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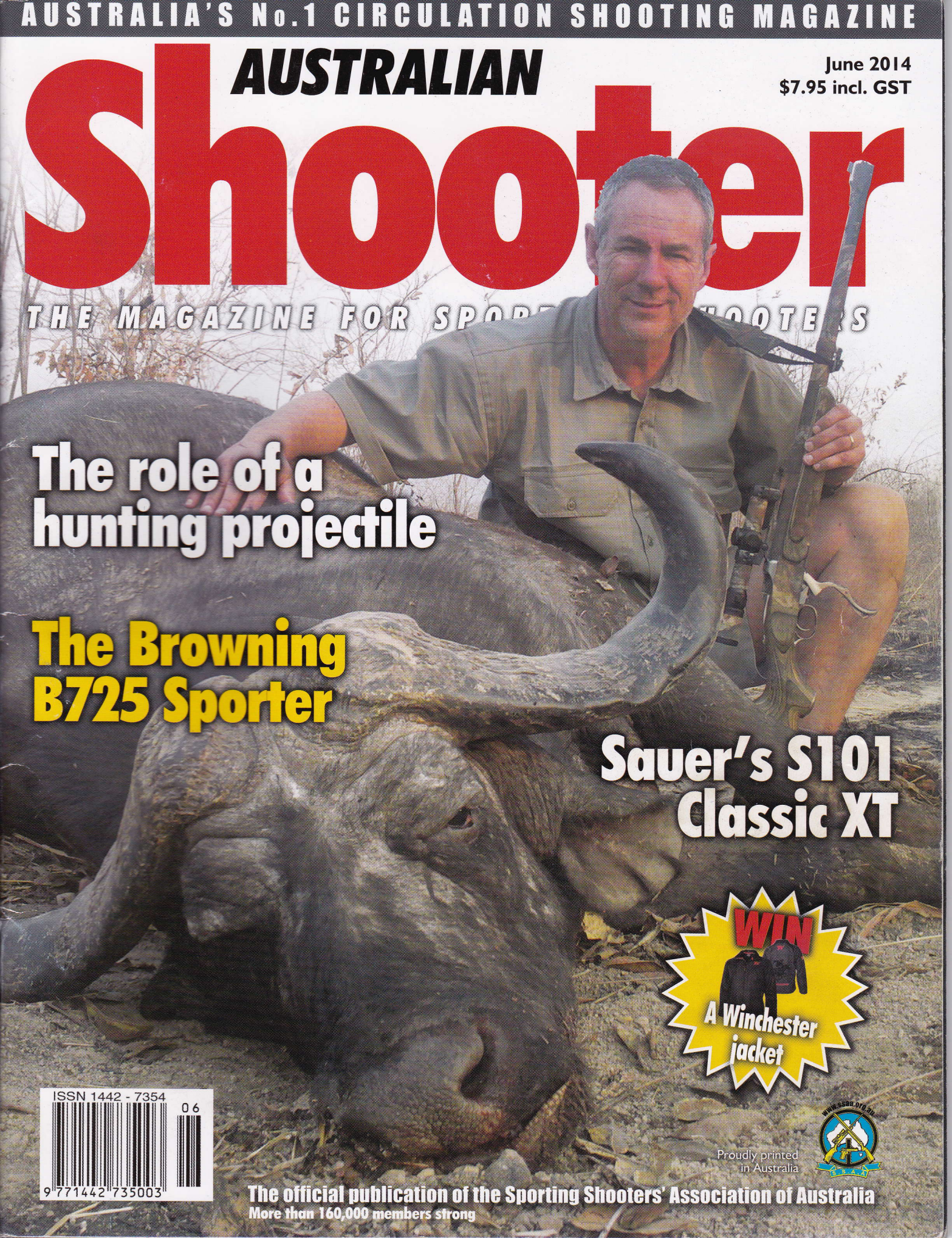

The role of a hunting projectile

The Browning B725 Sporter

Sauer's S101 Classic XT

WIN A Winchester jacket

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The role of a hunting projectile

This kudu bull was shot at close range in a thick mopane forest. The heavy 410-grain projectile from a Ruger No. 1 in .416 Rigby felled three small mopane trees before entering the chest on a frontal impact. Kudu are notoriously hard to kill, but this bull dropped to the shot and never moved again.

by Steve Hurt

This article is an exploration into the changing technologies affecting reloaders with a focus on hunting projectiles. Here, we will explore some of the basic principles, roles and applications of reloading the hunting projectile and hopefully debunk a few myths along the way.

