Round Ball Workshop,

December 2007, 'Woodstock'.

The purpose of this document is to study and focus on the factors that contribute to gilt edge accuracy in muzzle loading rifles shooting round ball projectiles. The following text and diagrams are based on my own personal experience and are not meant as a definitive text on the subject but more a directional guide/discussion paper for shooters at all levels.

Rifle basics:

It has been said that only accurate rifles are interesting. Indeed only rifles in good working order are likely to produce good accuracy. Before going into the specifics of how to tailor an accurate load for your round ball rifle there are some factors to consider regarding the working condition and design of your firearm.

- ? What is the condition of the barrel? Is the bore smooth and free of pitting? Is the crown crisp and sharp? Is the rifling deep and in good order? (Round ball barrels have rifling typically in the region 0.015 inch deep; much more so than barrels made for bullets.) Is the bolster/patent breech clean and in good order? Is the nipple/flash hole in reliable working order? Nipples burn out over time as the hot gases from the burning charge erode the internal channel and this leads to failing accuracy. Similarly flintlocks burn out flash holes/vent. Nipples also burr over making seating and removal of nipples a mission and such burrs impede on consistent ignition.
- ? Does the lock function as it should? Is the main spring strong and does it allow the hammer/cock to strike the nipple/frizzen firmly? Is the trigger let off crisp and smooth?

Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.

- ? Is the rate of twist of the rifling compatible with round ball? Round balls require much less rotational force to stabilise them in flight and typically the best rate of twist for .45-.50 calibre rifles is as little as 1 turn in 60-70 inches or slower. Forsyth in he early 1800's was a proponent of very slow twists for very large calibres at 'high' velocity (for the time; 2000fps) and was using twists of 1 in 100 for .58cal.
- ? Are the sights suitable for the type of shooting you intend to use the rifle for and do they suit your eyes?
- ? Does the rifle 'fit' you as an individual? Is it well balanced and not front heavy? Is the "pull" the correct length for you arms? Is the cheek piece the correct height? Is the weapon the correct orientation for you ie: left or right handed? Does the butt plate allow you to shoot comfortably?
- ? Calibre. Is the rifle "too much gun" for you? Does it recoil too much for your comfort?

If buying a second hand rifle take time to check it over thoroughly or have a competent soul do this for you. If buying new, take your time to find the right piece.

Round ball accuracy – getting it to shoot tiny groups:

I have identified nine (9) factors that I consider are critical in achieving fine accuracy with a round ball muzzle loader. What is fine accuracy? I have a <u>minimum</u> requirement of 1 inch groups at 50 metres from the bench (see target 1). The factors are as follows:

- **Ball fit.** Round balls are, in the vast majority of cases, sized very slightly less than bore size EG: .500 bore load round ball measuring .490-.495, .450 bore load round ball measuring .440-.445 (see diagram 'a'). The small difference between the

Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.

ball diameter and the bore size accommodates the patch under compression. When first developing loads if two sizes of ball are available I recommend you try both with various patch thicknesses to ascertain which the better option for your rifle is. Too smaller ball with result in poor accuracy; too larger ball will prevent ease in loading and likely ruin patches and likely deform the ball.

- **Patch fit.** Arguably the single most critical part of the load chain. The patch preforms three functions. It takes up the windage between the undersized ball and the bore/groove (see diagram 'a'). It holds lubricant to ease the passage of the ball/patch down the barrel. It acts as a rudimentary gasket to seal the bore and maintain pressure from the rapidly expanding powder charge. Patches MUST be tightly woven 100% cotton or linen ONLY. A loose weave will result in torn/blown patches. Any synthetic content will result in patch failure by way of the fabric melting or burning. Pillow 'ticking' and cotton drill fabric are particular effective patch materials. Patch thickness is vitally important. Fabric that is too thin will not seal the bore fully and allow 'flash by' of hot gases that will burn through the patch destroying accuracy. In addition the loose ball/patch fit affords too much lateral movement between ball and barrel and this also detracts from tight groups (see targets 2, 3 & 4). Material that is too thick will result in torn patches during loading (see target 5). In order to calculate the correct patch thickness for you rifle use the following formula.

  - Slug the bore of the rifle and measure (how to) the difference between the bore and groove (see diagram 'a'). Add to this figure the difference between ball and bore diameter. Half the sum to get patch thickness + or -.

Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.

(A-B) + (B-C) / 2 = patch thickness

Where:
A = groove dia. B = bore dia. C = ball dia.

To slug the bore take a round ball and flatten it slightly with a hammer. Drill a hole through the centre of the ball to engage a screw in to remove the ball from the barrel at the end of the operation. Lightly oil the bore and using a soft face hammer tap the ball into the barrel. The flatten ball should have a girth sufficient that both the lands and grooves engrave as it is hammered home. Once the ball is flush or slightly below the muzzle install a screw in the predrilled hole in the ball and extract both screw and ball with pliers. Now measure the engraved bore and groove diameters (see diagram 'a').

I tend to purchase fabric of the formula thickness and then a variation of thickness of 2-3 thousandths of an inch either side and shoot to see which material produces the best results (compression). When purchasing fabric it is a good idea to initially buy ½ a metre for experimenting then immediately secure 2-3 metres of the material you decide on to be sure of an on going supply. Wash it prior to shooting to remove the 'size' and iron flat.

- **Lubricant.** Whether you choose to use a liquid lube, grease of something in between there are two main aspects to consider. The first is the base of the lube. Petroleum based lubes are reputed to burn in the bore combining with the blackpowder residue to generate very hard fouling detrimental to fine accuracy. I favour non petroleum based lubes. The second consideration is the amount of lube used. Target 1 shows a near perfect 50m group shot using

Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.

a patch with a paste lube applied sparingly. Target 6 shows a group using the same patch but this time saturated in the lube. I discovered some time ago when still using "moose milk" lubricant that if I seated the ball with a dry patch on the ramrod jag that dried the bore on the way out, the groups shrank DRASTICALLY. In terms of lubricant less is often more.

- **Ball quality.** Historically I have weighed and visually inspected EVERY cast ball I have ever shot to ensure only near perfect balls went down range. Imagine my surprise after shooting target 7 using balls from a cold mould that were seriously ill formed and wrinkled. This reasonably good target not withstanding however I believe it still to be a very good idea to grade projectiles at very least by appearance in order to maintain fine accuracy. Near perfect projectiles remove one more variable from the mix.
- **Sprue orientation.** Sprues are created when a round ball is cast in a tradition style of mould. The sprue is where the excess lead is cut off by the mould sprue plate leaving a small stub (Lee moulds do not produce sprues per se). It is imperative to load round balls with sprues are loaded in such a manner that the sprue is centred and perpendicular to the bore axis. Target 8 shows the effects of loading and shooting a ball with the sprue out of alignment with the axis of the bore. The sprue being off centre causes the ball to wobble in flight opening up groups. It is likely however that this affect is proportional to the size of the ball IE: if all sprues are the same size (this is likely as sprues plates tend to be made the same regardless of mould calibre) then they will have a more damaging outcome on smaller balls than larger.
- **Powder charge variation.** There are great benefits to be had in experimenting with powder charge variations. Some barrels are very tolerant and will shoot equally as well with

Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.

light or heavy loads. These tend to be the barrels cut with a slower twist specifically for round ball. Increasingly in the more popular .45 and .50 calibres manufacturers are using the 1 in 48 inch twist of rifling to generate a compromise between round ball and maxi bullet. This twist is touted as being able to satisfy both projectiles as it is enough spin for a maxi and more than enough for a ball. In reality it is often not this simple and 1 in 48 barrels are not as flexible with powder charges when shooting round balls. This is where experimenting with loads beginning with the starting load and increasing in 5 grain measures (or less in small calibres or with quality powder) at a time to the maximum load will help identify the range in which a barrel shoots best. My advice is if you intend to shoot round balls get a rifle/barrel made for round balls only.

- **Cleaning.** Both between shots and at days end. Shot to shot consistency is critical in fine accuracy and maintaining a consistent and repeatable bore condition. If black powder residue is allowed to progressively accumulate in the bore pressures fluctuate and accuracy suffers. Finding a way to repeating bore conditions aids fine accuracy and the most practical way of achieving this is wiping the bore between shots. I use each side of one patch then discharge it IE: one patch will wipe the bore twice when reversed. Continuously using the same patch will not repeat conditions as the patch will become increasingly fouled and remove less and less fouling. Humidity comes into play also. A wet day keeps fouling soft, damp and easier to manage. On these days a dry patch for wiping may work well however on a very dry day with low humidity (IE: Canterbury NW wind) wiping with a dry patch is an invitation to a stuck ramrod.

