STEEL SHOT: WHAT YOU NEED TO KNOW. Part 2

In part one of this series, various aspects of the general situation with ‘Steel’ shot cartridges were investigated. They were: ‘Steel’s’ relative cost, the increased pellet numbers for the same shot size when compared with

Lead and its lack of velocity retention downrange and the much harder physical properties of ‘Steel’ pellets, with their ever present potential to cause damage by their direct contact with gun barrel steels.

In part two, the causes of dangerous ricochets when using steel shot pellets are explored, from the ground, woodland areas, other unseen hard objects, from the clay pigeons, and in some recorded cases, even the pellets themselves. I

In the USA

In the USA ricochets from steel, or indeed any other non-toxic pellets are a known serious threat to the safety of both shooters and bystanders and are not tolerated.

An example of this no nonsense stance on the ricochet issue, is that taken by the ATA in the USA, as the latest 2011 issue of their rule book clearly states:

'Any gun club allowing shot materials other than lead, shall be required to cover or shield all hard surfaces on trap fields which are known, or reasonably believed, to cause pellet ricochet with material which will prevent the shot pellets from rebounding and/or ricocheting'

An early lesson

Many clay shooters of a certain age will remember having fired one of the old-fashioned low powered 'BB' repeating air guns (they fired a steel round ball of 4.5mm diameter) *.

*(These were the USA 'air rifle' 'BB' pellet size of .175inch (4.5mm) diameter and were completely different to the much larger diameter modern plastic 6mm 'BB's that are now used in the so called air-soft guns, which are not usually airguns at all in the mechanical sense).

Unfortunately it became immediately apparent that if they were fired at anything remotely hard, such as a piece of wood or sometimes even the rim of a piece of previously broken clay pigeon, the steel balls would ricochet, sometimes directly back towards their point of origin.

This painful lesson was very quickly learned and such situations were carefully avoided. Even at only a modest 150 feet per second, ricocheting steel BB pellets could break the skin, draw blood, or cause a serious eye injury.

Most of these airguns also shot lead pellets as single shots and lead round balls, neither of which had anything like the same ricocheting tendencies of the steel varieties.
The 'Steel' BB pellets were cheaper than the Lead ones, but potentially far more hazardous.

'Steel' shotgun pellets although smaller in size, have much higher velocities than these old style airguns, so the potential for a hazardous ricochet from the ground, tree or any other relatively hard surface is very real indeed.

The causes of ricochets

Picture 2: These Italian steel shot target loads come with a ricochet warning, which must be heeded. 'BEWARE OF THE GROUND DO NOT FIRE AGAINST SOLID OBJECTS'

The importance of the 'Momentum' factor

Due both to their relative hardness when compared to Lead, and their lack of momentum when in flight at any given downrange velocity, 'Steel' pellets are especially prone to ricochets, with an inherent risk of injury to both the shooter and bystander alike.

To explain the effects of momentum in relatively simple terms, for our purposes here, it (momentum) can be taken to be the combination of the speed and weight of a pellet, which results in its ability to resist changes in its speed and direction of flight.

The heavier and faster a pellet of a given size is, the greater will be its momentum.

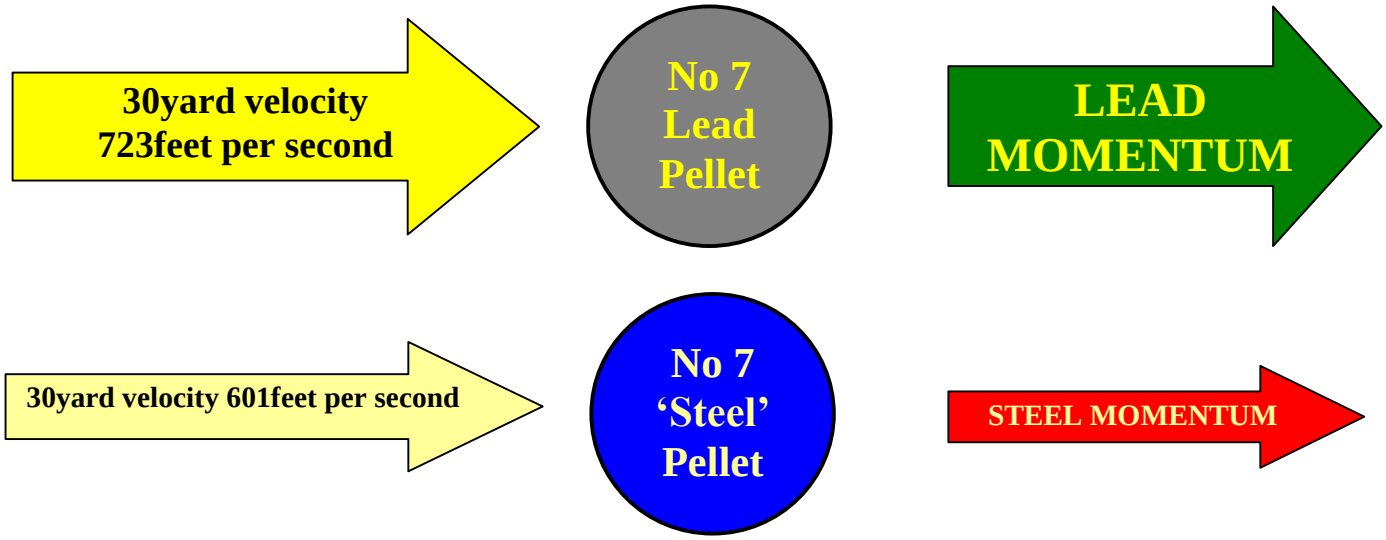
This also considerably increases its penetrating power, which has an effect on a pellet's ability to penetrate the structural integrity of a clay pigeon target and break it reliably, rather than bounce off of it.

