



LEAD SHOT SUBSTITUTES

WHAT YOU NEED TO KNOW

This information has been produced to give guidance to members who are either required to use non-lead shot, or either wish to use it for other reasons. The former includes all shotgun shooting on the foreshore and on designated Sites of Special Scientific Interest, and all waterfowl shooting inland (England and Wales), and all shooting over wetlands (Scotland and Northern Ireland). The restrictions can include game shooting and clay target shooting.

BASC's policy on lead shot is clear and unambiguous (see <http://basc.org.uk/about-basc/basc-policies/basc-policy-on-lead-ammunition/> for full details) - the key part is:

BASC will vigorously oppose any unwarranted restrictions on the use of lead ammunition. Discussions and decisions about possible restriction must fully involve shooting interests to ensure that social, environmental and economic consequences are taken fully into account by decision makers. The justification for any proposed restriction must be clear, substantial and science-based.

This information will be kept up-to-date with relevant developments in non-lead shot cartridges to keep members informed and able to make any choices they have or to choose to make.

BASC's approach

BASC has always worked to the principle that substitutes for lead shot must be safe, effective, environmentally acceptable and affordable. Let's look at each in turn.

Safety – This is the objective of the International Proof Commission (CIP) regulations for all cartridges. Safety is essential for both gun and user and is fundamentally concerned with the cartridge's service pressure not exceeding the safety limits of the gun's chamber. Safety is largely assured by cartridge manufacturers complying with the CIP regulations and the American SAAMI (ammunition industry) code of practice.

Effectiveness – We all have our own range limit – the distance at which we can consistently achieve clean kills. It could be said that the main lead substitutes are capable of killing quarry at longer ranges than most shooters are capable of consistently hitting their target. The key for success with any cartridge type then becomes shooting skill – the ability to hit your target.

Once you can shoot consistently well, your gun/cartridge combination is best guided by 30 years of American research through Tom Roster, and the Co-operative North American Shotgunning Education Programme (CONSEP), which BASC has long supported.

Roster's lethality table specifies the suitable gun/cartridge combinations for consistently killing each type of quarry species according to the shooter's range limits. It is based on the pellet count in the traditional 30in circle as the measure of cartridge performance as recorded in Roster's years of field and laboratory shooting research.

While the lethality table was developed mainly for steel shot, and, more recently, tungsten-based shot, these pellet counts still broadly apply for different shot materials after adjustments for densities of shot materials. Minimum 30in pellet counts necessary to achieve consistently high lethality of our quarry species are indicated below. These are based on 30 years of American shooting research.

Species	Minimum 30in pellet count
Small duck (Teal)	145
Medium duck (Wigeon, shoveler, gadwall, goldeneye)	120
Large duck (Mallard, pintail, pochard)	90
Small geese (Egyptian)	80
Medium geese (Pinkfoot/Greylag)	65
Large geese (Canada)	55
Small gamebirds (Woodcock)	160
Medium gamebirds (Red-legged and grey partridges)	140
Large gamebirds (Pheasant, red grouse)	100
Medium pest birds (Jackdaw, jay, magpie)	180
Large pest birds (Woodpigeon, crow, rook)	140

The clear message here is that we need to pattern our gun/cartridge choices to make sure they will deliver the minimum pellet densities at our personal range limit (See the Research Department's "Cartridge Patterning: We need to do it – and better" for more information).

Environmental acceptability – We have to rely on the US system for approving new shot types for waterfowl shooting as there is no comparable system in Europe. We need to make wider assessments of environmental acceptability before we can support new shot materials in this country, to head off any potential environmental problems. Nowadays new shot is commonly made by mixing existing materials and we must be sure that does not create future problems.

Affordability - The prices of cartridges are determined by the manufacturers and the market. The approximate current costs are indicated below.

Material	Range of prices per box	Approximate price per cartridge	Comment
Bismuth	£32.15 - £60+	£1.29 - £2.40+	Full range available for most users
Steel	£6.45 - £17.50	£0.26 - £0.70	Many steel loads are now cheaper than lead. Light clay target to high performance 'fowling loads are available
Tungsten-based	£28.50 - £60+	£1.14 - £2.40+	Mainly for 'fowling but variable costs due to different types, and some availability issues

