles have the same objective; a grooved bullet has the same dimension as the rifle's bore, with the grooves designed to relieve pressure by allowing the rifling a place to push displaced material in a quasi, surface-only swaging process. However, the shank on a banded bullet is the same dimension as the rifling, and the narrow bands behave like an engine's piston rings, sealing the bore. This greatly reduces surface area engagement, and therefore friction, allowing potentially higher velocities at lower pressures.

Both ends of this spectrum require radically different load practices if we are to remain safe and get the best result from our chosen projectile. Both approaches have also gone a long way to reducing the copper fouling issues of the early days, especially when a dry lubricant coating is applied.

Something that may surprise readers is that once high SSIP brass bullets have been swaged into the bore of a rifle, the projectile's resistance (coefficient of friction) is actually considerably less than most traditional or even soft copper projectiles. Like the steel wheels of a carriage on rails, once resistance is overcome, they are actually quite efficient. Softer, banded copper projectiles tend to behave a little more like rubber car tyres on the road with somewhat more grip, which is just as well if we want full combustion of our propellant to occur inside the barrel rather than the atmosphere.

The implications for reloaders are that for high SSIP projectiles, longer barrels and slower powders over standard primers are required to smooth out pressure build-up as much as possible. This can be a bit of a challenge for hunters using short-barrelled stalking rifles, as brass bullets really need to be driven hard to make them work terminally, due to the nature of the harder material.

It is here that design specs become confusing. Some brass projectiles take advantage of the brittleness of brass to shatter petals off and leave a solid plug to plough on through, such as the CEB ESP range. Barnes-X bullets are tempered to emulate traditional projectiles by developing a mushroom effect with sharp cutting petals, and will do so if driven hard enough or driven into tough, heavy game. Experience with this type suggests that light-for-calibre projectiles are the way to go to achieve best results for soft Australian game.

Low SSIP projectiles come into their own when the smaller, highly efficient cartridges are used. Projectiles from the GS Custom range are 'pure' copper, which is considerably softer and more ductile than brass. At extremely high velocity, petals will break off and radiate from the solid shank, but at more 'normal' moderate velocity, open up in conventional mushroom style, yet still cut a straight path on the way through. This style of projectile, generally speaking, requires

The GS Custom bullet, left, is a banded and coated copper hunting projectile with an SSIP of 754psi. The Barnes bullet is a grooved, non-coated bullet with an SSIP of 4351psi. Such a wide pressure range cannot be ignored by handloaders. Note how neat and precise both bullets are at the meplat, contributing greatly to accuracy. Such precision isn't easily achieved with swaged projectiles without additional effort from the reloader.

adequate barrel length, faster powders and a Magnum primer to ensure complete powder combustion. When this formula is used, higher velocities and surprising accuracy are the result.

Regardless of the design philosophy, it is rare to find any of the new-generation projectiles in a game animal. Apart from the occasional petal, complete penetration is the norm.

Given the stunning accuracy of CNC machining these days, target-quality accuracy is now achievable and more a function of acknowledging the nature of the material and working with it, rather than scratching your head and wondering why things aren't going to plan when using conventional practice. Wherever possible, make sure the manufacturer's recommended loading process is used; it's provided with good reason and the results will very likely surprise. ●