



The Gun Trade Association advice sheet on the use of lead-alternative ammunition for live quarry shooting with shotguns.

Background

When we shoot live quarry, the chemistry of the shot has no importance; what's critical are its physical properties – density, size and energy – and the number of those shot that hit the target. Sufficient energy density – shot numbers, size and energy – being transferred effectively into the target is what produces a humane kill.

That kinetic energy is a combination of the shot's mass and its velocity. $KE=1/2MV^2$. The mass of a piece of shot is a combination of its size and its density. So, what we need is a combination of shot numbers, shot size, material density and velocity to create the right effect at the ranges we are engaging the target.

The gun is the machine that converts propellant energy into kinetic energy of the shot. The barrels point the shot in the right direction and the chokes – a slight constriction at the muzzle - help shape the shot load to fly through the air in the most efficient manner.

The shot in flight spread out, side to side and front to back. That spread produce the 'pattern' at the target range. Different chokes produce different patterns. The more choke, the tighter the pattern. The choice of choke, velocity and shot size produce the optimal pattern.

Moving away from lead makes us look at other materials and the way we vary these factors to produce the target effect.

Ammunition manufacturers have been doing this for years to provide different options for shooters – materials, velocities, sizes etc. The shooter should explore these options to see what works best in their gun for the type of shooting they do. Most of us should get out on the range more to check the pattern of our guns and ammo.

What's on offer?

Manufacturers have developed a range of different cartridges utilising different materials.

Nearly matching lead's density, another metal **Bismuth**, produces very similar effects. It is softer than barrel steel, so can safely be fired with simple fibre wads for field use. It's been used for years for wetland shooting and is very effective. Moving up one shot size is often recommended. The challenge is that it is significantly more expensive than lead.

Tungsten is a metal that is denser than lead but very hard. Powdered and mixed with polymers (plastics), or alloyed with iron, it can be formed into shot that behave similarly to lead. It is now available with a bio-degradable shot cup. Again, it's been used effectively for many years but is also expensive and in its polymer form, contributes small amounts of plastic to the environment.

Steel is cheap and widely available. Actually, the shot is made of soft iron. It lacks the density of lead and is almost as hard as the barrels, but the manufacturers have got around those issues. First, steel shot cartridges use cup wads to prevent the shot from touching the barrel walls. These have traditionally been made from hard plastics but now environmentally friendly fibre or water-soluble cups available. Secondly, to make up for the lower density, size and velocity can be changed.

For live quarry shooting you should choose a size two larger than your old lead size e.g. If you were shooting size 6 lead shot, you should choose 4s in steel.

'Standard steel' cartridges have been designed by manufacturers in association with proof authorities¹ that can be fired through any nitro-proved gun². They must have a cup wad to protect the barrel; they have a maximum shot size of 4; and they have to conform to the normal pressure limits of nitro proved guns.

Trials in 1991³ using standard steel cartridges with light loads (24 grams) demonstrated that even light walled game guns of contemporary manufacture with ¾ chokes showed no damage after firing 1000 rounds.

Standard steel loads can be fired safely through light walled guns but there is a risk that in some circumstances a slight bulging at the choke neck can occur. The likelihood of such bulging is increased by heavy loads, large diameter shot and steep, tight chokes. Old guns may be more vulnerable. The British Proof Authority recommend less than half choke (0.5mm). Such a bulge would not be an immediate safety issue but would inevitably have an impact on its proof status and value. Having a gunsmith widen the chokes would reduce this risk. Further trials to quantify this risk are planned.

Increased velocity can also be achieved by changing the propellant and generating more pressure. Such cartridges are known as '**high performance**' steel. They should only be fired in guns proved for steel. This is indicated by a 'fleur-de-lis' mark on the gun and the words STEEL SHOT.

Steel shot cartridges are similar to the price of lead.

What now?

1. The first thing you should do is to look at your gun, possibly with the help of a gunsmith. Look at the proof marks.

a. **What is the bore size?** – 12, 16, 20 etc.

With 80% of all cartridges sold being in 12 gauge, this will present the widest choice. Some 20 gauge options are available and more will appear. 16 and smaller gauge guns will be limited to bismuth options at the moment.

b. **What is the chamber size?** This will be marked in the old inch system or in millimetres.