  A very astute shooter from Rotorua gave me a valuable tip when wiping between shots. He shoots, drops a charge

Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.

THEN wipes the barrel. The theory is that wiping after charging deposits fouling onto of the powder charge which will subsequent blow it out of the barrel. Wiping on an empty chamber may accumulate the fouling in the chamber area which will likely generate ignition variables.

End of day cleaning is EXTREMELY important. As blackpowder residue is hydroscopic (attracts water) it must be cleaned out of a barrel to avoid rust and subsequent erosion of the metal that is guaranteed to destroy fine accuracy. I am 100% sold on flushing rifles by attaching a tube to the nipple or an insert for the flash hole. Flushing fluid through the breech area is a sure fire way of removing residue and keeping the ignition pathway clear for consistent firing. Nothing will ruin your shooting faster than hang fires and misfires.

- **Over powder wads.** Over powder wads can be beneficial when using a very wet patch to avoid powder contamination. They also act as a protective barrier between a large, hot burning charge of powder and the relatively fragile fabric patch. Wads are usually cut from woollen felt and may be lubed to assist in sealing the bore and too soften fouling. An alternative is 'double patching' where a ball patch is seated on top of the powder charge then a patched ball seated over this. The additional patch acts as a protective barrier is the same way as a wad.
- **Powder quality.** Here in NZ we are not at all spoiled for choice when it comes to powder. With the exception of a small amount of GOEX powder left behind by a film crew our options for black powder are limited to Chinese Thundershot. The Chinese powder is not up to the quality standards of the US or European powders and is classified as a "musket" grade powder at best with a lower energy and heavy fouling. Grain for grain it is necessary to burn larger charges of Chinese powder to produce velocities

Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.

similar to that of the better grades of powder. In addition as the Chinese powder does not burn as cleanly as other brands maintaining bore condition can be more difficult. This said it is capable of producing some very expectable accuracy and other than resorting to expensive blackpowder substitutes such as Pyrodex this is the only choice we commercially have. One way in which to improve the 'quality' of this commodity is the sieve the powder to remove the 'fines' and create a more consistent granulation. 'Fines' are pieces of material within the mix of powder generally either powder much finer than the specified granulation or excess graphite (use to coat powder). Brass sieves are the only safe way to do this and I am told may be sourced from laboratory supply outlets. By taking away the finer and coarser granulation of powder you are left with a batch of propellant that will burn at with a greater consistency and produce fewer variations on the target. Consider this. For any given container of powder, as time passes, the finer particles within the mix migrate progressively towards the bottom of the can/bottle. This will alter the burning rate of the powder as the level decreases in two possible ways. If the 'fines' are powder the burn rate of the powder will increase towards the bottom of the can as fine powder burns faster than coarse. Conversely should the 'fines' be non-combustible graphite the burn rate will decrease as the charge will, in real terms, contain much less powder per given measure. Either situation will generate variation in velocity and pressure.

Crushing powder when seating a ball will do the shoot no favours on the target unless the crushing is consistent and this is very difficult to control on the shooting line. When seating a ball do so in a way that it is positioned firmly on the powder each time without crushing. The patched ball

Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.

need only be seated on the powder. It does not need to be 'rammed' home.

By now the reader will have noted a few reoccurring statements in the above text. "Fine accuracy" and "consistency". By eliminating the variables in black art that is shooting the round ball we can achieve both to a very satisfying degree. It is not realistic to expect fine accuracy when using poor combinations of components. Change one variable at the time only and above all TAKE NOTES. The time and money spent at the bench is well worth the effort.

As pointed out at the beginning of this text; this is not intended to be a definitive work on the subject however I have been able to enjoy a limited amount of success over the years and this document is my way of sharing this knowledge.

