Ballistic coefficients and hunting

by Steve Hurt

Walk into any gunshop or read any marketing material from bullet or ammunition manufacturers these days, and a customer would be hard pressed to enter into the selection process without some reference being made to the bullet's ballistic coefficient (BC). In fact, depending on the source, you could be forgiven for thinking that a bullet's BC is the most important basis on which selection should be made. It's hard to imagine anything further from the truth for general hunting purposes.

Before this can be understood, a few foundation stones have to be laid. BC is a reference to a projectile's efficiency in slipping through the air and not a descriptor of terminal performance, and certainly not accuracy. BCs can be expressed against a number of standards and there are at least eight as far as small arms are concerned. These standards were developed many years ago in Gavré, France, and have become universally accepted as the international standard for comparing projectiles of the same design.

The goal, among others, was to calculate the flight path of a projectile. This is where the G in a bullet's BC reference comes from in the terms 'G1' or 'G7', with which many shooters are familiar; it simply nominates the standard to which the bullet is being compared. Now the standard for each reference is very precise in its proportion and *any* change to any dimension discounts a *direct* comparison to that standard. Without going into the various in-flight characteristics of each standard, the one that is most often quoted is the 'G1'. This is primarily because it is the least efficient standard for cutting through the air's resistance and any comparison with this will make the stated BC of a particular bullet appear most favourable.

It is at this point that we must understand that a bullet's in-flight efficiency is not necessarily a qualitative assessment of a bullet's potential accuracy. Indeed, highly efficient BC bullets often require tighter barrel twists than normal to stabilise, and even then, they may not stabilise until they are further out. This stability is frequently achieved beyond normal hunting ranges, sometimes further than 300m. As we shall see, unstable projectiles can be unpredictable in terms of humane hunting outcomes.

Further, if anything, high BC ratings have an almost inverse relationship with terminal performance from a hunting perspective. In other words, the higher the bullet's BC, the less likely it is to provide consistent terminal performance by *reducing* the shockwave the bullet produces. Minimal shockwaves produce highly efficient flight paths, but it is this very same shockwave that is a significant (but not by any measure the only) part of what we come to rely on to deliver humane terminal performance. See Figures 1 and 2.

The solution seemingly appears in the form of a high BC expanding bullet. Now the design implication for bullet-makers is not quite as obvious as we might like. The problem is that maximum flight efficiency requires the smallest meplat (bullet tip) possible. This area of the bullet has more than twice the influence on a bullet's BC than any other area of the bullet, including the boat-tail. Making an expanding bullet with a very small meplat is challenging. Such a bullet requires extremely high ratios of pressure to the meplat surface area to expand, with the reliability of this

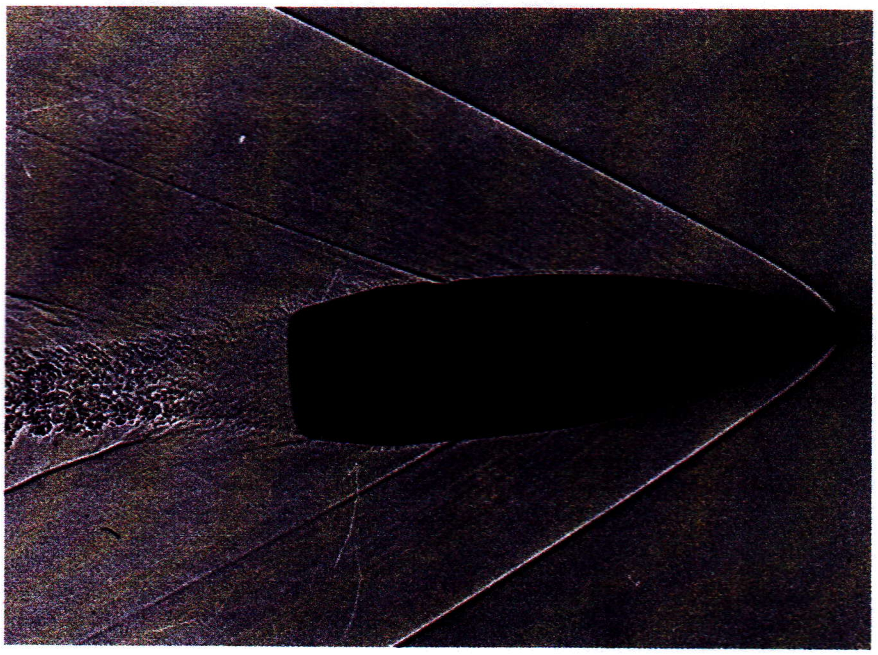


Figure 1: The shockwave of a high BC in full supersonic flight.