The traditional game gun was chambered for 2 ½ inches (65mm). Proof rules (CIP)⁴ state that cartridges marked 65mm and 67mm can be used safely in 65mm chambered guns. Larger 2 ¾ in (70mm) chambers offer you more options. 3 in (76mm), more again. Make sure you never use a cartridge that is bigger than the chamber size for which it was designed.

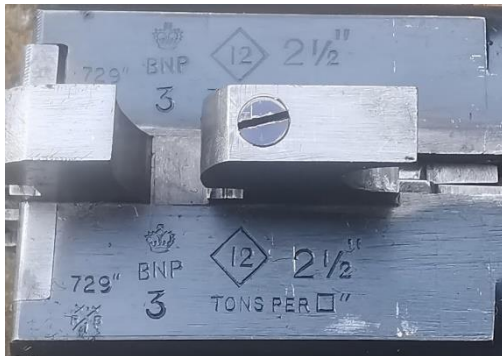
¹ Rules of Proof 2006. http://www.gunproof.com/Proof_Memoranda/RULESOFPP.PDF

² Steel shot should not be fired through Damascus steel barrels.

³ The Assessment of the Tolerance of Shotgun Chokes to Steel Shot – An Initial Study, Allsop, RMCS, May 1991.

⁴ 'Commission internationale permanente pour l'épreuve des armes à feu portatives' – CIP, the international rules of proof that pertain to UK.

c. **Is it 'nitro proved'?** Guns proved in UK will have either the London or Birmingham marks.



An old 65mm (2 ½ in) chambered gun showing nitro proof suitable for 'standard steel' cartridges.

Guns from abroad should have appropriate CIP marks. (Explained in the Rules of Proof and on the CIP website). These guns can fire 'standard steel' cartridges.

d. **Is the gun Steel proved?** Guns that can fire 'high performance' steel cartridges will be marked with the 'fleur-de-lis' and may state STEEL SHOT. They will have been tested to the 'superior' proof pressures. Without that mark the gun should never be used to fire high performance cartridges, whatever the size.



A modern gun showing nitro, superior and steel proof for 76mm (3 in) cartridge. The 'fleur-de-lis' shows it is suitable for high performance steel cartridges.

e. **What chokes have I got?** Steel shot is less compressible than lead as it accelerates up the barrel and gets squeezed by the chokes. As a result, the high-performance steel cartridges have limits on what should be used. Shot sizes exceeding 4mm (BB and larger) should only be fired through a choke less than 0.5mm (half choke).

f. **What do I use my gun for?** Not everyone is shooting at high pheasants at maximum range. Be realistic about your shooting needs. A standard steel cartridge will still be effective on game and pigeon out to at least 30m. If you absolutely need to engage challenging targets, the most effective solution will be to use a modern gun designed and built to fire high performance steel. Wildfowlers have been successfully using steel for years on long range targets.

g. **What should I look for on the ammunition?** Manufacturers are obliged to make ammunition to CIP standards; the UK manufacturers having their ammunition tested at the British Proof Laboratory in Birmingham. This is shown



with a CIP mark. Only CIP approved ammunition should be used in guns with CIP proof. Boxes should then be marked with warnings for steel as appropriate.



High Performance cartridges should be marked with a pressure warning 'Max 1050 bar' or 'for weapons proofed to 1320 bar'.

Some old stock may not have all the markings. Check with your supplier, look at the box, the cartridge and, if necessary, the manufacturer's website to determine the type.

Steel cartridges. Both marked 'steel'. High-performance left with the pressure warning, standard on the right.

h. How do I test new combinations? Using the advice above and talking to your gun shop, find some ammunition that matches your and your gun's needs. Then get out to test the patterns. Many shooting grounds will help you test the pattern of your gun. Steel shot, because they deform less than lead, often produce better patterns. Use paper or cardboard targets. Old steel plates are unsuitable because of the ricochet risk. We should all do more patterning to know what works in our guns – different chokes and different types of cartridges will all deliver different patterns. At the range you shoot your quarry, find what provides enough shot of the right size to effectively hit a target.

Then get out in the field. Farmers everywhere need help protecting their crops and pigeons are great for getting the eye in. You will quickly see that steel or other alternatives works and build your confidence ready for the game season.

Get more advice from members of the Gun Trade Association or your local gunsmith who can be found at <https://gtaltd.co.uk/find-a-member>

This fact sheet will be updated with new data from trials as it becomes available. See the [GTA site](#) for the latest version.

The GTA is grateful to the British Proof Authority and Dr Derek Allsop in the review of this guide.



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