‘Steel’ Shot

What shooters need to know

PART 1

Since the earliest manifestations of the sport, clay pigeon shooters have always used cartridges containing lead shot pellets. From the ballistic viewpoint, a modern lead alloy makes an excellent shot material. Its density (weight) per pellet is just about perfect, for both ranging power (on full distance clay pigeons) and the maximum distance that it will travel for safety purposes.

Sympathetic Lead

Its relative softness when compared to the shotgun’s barrel wall means that any type of wadding can be used, without potentially damaging the gun by contact with the lead pellets, as they move from the cartridge casing to the gun’s muzzle. Because of this endearing trait, shotgun barrels have been traditionally made from relatively soft steels that could easily cope with a lifetime of firing lead shot pellets through them.

Their barrel wall thicknesses could also be kept to minimum levels, so that they could then be made within reasonable weight limits, thus keeping the overall lightness and balance of the gun to an efficient level for handling purposes.

Most shotguns in current use are only designed to fire lead pellets.

In recent years, when the price of lead (along with many other things) started to climb to its present high level on the commodity markets, lead shot loaded cartridge prices inevitably rose as a direct consequence.

'Steel's' emergence

We then started to see the gradual, but then increasing use of 'Steel' shot target loads, by some shooters who were looking to save money; it appears that this was their only motivation, ('Steel' shot is actually made of iron).

The physical properties, downrange abilities and potential for other mishaps with the use of these 'Steel' pellets were (and still are) not generally known.

In the media, various statements were inferred and implied as to 'Steel's' suitability and fitness for purpose, by those who had a vested interest in the increased take up of these steel pellets.

In some cases this was for political advantage, to further their agendas, and in others, purely for increased profit motives. The international C.I.P. proof authority had previously laid down strict procedures and other limitations including maximum allowable velocities, chokes and other restrictions for the use of 'Steel' pellets in specially built steel shot proved shotguns.

Ordinary shotguns (such as the vast majority of clay pigeon guns now in general use) that have only been proofed for lead shot have been given a more restrictive brief as to their 'Steel' shot usage.

Cheaper and lighter

To help to redress the balance and make lead cartridges more cost effective, the ultra light 21gram 12bore loads were then introduced to the market place with a view to cutting production costs, by the simple virtue of having 25% fewer lead pellets than the commonly used maximum weight 28gram cartridges.

(From a personal viewpoint, after spending 5 years of ballistic testing and development prior to their commercial introduction, 21gram 12bore lead shot loads work surprisingly well if loaded correctly for any given application).

Why use 'Steel'?

So with very little practical difference in the cost of 'Steel' shot and the ultra light lead shot cartridges, there would appear to be no real need to use 'Steel'.

The real issues here are that the actual performance and other limitations of ‘Steel’ shot pellets remain virtually unknown among clay pigeon shooters.

Unfortunately various misconceptions, false beliefs, general mischief and downright irresponsible disinformation, have been circulated about them, to encourage their extended usage.

It is the purpose of these ongoing series of articles, to fully show and explain in plain language, the whole truth about ‘Steel’ shot cartridge downrange performance and liabilities, in an even handed manner.

It is essential that all clay pigeon shooters appreciate and understand the very many issues (some hazardous) involved in the use of ‘Steel’ shot cartridges.

Physical properties

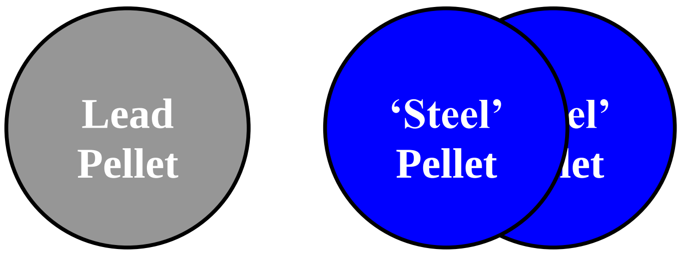
We will begin by examining the physical properties of both lead and ‘Steel’ shot pellets and what they mean to the clay pigeon shooter.

Weight

It appears that there are still some shooters who are not aware that ‘Steel’ pellets are considerably lighter than their same sized lead counterparts.

Taking UK sized number 7 pellets (2.4mm) as an example, a comparison of the weights of the ‘Steel’ and lead pellets can be made.

The standard Lead target pellet is 45% heavier than the corresponding ‘Steel’ pellet, which has the same diameter and frontal area.



Very nearly 1.5 steel pellets are needed to match the weight of a single Lead pellet.