This bottle was shot at 900m with a 6.5mmx284 and struck at 1700fps with 820 ft-lb of energy from a high BC bullet. Yet, along with its counterparts, it didn't even tip over when hit. Identifying hits at this range was a real challenge. Only closer inspection revealed the surprising results.

Top right; the same bottle showing the exit hole.

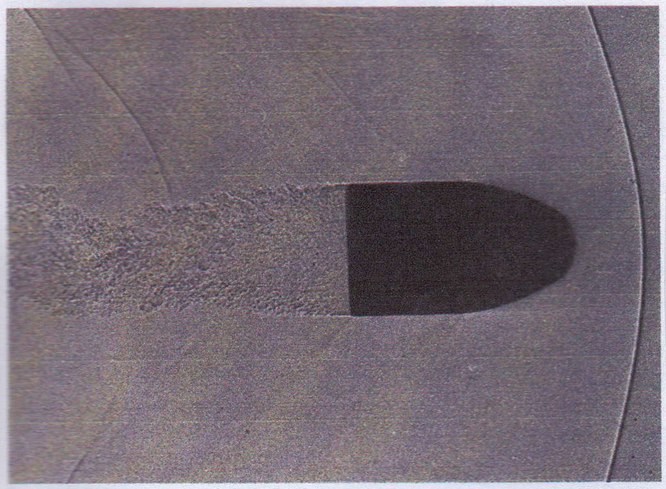


Figure 2: The shockwave of a round-nose bullet approaching the sonic barrier. Note the shape, location and proportions of this pressure wave. This is significant to terminal performance.

ratio diminishing very quickly beyond the range threshold.

Consider the following examples.

Five water-filled milk bottles complete with lids were placed at each marker, at distances of 300m to 900m, in 100m intervals. High BC hunting bullets were fired from a 6.5mmx284-calibre rifle at each set in turn. Bottles hit at ranges up to 600m all exploded as expected. At 700m, the bottles did not consistently explode and only tipped over. By 900m, none of the five bottles even tipped over, with each of the bottles simply developing a slow leak down to the bullet hole. Obviously, the bullets were not opening up on these low-resistance targets at this range, but nor were they at the closer ranges where they did explode if the exit holes were anything to go by. The energy calculations according to the JBM ballistics program declared almost 820 ft-lb and a velocity exceeding 1700fps at the 900m mark.

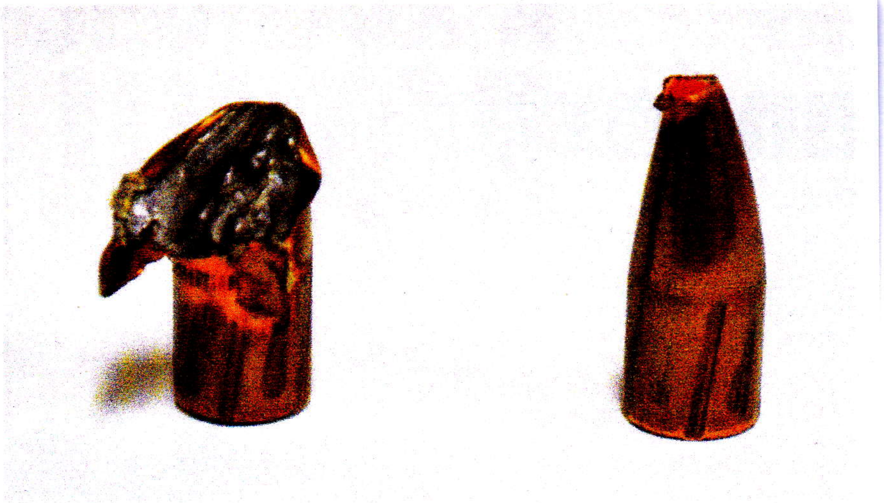
These bottles are the result of the .22 rimfire experiment. Again, note the similarity of the entrance and exit holes, indicating that no expansion occurred from the RWS high-velocity round-nose hollow-point projectile, yet all bottles were shattered and tipped over. The bottle on the right was struck at 150m with sufficient energy transfer to blow the cap another 4m away.