Projectiles

Rule of thumb 1: Regardless of projectile choice, type or style, hunting projectiles should be seated at least .01" off the lands.

Projectiles should not be seated into the lands for hunting loads. Seating projectiles into the lands during a hunt may lead to an unnoticed projectile becoming stuck in the throat of the chamber. If you close the bolt, chambering the round and then open it without firing, the bullet may become lodged in the throat.

It should also be understood that seating projectiles into the lands usually produces increased chamber pressures with most hunting projectiles. In many cases, rifle magazines will prevent seating into the lands anyway. This is a deliberate tactic used by the manufacturers and is specifically designed to ensure that the situation of a stuck projectile doesn't occur in a difficult to detect or manage situation. It should be noted that trialling different seating depths also has the capacity to influence accuracy a great deal, and is often well worth the effort.

Rule of thumb 2: Although there are many factors which affect the cartridge brass purchase or grip on a projectile, it is good hunting practice, regardless of the projectile selected, that hunting bullets be loaded into the case with a neck tension between .001 and .002" wherever possible. (Crimping should only ever be considered when heavy-recoiling magazine rifles are being used and the projectile permits.) Less than this tends to allow changes in bullet seating in the magazine, generated by recoil and inertia, which is likely to again effect changes in pressure and accuracy. More than this is not only unnecessary, it again appears to adversely affect accuracy.

Neck tension can be assessed by full-length-sizing a case and measuring the neck with a quality micrometer. Load the case with your projectile and measure again. If the result is outside this recommended range, check the dimensions of the projectile first. If the projectile is within specification, the solution will have to be explored in either changing the brass, or the expander button in the die. Neck turning is an option, but it is a task best left to those chasing extreme accuracy.

Projectile vs objective

With the bewildering array of projectiles available on the market today, it can be extremely difficult to make a choice without some experience to guide us. However, experience can be a liability when new, game-changing technology arrives to challenge our view of the world.

Let's briefly revisit some of the basic principles. Our primary objective is to deliver sufficient destructive force to the vital organs of the quarry, to effect a quick

and humane death, reliably and consistently. One lucky or poor shot does not constitute a 'ballistic standard'.

As reloaders then, we need some guidelines as to how to determine likely favourable and humane outcomes. The old rules and current tradition based on jacketed lead-core projectiles state that we require 'adequate':

- bullet mass
- velocity
- sectional density
- momentum, and
- energy

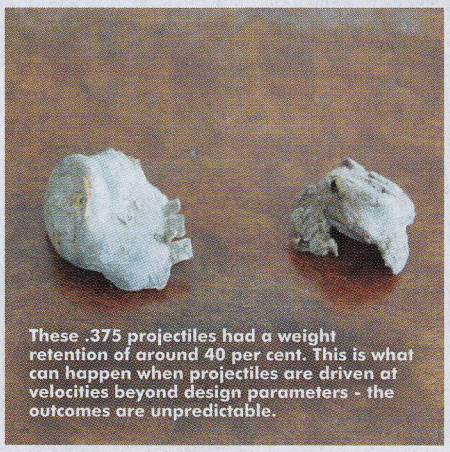
Now, of course, when using conventional jacketed lead-core projectiles, these principles remain as equally valid today as they were 10, 50 and 100 years ago. The thing is, even the so-called conventional projectiles have changed significantly over the past four or five decades. Partitions have been added, cores soldered to jackets, core hardness manipulated, so-called aerodynamic plastic expansion tips added and the list goes on, so even the term 'conventional' has expanded to a broader definition.