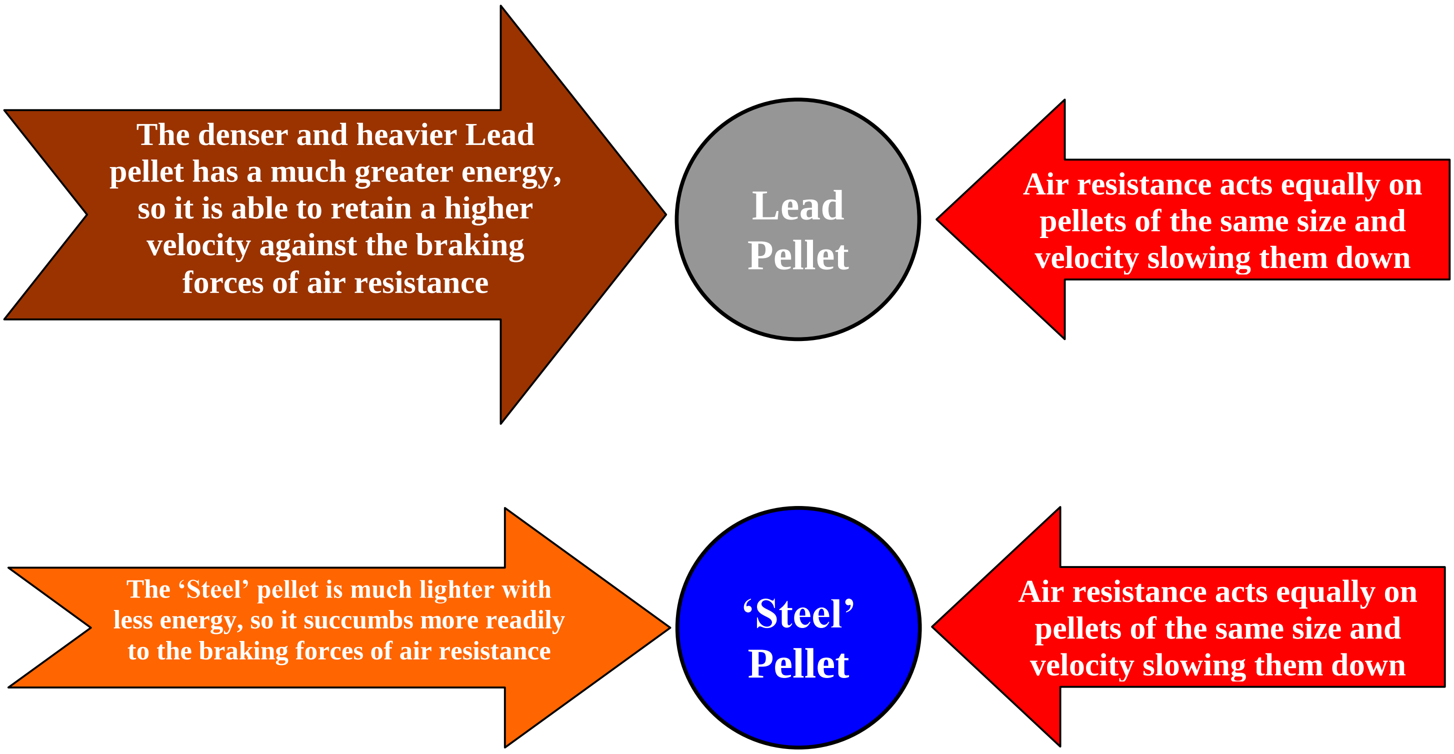
Density

This big increase in the Lead pellets' weight is due to the vastly different density of 'Steel' and Lead as a pellet material; the lead pellets are considerably denser than the 'Steel' varieties, so they are much heavier.

The denser Lead pellets also have a much greater momentum: meaning that they are much more resistant to any change in their velocity and direction than 'Steel', this is also due to their greater weight for the same shot size.

Identical velocity

If both the same sized steel and lead pellets are fired at the same velocity, the steel ones will lose their velocity far more quickly, due to their lower density. Because both the Lead and 'Steel' pellets have the same frontal area, which means that they both have to force an identical path through the air. The heavier lead pellets will be able to resist the braking effects of the air much more effectively and retain a higher velocity further downrange.



It must be appreciated that the resistance of the air to a shot pellets' flight through it is considerable. It can perhaps be compared to wading through water; a much larger effort is needed to do it more quickly.

An extreme example of this velocity sapping effect of higher and lower pellet densities, would be to compare a ping-pong ball ('Steel') and a golf ball (Lead), both launched at an identical speed. The golf ball easily outranges the ping-pong ball.