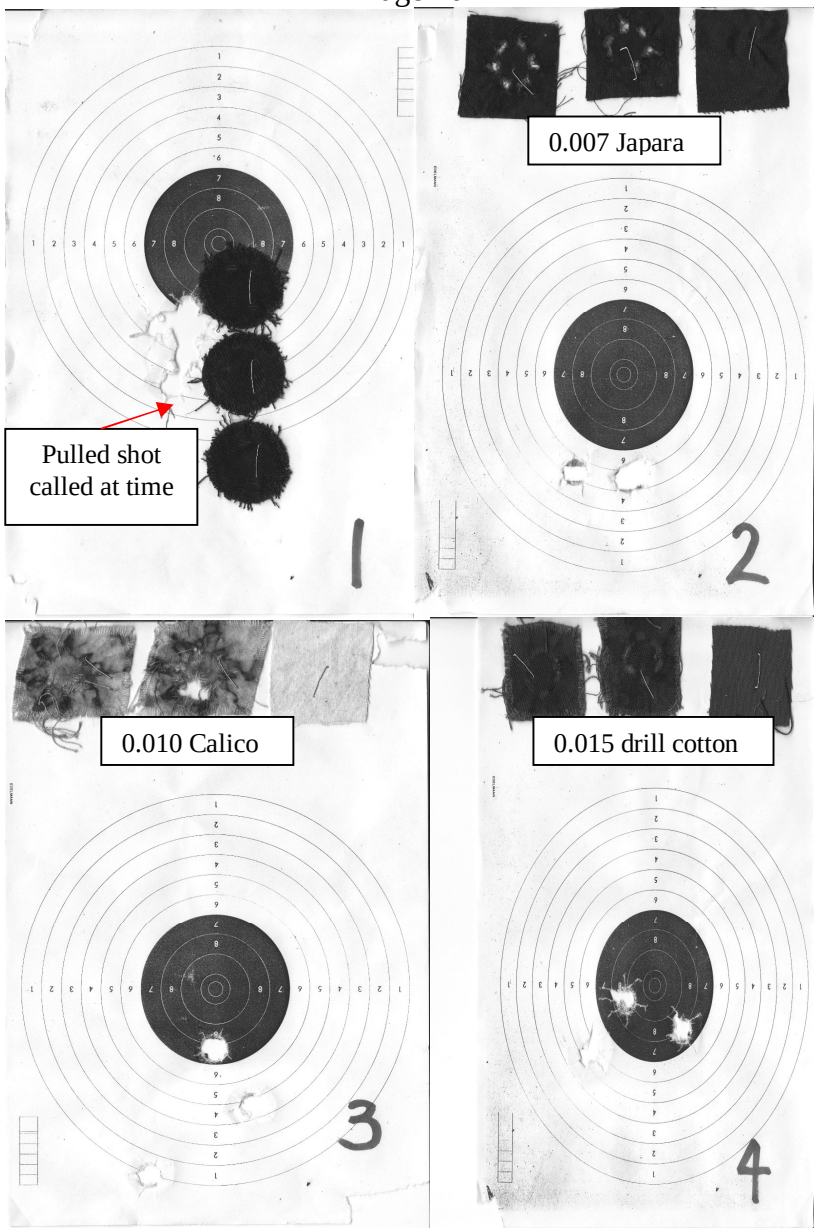
For further discussion feel free to email me at info@beavergrease.co.nz

Best regards and keep your powder dry.