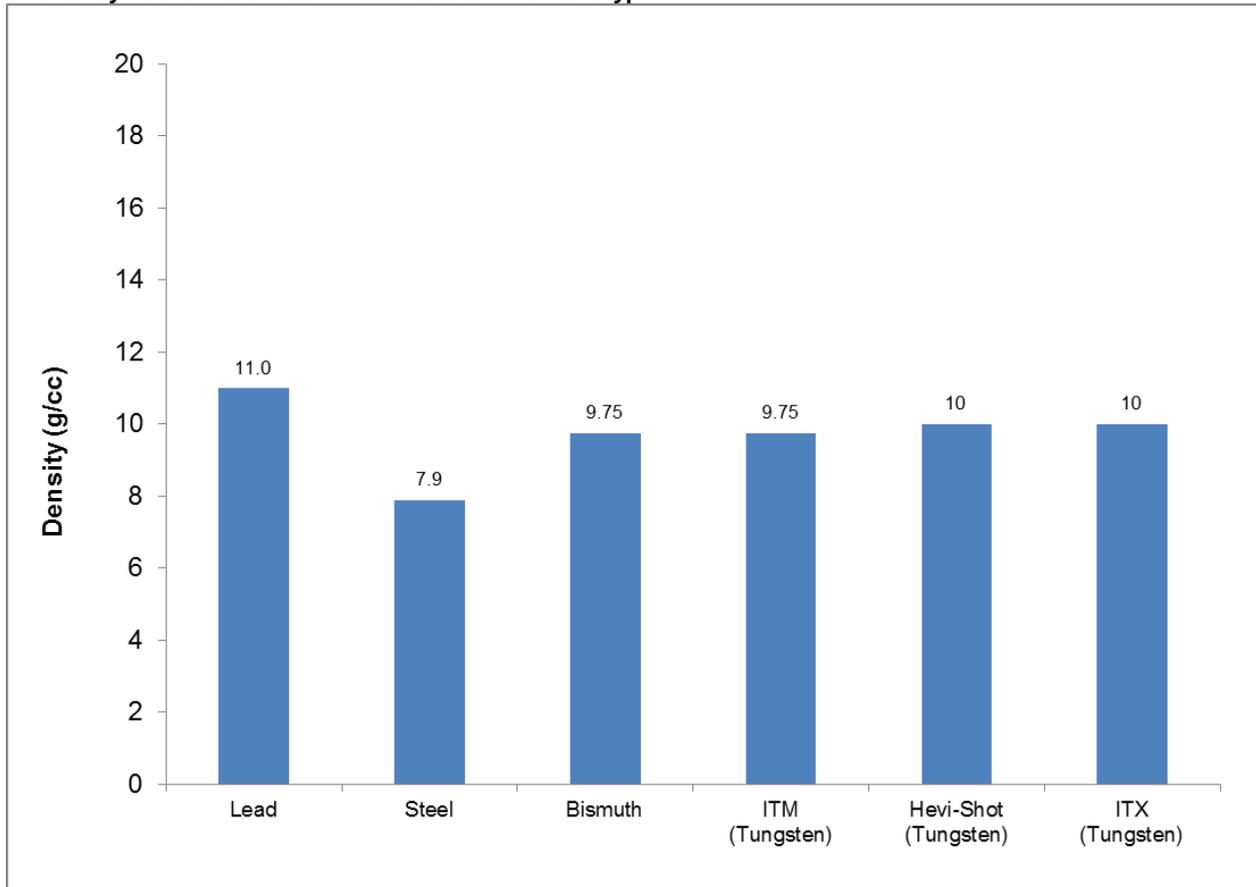
Suitability for different types of shooting

There are probably as many views about lead shot substitutes as there are people who shoot. Some are based on first-hand experience, some on hearsay, and some on misunderstanding.

Some basic facts about current shot materials, namely their density (in grams per cubic centimetre) are given below.

Very broadly, and for differing reasons, the main non-lead shot types lend themselves more to some types of shooting than others. With appropriate knowledge and care most can be used more widely, with cost likely to be one of the factors involved in choice of cartridge.

The density of lead and some common non-lead shot types



Bismuth

Less dense, but as soft as, lead, making it widely usable, including older or Damascus-barrelled guns. Available for most bores in many sizes and in fibre or plastic wads. Advisable to increase pellet size by at least one (e.g. UK no.4 (3.1mm) instead of UK no. 5 (2.8mm)), to maintain penetration energy levels.

Steel

Substantially less dense than lead so pellets *at least* two sizes larger than lead are normally needed to achieve similar penetration energy levels. For example, at least UK no. 3 (3.3mm) instead of UK no. 5 (2.8mm). Its greater hardness, though, can mean both tighter patterns and deeper penetration than with comparable lead. It normally comes in protective plastic wads necessary to protect barrel walls from contact with hard pellets. Steel's use in standard guns or in high performance loads is guided by the CIP (see below).