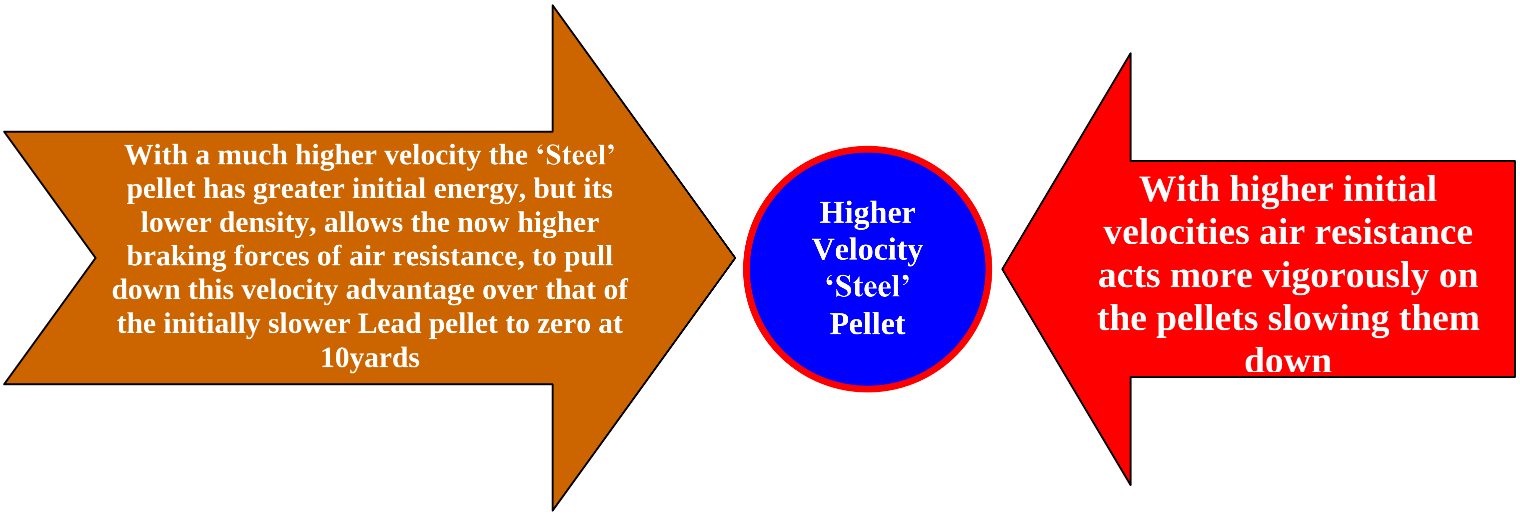
The difference between the two shot pellet types is not as marked as with this extreme example, but it is very significant indeed. With the same shot size, a much heavier lead pellet is able to resist these forces far more readily than the lighter 'steel' one because it is denser and thus retains a greater velocity and a very much higher energy.

Higher velocity

So with this in mind, the faster the pellet leaves the muzzle of the gun, the greater will be the retarding forces of air resistance acting upon it. This is why higher velocity cartridges, always lose a much larger percentage of their initial velocity advantage, when measured over the same distance as the slower loading. Heavier and therefore denser same sized pellets will lose a smaller percentage of this advantage downrange.

This does not mean of course that the higher velocity pellets are not faster at any given distance downrange than the slower pellets, but that they have a greatly reduced speed advantage when they get there: this effect is much more marked with the lighter and less dense 'Steel' pellets.