The second experiment involved a .22 rimfire rifle using the same test media, at ranges from 40m to 200m. The bottles were spaced at 20m intervals to 100m, and 50m intervals to 200m. Surprisingly, *all* the milk bottles exploded on impact out to 200m. Again, there was no evidence of bullet expansion at ranges beyond 60m, as the unexpanded exit holes that often sat to one side of the bottle splits could be measured. According to JBM, the energy rating of the little .22 rimfire used at 200m was just 64 ft-lb and a pedestrian 850fps.

Let's ponder that for a moment. A bullet with more than 12.5 times the energy and twice the velocity could not explode the bottles and the smaller bullet did so emphatically. At the extended ranges for each calibre, none of these bullets demonstrated any sign of opening up.

So what does this demonstrate? No-one is suggesting that the 6.5mm bullets were not dangerous at the 900m extended range, or that the bullet was less lethal than a .22 rimfire at 200m. That's clearly absurd. Equally, the milk bottle test *does not* simulate a game animal, any more than lab-shot ballistic gelatine simulates a long cross-gully shot at a mud-encrusted boar or sambar stag.

What the experiment does seem to imply is that the frontal area of the bullet's



Both these .30-calibre projectiles were fired into four wet phone books at equivalent lower velocity, to simulate impact at longer range. The ballistic-tip bullet was designed to expand, yet it completely penetrated all four books and was found buried in the sandbank behind the target. With closer inspection, the polymer tip can be seen driven back into the bullet without further result. The hollow-point flat-nosed bullet also failed. Apparently, the lead alloy shattered, rather than deformed. It was found in the fourth book having tumbled significantly, but all the energy was delivered and the damage substantial.

meplat has an enormous influence on the *way* energy is transferred in the shape of the shockwave, even when the projectile fails to open up. Given that the high BC bullet had a small meplat, and the rimfire bullet a round nose the shape of the projectile appears to have a great deal to do with how bullet energy is delivered on impact.

Now, any experienced hunter who has used flat- or round-nosed projectiles knows that such bullets are highly effective terminal performers. While they might lose more energy at say 200m than a sleek-looking high BC projectile, the energy is delivered in such a way that any observer can obviously tell the difference. That a flat- or round-nosed projectile can be relied on to expand more consistently is hardly news. An increase in reliable expansion from this bullet style is a real bonus in terms of terminal outcomes and a clear advantage. A hundred per cent of 800 ft-lb delivered and received is far more terminally effective than 1000 ft-lb delivered, but only 50 per cent received due to expansion failure and overpenetration. Given that much of our game is relatively lightly structured and shock susceptible, these principles are important. Quick and humane outcomes are after all, our primary objective.

The current infatuation with high BC bullets for extremely long-range hunting just in case the opportunity of a lifetime comes up at a genuine 400m really also has to be brought into question. Has the shooter had the practice or have the skills? Is a general walkabout hunting rifle, scope and ammunition package really the way to go to tackle such opportunities? A 'wing and a prayer while there's lead in the air' is hardly an ethical or respectful approach to the game we hunt. When we consider that the use of such bullets may risk lesser performance for the majority of game actually taken, we really must consider our everyday applications more carefully. Have we really become so lazy that we can't get within 300m of our quarry? Hardly, so why the need for extremely high BC bullets?

This is not to say that long-range hunting is not appropriate; it's just an area for specific skills, equipment and situations. But unless the hunting conditions frequently exceed a genuine 300m, the importance of a bullet's BC is almost as irrelevant as the color of the box the bullets came in.

For the 'doubting Thomas', or those simply wishing to explore this subject in greater detail, a tremendous scientific study was conducted by Duncan MacPherson in his book, *Bullet Penetration: Modelling the Dynamics and Incapacitation Resulting from Wound Trauma.* The work produced from these studies became the foundation by which all ammunition is assessed for American federal and state agencies today, despite being written almost 20 years ago.

In the meantime, why not try these experiments varied to meet your hunting conditions? There might just be a discovery of more appropriate bullet and ammunition choices. ●