There have been many attempts by experienced and qualified people from just as many backgrounds (some better qualified than others), who have tried to quantify and qualify these traditional issues and their relationship with each other. Each in turn has made various attempts to establish formulas to describe such rubbery standards as 'killing power/effect', relative penetration, shock effect and so on, for the purpose of selecting the 'perfect rifle/cartridge' combination, guaranteed to produce the 'perfect shot'. Many would have heard of the optimum game weight theory, Taylor knockdown theory, and a great many others, all based on frontal area, momentum and energy. In scientific terms, for a theory to be considered potentially valid, it has to be qualitatively and quantitatively repeatable. None of these theories conform to such standards often enough to be considered anything other than rough guidelines with an infinite number of exceptions!

Woodleigh .416 projectiles recovered from a buffalo cull program and a trophy kudu. Weight retention averaged 89 per cent. Performance was emphatic.

So why has such an important subject escaped scientific modelling, capable of satisfying even general acceptance in the academic and real-world application communities? Reality is extremely complex. The number of variables, such as those suggested above, is just the starting point. Within each one, there are many more variables.

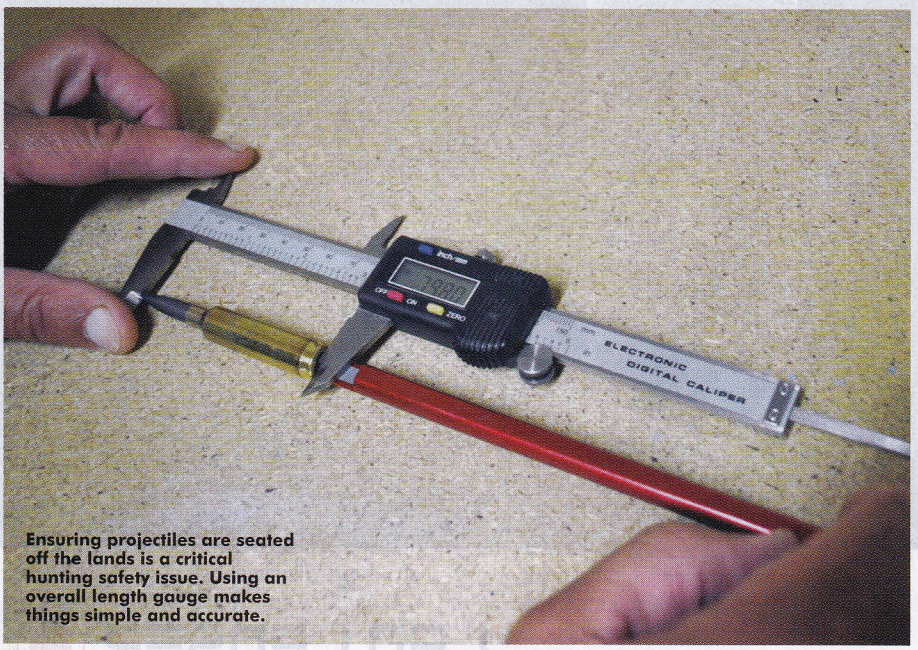
For instance, take the issue of simple momentum. It is not possible to use simple momentum (mass x velocity) in any formula, unless it can factor in changes that will inevitably occur on or during impact. Changes such as bullet shape, angle of approach, ductility, structure and so on, all change the numbers such that they vary so greatly and unpredictably as to make any calculations or comparisons close to useless in forecasting outcomes. Then there is the subject of the rate of those changes. The principle of these challenges applies to all the basic variables.



These .375 projectiles had a weight retention of around 40 per cent. This is what can happen when projectiles are driven at velocities beyond design parameters - the outcomes are unpredictable.

To make matters worse in all of this, we have only focused on load and bullet performance. The biological structure, psychological state and physiological response of the target species introduces a great many more.

So, is there anything that will enable us to assess the suitability of a particular cartridge combination for a specific hunting application? Well, yes. The very best exploration on this subject was developed by Duncan Macpherson (an aeronautical space engineer who worked on the US missile program together with Dr Fackler,



Ensuring projectiles are seated off the lands is a critical hunting safety issue. Using an overall length gauge makes things simple and accurate.

a surgeon responsible for training other US surgeons in the treatment of bullet wounds) in the book *Bullet Penetration: Modeling the Dynamics & the Incapacitation Resulting from Wound Trauma.* This benchmark work has become the standard by which the FBI assesses all ammunition for law enforcement application consideration.