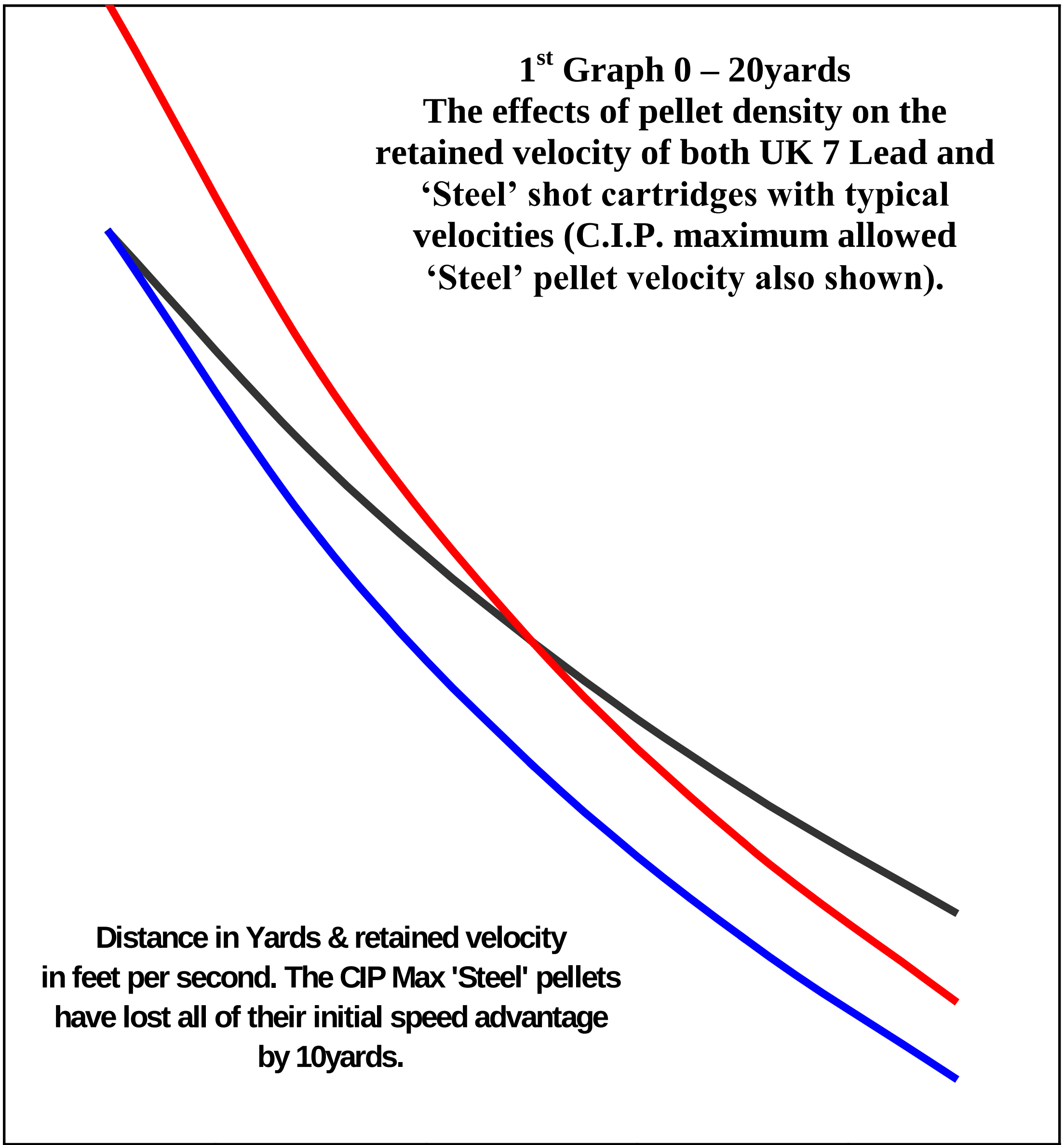
Returning to the ping-pong ball by way of example, even if it is launched very much more quickly (such as in a smash shot at table tennis), the increased air resistance forces at the higher speed slow it down visibly faster.