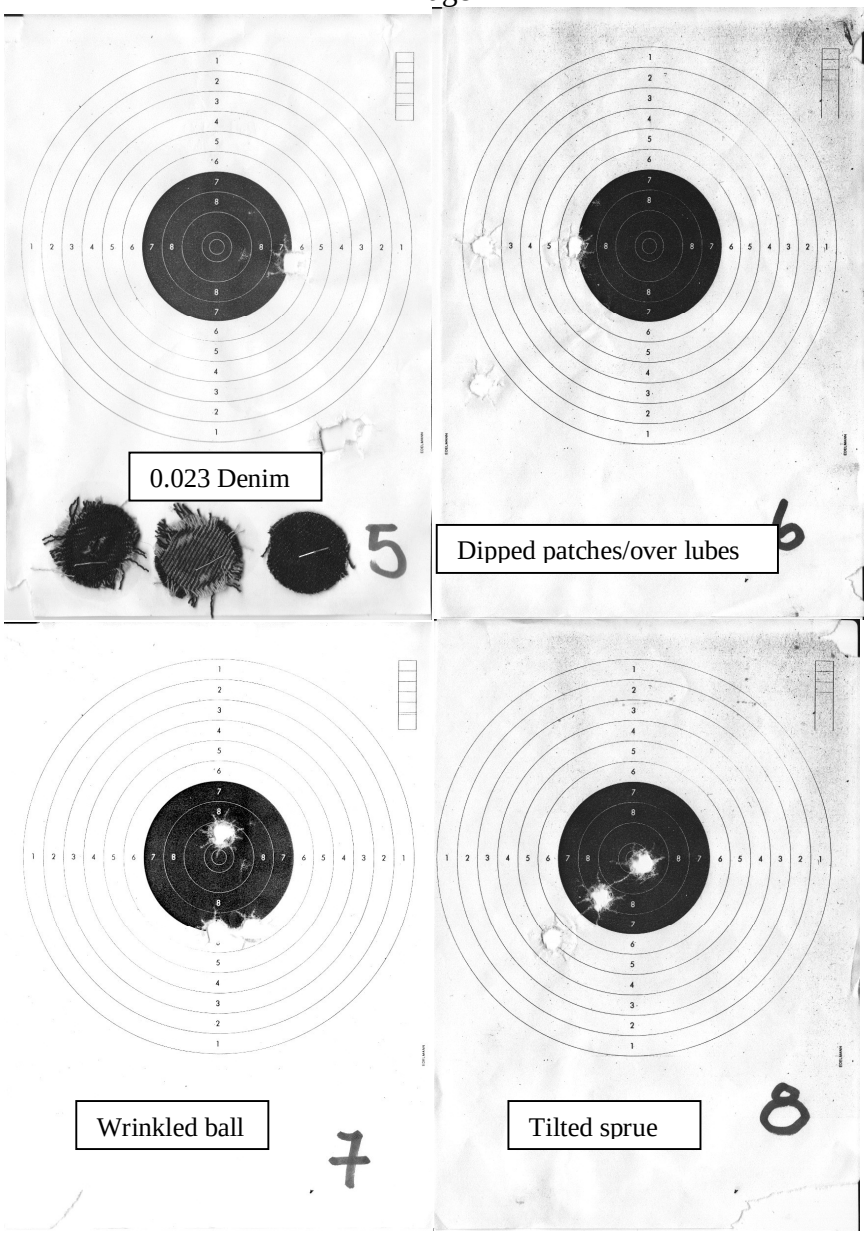
The following targets were all shot under these conditions:

Bull size – 2 inches/50mm
Range – 50 metres/55 yards
Shooter position – Bench rested, front hand supported
Rifle – Flintlock, Isaac Haines, .40cal, Colerain barrel
Charge – 30gr 3Fg black powder
Ball – Cast Lyman .395, pure lead

Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.



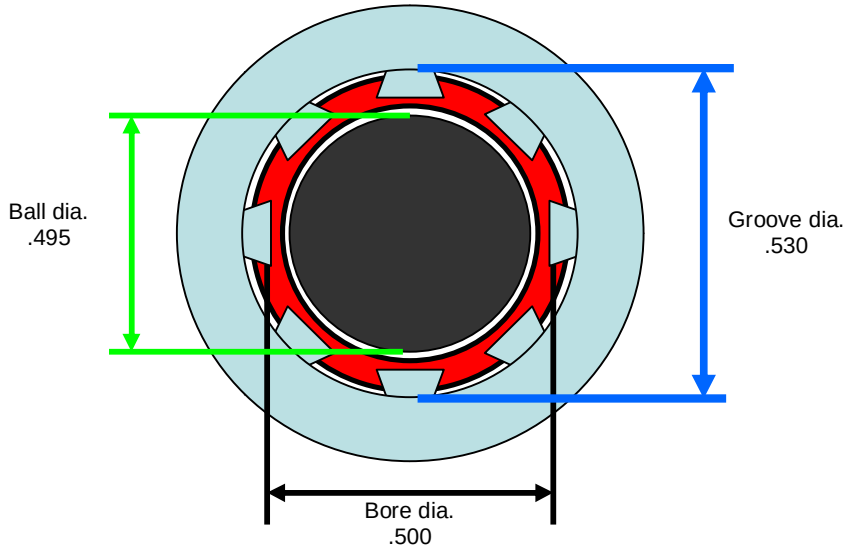
Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.



Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.

Diagram 'a'

Ball	.495 (5 thou less than bore)
Groove	.530
Difference	.035
Patch thickness	.018 (1/2 difference ball/groove)



Copyright Jeff Brown, 'The Cast Bullet Kid' 2007. Reproduction prohibited without prior permission from the author.