Recent trends in American loads include increased speed as well as different-shaped pellets. There is no evidence yet that these increase shooting effectiveness in the field. Higher velocities have been found to limit pattern densities beyond some 45 yd.

Care is needed before using steel loads in old, thin-walled, English game guns. It is not advisable in Damascus-barrelled guns unless the barrels have been recently nitro-proved, and standard steel cartridges (see below) only are used.

Care is needed with some steel loads claimed to be high velocity – they may exceed CIP limits and increase risks to guns. Use of such loads could also jeopardise insurance claims in the event of any damage.

Tungsten

Tungsten-based shot appears in various brands, comprising different mixes of tungsten and other metals or plastics. Impact Tungsten Matrix (ITM) comprises tungsten and nylon, while TMX contains tungsten and iron, suited to muzzle-loading guns. Hevi-Shot also contains some nickel and iron. American loads are more variable. Most tungsten types are similar in density to lead, but some are denser (mainly US brands).

Although it is tempting to use such cartridges to increase shooting range (often encouraged by their makers) they should be used to increase lethality within the shooter's normal shooting range. Fibre and plastic wadded loads are available. Some hard shot types, especially American, though, need to be used with care – see CIP below.

The International Proof Commission (CIP) and steel-like shot

The CIP is the international body which governs the proofing of firearms, and safety of cartridges. It is primarily concerned with the safety of guns, however, and not for their performance in the field. As a result cartridge performance may be limited to some extent.

For steel-like shot the CIP imposes limits on velocity, momentum (weight of load x velocity), and pellet size. For pellets BB and larger it also limits choke, to maximum half choke. Currently the regulations cover 10 bore, 12 bore, 16 bore and 20 bore guns/ cartridges.

There are two types of steel shot cartridges: Standard and High Performance.

- Standard steel shot cartridges, meeting defined limits of cartridge size, and shot velocity and momentum, can be fired through standard and magnum-proved guns.
- High Performance steel cartridges, with their own, higher, size, velocity and momentum limits, are to be fired only through guns which have passed special steel shot proof.

Some hard tungsten-based shot types are now treated as steel, and are to be used accordingly. Most tungsten-based shot types, though, including ITM, TMX, Hevi-shot II (but not Hevi-shot I) and others, are made to a similar softness to lead and are treated by CIP as lead. This is welcome as it no longer unduly limits performance of several new shot types appearing on the market.

Information on the regulations and recommendations are available from BASC's research team.

History of lead substitutes

Development of substitutes began in the USA in the 1960s and 70s following the findings of the wastage of waterfowl from ingested lead shot poisoning. Coating lead pellets to prevent the toxic metal getting out was first tried but none proved effective.

Steel (or more correctly, soft iron) shot then emerged although not without controversy over early effects on shotguns themselves, and its effectiveness in the field. More recently a whole raft of materials based mainly on tungsten has appeared.

Lead substitutes in the UK

Rather few metals in the periodic table lend themselves to being made into gunshot not least because of their unsuitability and high cost of manufacture. Tungsten in the 1980s appeared a possible runner, with its much higher density compared with lead (see graph).

Eley Hawk tried it first in *Black Feather*, made from tungsten powder in a polymer base. This proved ahead of its time and too expensive and quietly faded away. The company then moved to bismuth and developed a successful product line. Since then other loaders have developed mainly tungsten-based shot types.

Others worth noting include the infamous *Molyshot* (did it actually exist?); depleted uranium (great for night shooting); zinc, which was toxic, and tin. *T-shot*, a coated-lead shot, has been around for many years but not taken up seriously.

In the USA there are many shot types approved for waterfowl shooting by the Federal Government. Most comprise varying combinations of tungsten with different materials, including copper, iron, tin, nickel and bronze, or mixed with polymers. Some of them find their way into this country.

Key requirements

Damage to vital organs is needed to kill a bird or animal as rapidly as possible. This is what responsible shooters seek to achieve with each shot. Then the quarry is retrieved and put to good use. This requires:

- accurate placement of the shot pattern on the target
- a pattern of pellets that is dense enough to ensure that at least one vital organ will be struck
- sufficient pellet energy to ensure the penetration of one or more pellets through feathers or fur, skin and muscle, into those organs.