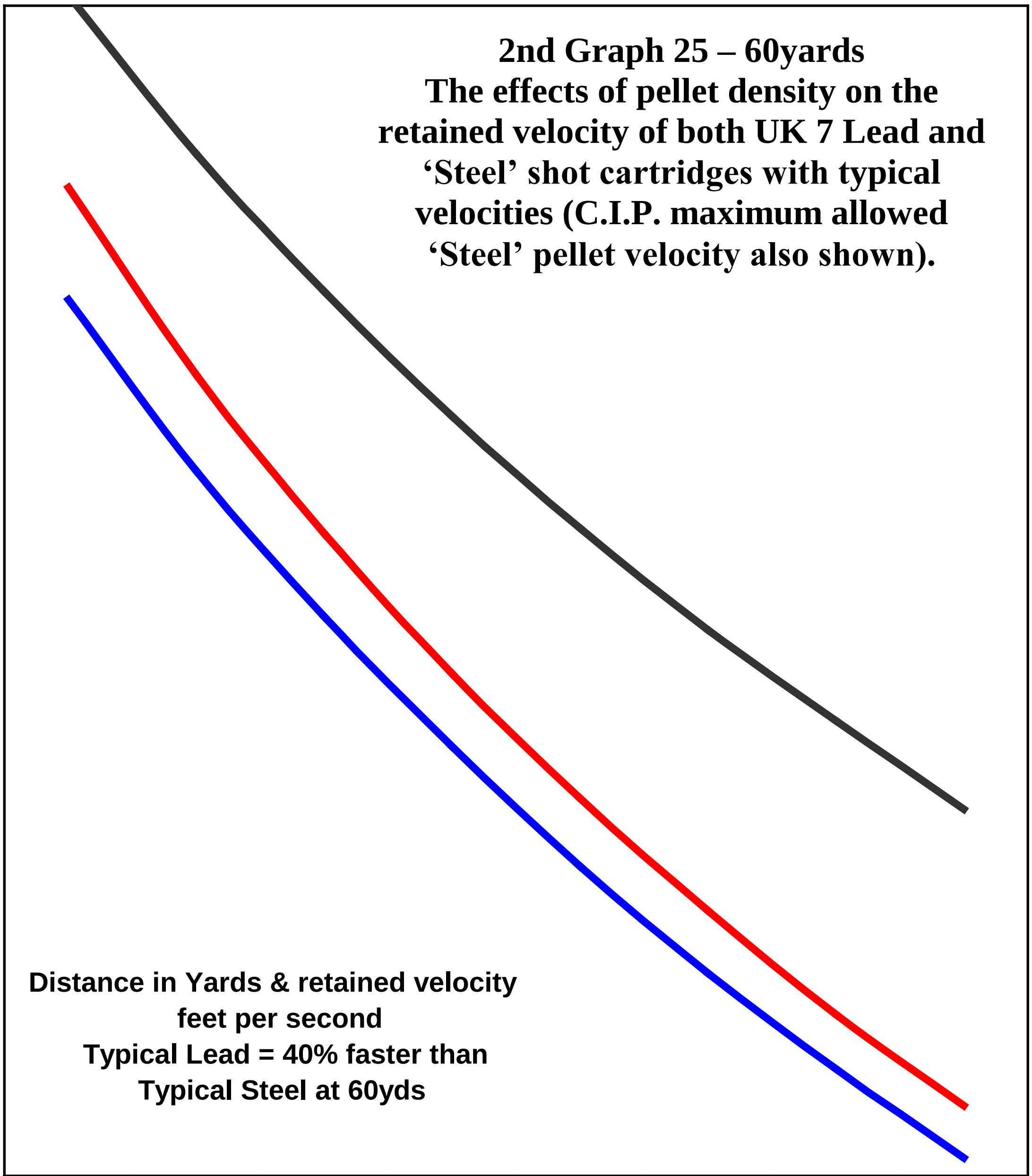
The actual effects of the lower density of the 'Steel' pellets, is shown in the retained velocity-charts.

When examining the charts (contrary to what has been suggested in some quarters), increasing the typical velocity of the 'Steel' pellets up to the maximum allowed by the C.I.P. proof authority (1312fps @ 2.5metres) has very little beneficial effect.

(One practical problem is the very understandable reluctance of the manufacturers to sail too close to the C.I.P. velocity limits, as extreme weather conditions might push the velocities beyond it).



	0yd	5yd	10yd	15yd	20yd
Typical Lead UK7	1300	1150	1031	934	853
CIP Max Steel UK7	1450	1207	1031	899	795
Typical Steel UK7	1300	1098	950	836	744



	25yd	30yd	35yd	40yd	45yd	50yd	55yd	60yd
Typical Lead UK7	784	723	670	622	579	540	505	471
CIP Max Steel UK 7	710	638	577	523	475	432	392	357
Typical Steel UK7	667	601	545	495	449	408	371	337

The initial advantage of 150 feet per second, imparted with the maximum C.I.P. velocity ‘Steel’ 7’s, has dropped down to just 28 feet per second at 40yards; giving an increase in effective ranging power of only 3yards.

Also, by the relatively short distance of 10yards, the maximum velocity ‘Steel’ pellets, have rapidly slowed down to match the speed of the initially slower lead pellets, losing all of their 150fps advantage.
Beyond this distance, they too drop way behind the lead pellets’ commanding velocity lead.
The extra 150feet per second at the muzzle, is barely worth more than 5.5% extra velocity (24fps) at 50yards over the typical ‘Steel’ pellet loadings.

Firing lower density ‘Steel’ pellets at the maximum allowed C.I.P. velocities has but a tiny downrange advantage over the typical ‘Steel’ pellet loadings. It simply does not deliver an adequate return for the inconvenience of extra recoil and noise.

Greater pellet density (such as with lead) means a much higher retained velocity as the range increases.
The chart shows that at 50yards the Lead pellets have a 25% higher potential velocity than the ‘Steel’ pellets, even though both were fired at the same speed.