Unfortunately, as comprehensive and scientifically verifiable as this work is, the mathematics involved are way beyond meaningful application or use by the average hunter. As a result, we are left with simplistic programs, which, while not very good and are indeed fundamentally flawed for the reasons previously mentioned, are a starting point for the average hunter for developing a feel for what does and doesn't work.

In the following exploration, it is important that we don't take the numbers too seriously, and do not take any of the 'answers' to have any relationship with another 'answer'. The figures have no mathematical relationship to another in terms of application. In other words, if the metrics of a particular selection comes up with the figure '1000', it does not mean that it is twice as good a package than one that comes up with an answer '500'.

Cape buffalo are large, heavy and potentially very dangerous. This is not the time or place to be wondering if you or your equipment are up to the job!

HITS

The following commentary is taken from the Hornady website (www.hornardy.com) and is a reasonably helpful contribution to this discussion. The Hornady Index of Terminal Standards or 'HITS' score is calculated as momentum (simple momentum = mass x velocity) x sectional density (mass in grains/7000/diameter^2) x a constant; in this case 70, to give the scale proportion.

In theory, if you know your bullet weight, diameter and impact velocity, you can evaluate the relative suitability of a conventional projectile for a hunting purpose.

The Hornady website states:

Remember, HITS is merely a guideline to help you choose the proper bullet/cartridge combination. Be sure to consider impact velocity and bullet construction and select a bullet that is appropriate for your situation.

Small game: Less than 500 HITS

The basic rule of thumb is that an HITS rating of 500 or below describes a bullet/cartridge combination best suited for small game animals weighing less than 50 pounds (22kg).

Medium game: 500-900 HITS

A rating of 501 to 900 applies to bullet/cartridge combinations that are applicable for medium-sized game such as deer, antelope, black bear and caribou, or game weighing 50 pounds (22kg) to 300 pounds (134kg).

Large game: 901-1500 HITS

A rating of 901 to 1500 specifies cartridge/bullet combinations well-suited for large and heavy, but not generally considered dangerous game. This includes elk, moose, African plains game, red stag, American bison and other animals weighing between 300 pounds (134kg) to 2000 pounds (893kg).

Dangerous game: More than 1500 HITS

A rating of 1501 or greater indicates cartridge/bullet combinations that are suitable for dangerous game - game that is content hunting you back. There is no weight rating on this category since animals like African lions may weigh only 400 pounds (179kg).

There is a program on the Hornady website to assist in evaluating a specific calibre, weight and velocity of any chosen package. Just remember to use *impact* velocity, not *muzzle* velocity, from a competent ballistics program such as JBM or Lex Talus. Running these numbers is a reality check in evaluating the effective range of any particular conventional projectile and load/cartridge combination for a specific application.

While this is a helpful contribution to the discussion, it is obvious that there are some major deficiencies in this formula. Tougher bullets don't need to be quite as heavy to penetrate deeper, than frangible ones. Core-bonded projectiles are likewise. Bullet shape doesn't just affect flight path, it affects how the projectile will behave on impact. Aerodynamic projectiles tend to delay expansion and are less predictable on impact. Less aerodynamic, big frontal area round-nose bullets tend to open up and deliver their energy earlier if they are soft-points, and behave very differently if they are solids. Nowhere in this formula is any attempt made to quantify the braking effect of an expanding bullet and compare it with a 'standard' solid. No standard exists in this context. Essentially, this formula does not quantitatively address the issues of:

- Projectile ductility
- Expansion
- Cavitation (and therefore the shape of wound channels)
- Biological response (some game animals, such as fallow deer, are susceptible to nervous system shock, while a sambar stag is not so)

In other words, there is no attempt here to quantify or factor in the parabolic shape of the wound channel and match it to the nature of the game. However, experimenting with the HITS program is still an interesting and worthwhile exercise, if nothing else than to play the 'what if' game.

Much has changed in the world of hunting projectiles. Some of the new technology bullets and the principles they seek to address as a result of Macpherson's and Fackler's work is a fascinating subject all on its own. ●