Nowadays there are substitutes for lead shot for most shooting disciplines, though lead provides the standard against which newcomers are judged. Each has its strengths and weaknesses and it is important to understand them to ensure consistently clean kills and safe shooting.

Material density and hardness are two important factors.

For a given size (diameter) of pellet, higher density results in more energy for penetrating into vital organs to achieve a clean kill at a given range. The reverse, though, occurs with lower-density materials. Such shot types are widely presumed (often without good reason) to be less effective and so more likely to wound than kill. They can be used effectively, though, if you compensate by increasing pellet size, ensure that pattern density is adequate and, as ever, shoot only within the effective range of the cartridge chosen and your own shooting skill range limit.

The downside of high density types (mostly tungsten-based) is that they encourage, especially through their marketing, shooting at longer ranges than most shooters' shooting skill levels allow. This will result in more wounding.

Hard shot such as steel is criticised because it is thought to pass through quarry, not killing it in the process. However the evidence is that, as long as one or more vital organs are damaged on the way through, the shot should be lethal. Hard shot types are also claimed to ricochet more than soft types, but good practice and shooting ground management can minimise risks. Lead and other shot types also ricochet.

Hard shot does need to be kept clear of barrel walls and plastic wads are used to achieve this. A problem arises, though, for fibre-only shoots or shooting grounds. New fibre wads suitable for such shot are being developed but have not been tested by BASC.

In conclusion

There is a range of lead shot substitutes for those who need or want to use them. They all have strengths and weaknesses, some being more suited to a given type of shooting than others. Each, though, should be used within its own limitations so that our quarry is killed humanely and without unnecessary suffering or wastage of good food. It may take a little time at the pattern plate to find the most effective cartridge(s) for each type of shooting. An information paper on patterning guns/cartridges is available to download from the research team pages at www.basc.org.uk or by telephoning the research team on 01244 573016. The CONSEP guidance is an invaluable starting point for evaluating the potential effectiveness of each type of cartridge, but additional advice is available from the BASC research team.

Homeloading/large-bore guns

For homeloading advice, particularly with tungsten materials, and fibre shot wads, contact Clay and Game at Unit 18, Redcliff Road, Melton, HU14 3RS, telephone 01482 631066, email clayandgame@aol.com; and for bismuth, Alan Myers at Ballistic Products UK, Vicarage Farm, New House Lane, Winmarleigh, Garstang, Lancashire, PR3 0JT, telephone 01995 604251. These specialists have information, materials and advice for homeloading, particularly large-bore guns in a variety of non-lead materials.

Information and advice

Technical information is available from the research team at BASC Head Office on how, when, where, etc, non-lead cartridges must be used, the characteristics of the substitutes and other information related to their use in the field (including clay shooting).

Finally – BASC urges ALL wildfowl and wetland shooters (both inland and coastal), and all other shooters affected by the lead shot regulations, to abide by them, and to use non-lead cartridges responsibly where required and in the best interests of our quarry and our sport.

Non-lead Shot Cartridge Manufacturers

Cartridges loaded with non-lead shot are available from most gun shops and shooting grounds. The following main UK manufacturers have the following cartridges available:

Company	Telephone	Website	Shot Types
Eley Hawk Ltd	0121 352 3272	www.eleyhawkLtd.com	Bismuth Steel
Gamebore	01482 223 707	www.gamebore.com	Tungsten-based Steel
Hull Cartridge Co Ltd	01482 342 756	www.hullcartridge.co.uk	Steel
Lyalvale Ltd	01543 434 400	www.lyalvaleexpress.com	Steel
Caledonian	01330 820 444	www.caledoniancc.com	Steel

If you cannot obtain non-lead cartridges from your usual retailer, try contacting the manufacturers direct. There are several overseas producers who have a range of steel shot cartridges on the Continent. Information on the availability of their cartridges is best obtained from their distributors in this country; these include:

	Telephone
Rottweil – Ruag Ammotec	01579 362 319
Sellier and Bellot – Edgar Bros.	01625 613 177
Winchester – BWM Arms Ltd	01235 514 550

Whilst a range of higher performance steel and other shot cartridges is available in the USA, they are generally not available in the UK due to their having been developed to suit guns of American styles, and are not suitable for the majority of guns in use in the UK. However, CIP regulations now allow the use of some of these cartridges in this country with Steel Shot Proof guns.

Contact their importers for information and supplies:

	Telephone
Remington – Edgar Bros.	01625 613 177
Winchester – BWM Arms Ltd	01235 514 550
Federal – GMK Ltd	01489 587 521