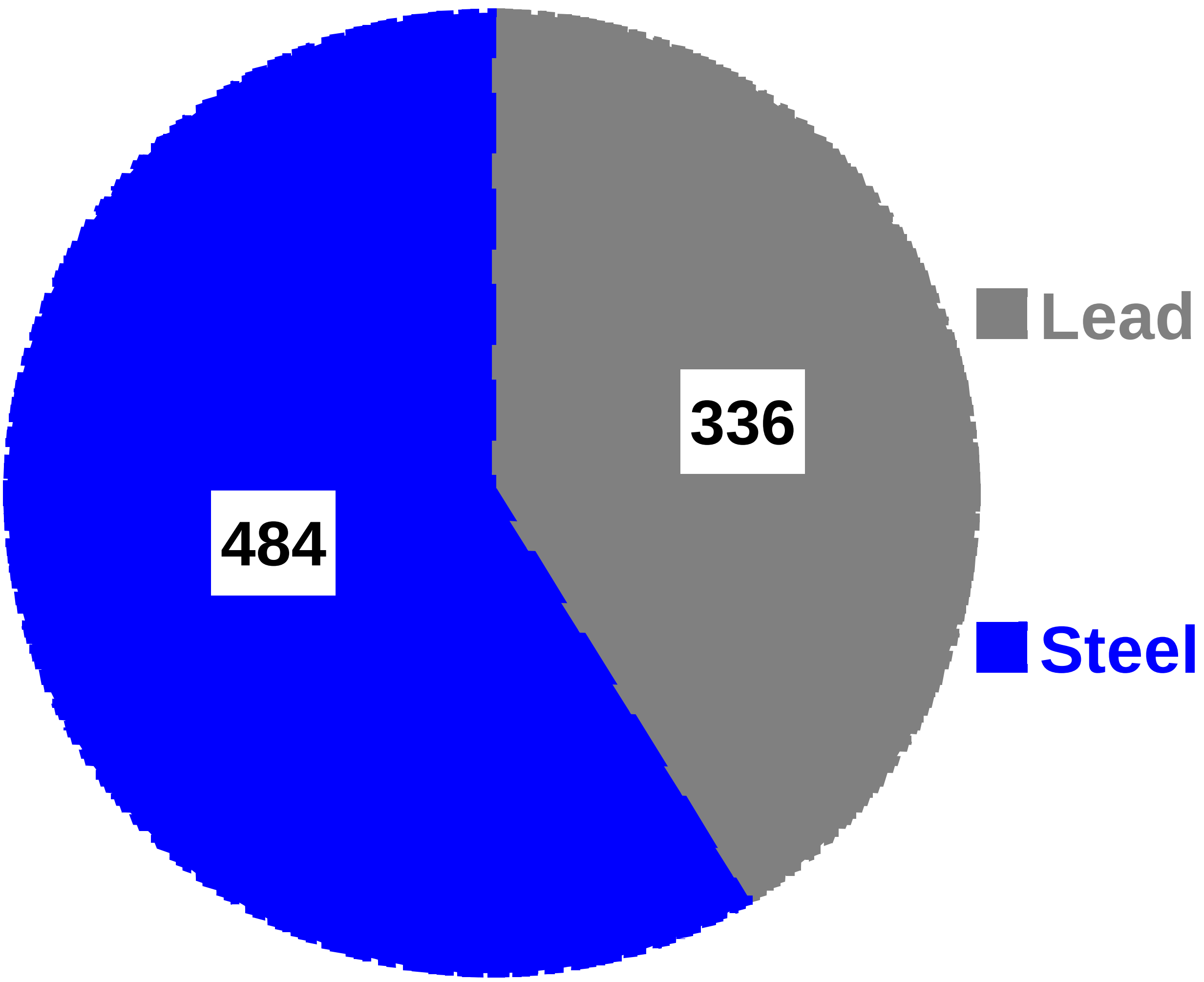
Heavier, denser pellets (Lead) that retain higher velocity downrange, have very much greater target breaking power, than the lighter and slower ‘Steel’ pellets.
All of these issues will be investigated in much more detail in the following parts of this series.

Numbers of pellets per loading

There appears to be some confusion over the pellet counts present in ‘steel shot’ target loadings.

Clearly, as ‘Steel’ shot pellets are much lighter than their same sized lead counterparts, then by inference, there must be larger numbers of them for any given weight of shot. If we stick with the UK number 7 size as an

'Steel' and Lead same sized (UK 7) pellet counts For a 28 gram load. There are 44% more pellets in A 'steel' shot load when compared to a budget Lead cartridge



example, then a 28gram loading of ‘steel’ shot will contain 484 pellets. This same weight of shot in a budget lead loading will have around 336 pellets.

What this actually means is that there are 44.1% more ‘steel’ pellets in any given loading than the same sized Lead shot.

Unfortunately the much lower target breaking power of the same sized, lighter ‘steel’ pellets, is proportional to both their higher numbers and their more rapid velocity losses at range.

When both are fired at the typical velocities shown in the velocity charts, at 40yards the Lead shot pellet has 2.25 times more striking energy then the ‘Steel’ pellet.

This is an enormous advantage for the Lead shot, showing that the combination of both the lighter ‘Steel’ pellet, and its much lower retained velocity at longer ranges is a disaster, as the consistent target breaking power simply isn’t there with ‘Steel’.

Having all of these extra ‘Steel’ pellets is of no practical use whatsoever if they cannot be relied upon to break clay targets at full ranges.

This very pertinent issue will be fully explored in the following parts of this series.

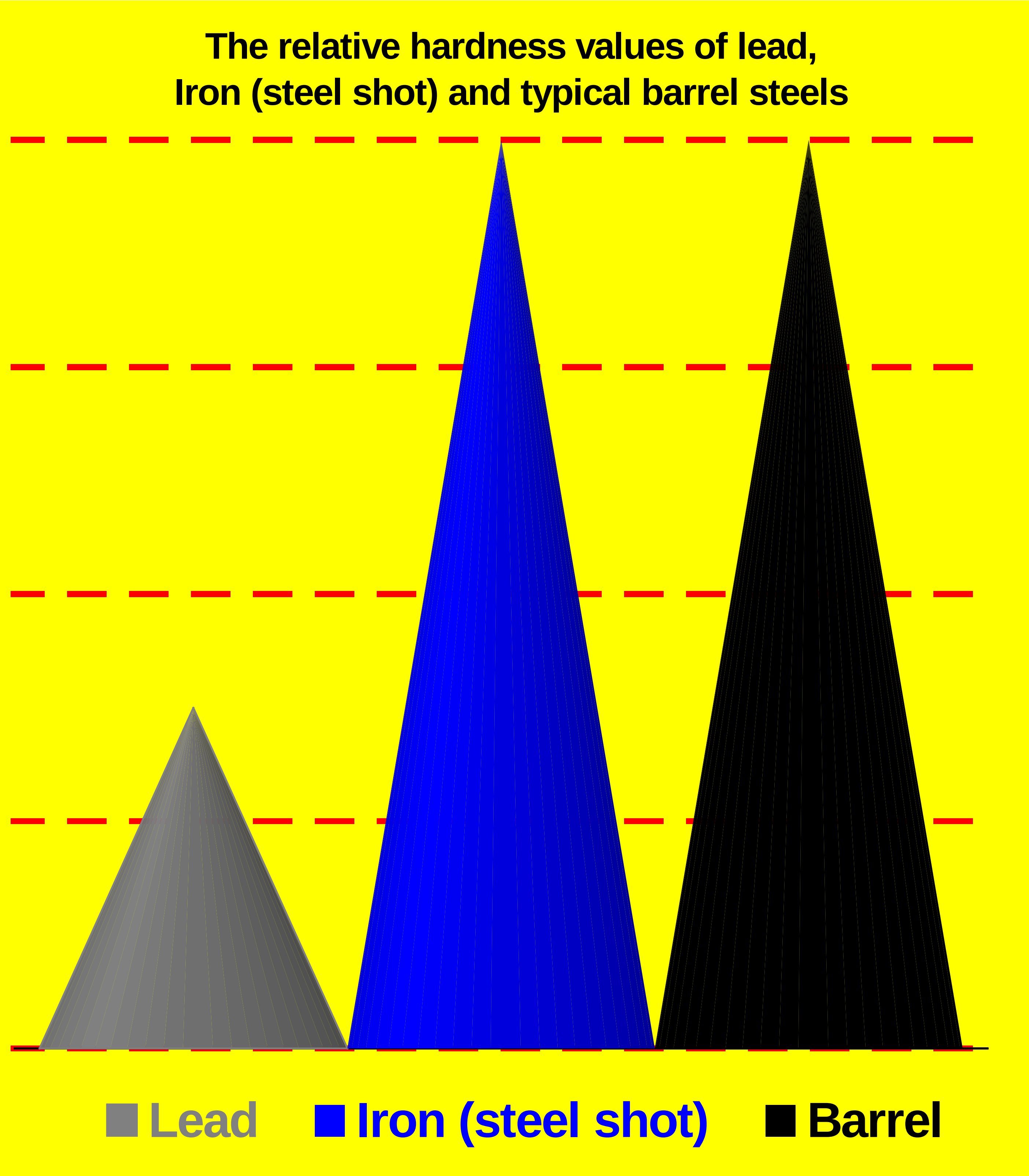
Pellet hardness

As well as being considerably lighter than lead, steel shot is also many times harder.

It is this unfortunate attribute that makes it imperative that there must be absolutely no chance whatsoever, of any frictional or impacted contact with any part of the gun’s bore, choke, or chamber cone, by the steel shot pellets.

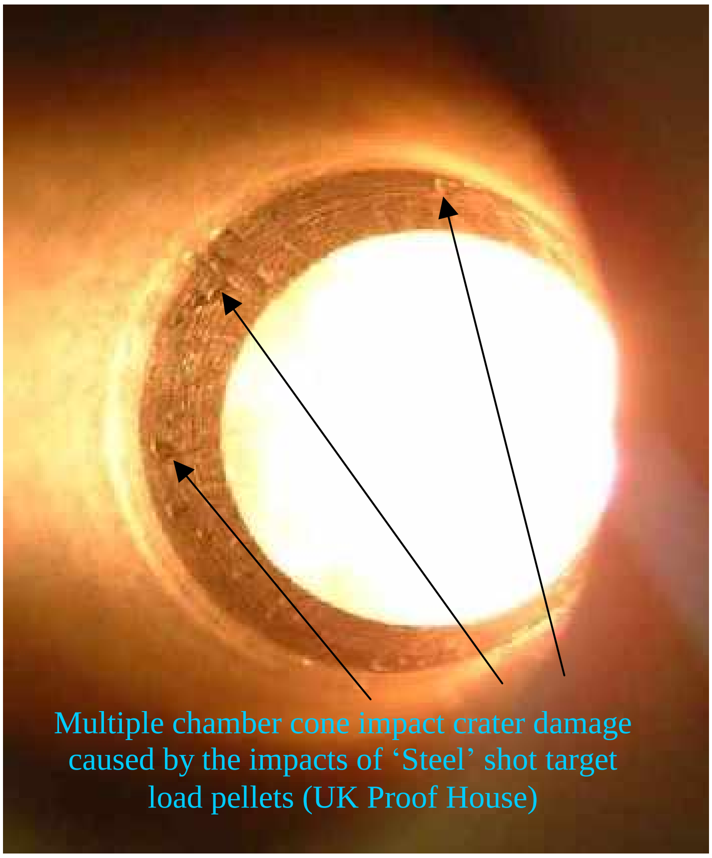
If this does happen (and it most certainly has on some occasions), then serious gun damage is inevitable. To help put this into perspective the hardness chart shows the relationship between ‘Steel’ shot, Lead and typical barrels.

Material hardness chart: showing the relative hardness of lead, soft Iron (steel shot) and typical barrel steels.



From the chart, immediately we can see that there are most definitely going to be damage issues, if there is any barrel wall contact from the ‘Steel’ shot (Iron) pellets.

The ever-present potential for gun damage with ‘Steel’ shot pellets.



It must be appreciated that the 'Steel' pellets are very much harder than lead, needing mandatory protection of the gun's bores from any contact with them.

If contact is made, this can and does, cause scoring of the barrels and impact craters at the chamber cones.

Left: Evidence of this type of chamber cone damage, can be seen inflicted on a European made over and under that was only two weeks old. The bores and chokes were also badly scored.

The image shows multiple steel shot pellet impact damage craters at the chamber cones

The proof house traced the cause of the damage to the 'Steel' shot target loads that the owner had been using in it. The pellets were incorrectly loaded outside of the shotcup, which resulted in the above damage.

Conclusion:

There are many issues with 'Steel' shot, not least its lack of density, (weight) when compared with Lead shot.

'Steel' shot cartridges are slightly cheaper (at the moment), but market forces will almost certainly alter this in future.

'Steel' is completely unable to compete with the velocity retention of Lead with the same shot sizes, although it has many more pellets in the same weight of load, this is of no effective benefit to the shooter. Because the equivalent sized Steel pellets are much lighter and progressively slower downrange, their target breaking power is but a small percentage to that of Lead. Pushing 'Steel' pellets right up to the legal maximum velocity is impractical, as there is no worthwhile improvement in ranging power.

The UK Proof house will confirm that 'Steel' shot pellets have caused gun damage on occasions where they have been in contact with either the chamber, chamber cone, chokes or barrel wall: with the material hardness of the 'Steel' pellets and the pressures involved, this is inevitable.