However, even with identical levels of momentum, harder pellets (such as steel) are more likely to ricochet than their softer Lead counterparts, especially if the target has a relatively hard surface.
The softer Lead pellets deform more readily when they strike a relatively hard object, this attribute in itself helps to transmits more of their available striking energy to the target, avoiding ricochets.

To demonstrate the variation in momentum levels more clearly, figure 1 shows the relative difference in the momentum of identically sized pellets of both Lead and 'Steel' UK number 7's at 30yards with both of them being launched at the same initial typical velocity as found with general clay shooting cartridges.

Picture 3: A multiple trap clay 'rabbit' layout. Shooting clay 'rabbits' with steel shot target loads is extremely hazardous.
Multiple ricochets can easily result when the hard ground or stones within it are inadvertently struck. This can also occur when the steel pellets strike the 'clay rabbit' at certain angles and distances from the shooting stand.
'Clay rabbits' are considerably tougher than normal clay pigeons, which can increase the incidence of ricochets considerably.
With a Lead shot ban and with only Steel shot as an affordable alternative, excellent clay rabbit stands like this one, will be have to be relegated to the history books on safety grounds.

Figure 1



30yards

Although it is just over 41% heavier than the 'Steel' one, the softer Lead pellet has more than double the striking energy, with a commensurate increase in its momentum.

As well as being considerably heavier, the Lead pellet is also travelling more than 20% faster.

At 30yards the potential resistance to ricochets of the 'Steel' pellet is trebly hampered, as it is both much lighter and also now much slower than the Lead pellet with a lower momentum, as well as being much harder.

With less than half of the striking energy of the Lead pellet, the much lower momentum of the 'Steel' pellet means that the resistance of the air to its flight, is able to slow it down much more readily, than with the faster and heavier Lead pellet.

All of these factors mean that the 'Steel' pellet is much more likely to ricochet.

Unbroken targets with steel shot and their ricochet implications

Picture 4: After receiving no less than 8 direct pellet strikes from a 'Steel' target load, (all of which ricocheted off of it), this clay pigeon flew on intact and didn't even break when it landed on the ground. The steel pellets lacked the necessary individual momentum required to penetrate the structure of the clay pigeon and break it.

'Steel' pellet ricochets with an outgoing 45mph Clay Pigeon

The speed of the outgoing clay pigeon reduces the impact velocity and energy of the striking pellets.

The effectiveness of shotgun pellets on a 30yard 45mph outgoing clay pigeon is the same as if the clay pigeon were crossing directly across in front of the shooter at 36yards — 6yards less ranging power.

What this means is that although the number 7 steel pellet in the momentum comparison is travelling at 601 feet per second at 30yards when it strikes (the clay pigeon), the speed of the outgoing clay pigeon has to be taken off of the pellet's speed (45mph = 66 feet per second) to find the real striking velocity.

The ‘real’ striking velocity is, the steel pellet’s 601 feet per second minus the 66 feet per second of the 45mph clay pigeon, which is travelling away from it.

This leaves a ‘real’ 535 feet per second impact velocity when the steel pellet hits it, reducing the steel pellet’s hitting power by 21% (from 0.72ft/lbs down to 0.57ft/lbs).

The ‘Steel’ number 7 pellet at a ‘real’ 535fps, now only has marginal momentum and striking energy levels to successfully break the outgoing 45mph Clay Pigeon, unless it is able to transmit 100% of its hitting power with strikes at the thinnest and most vulnerable points – which it cannot do consistently, the result is ricochets and unbroken targets.

For comparison, the lead number 7 pellet’s ‘real’ impact velocity has dropped down from 723 to 657 feet per second and the hitting power has dropped by 17% (down from 1.46 to 1.21foot pounds of striking energy).

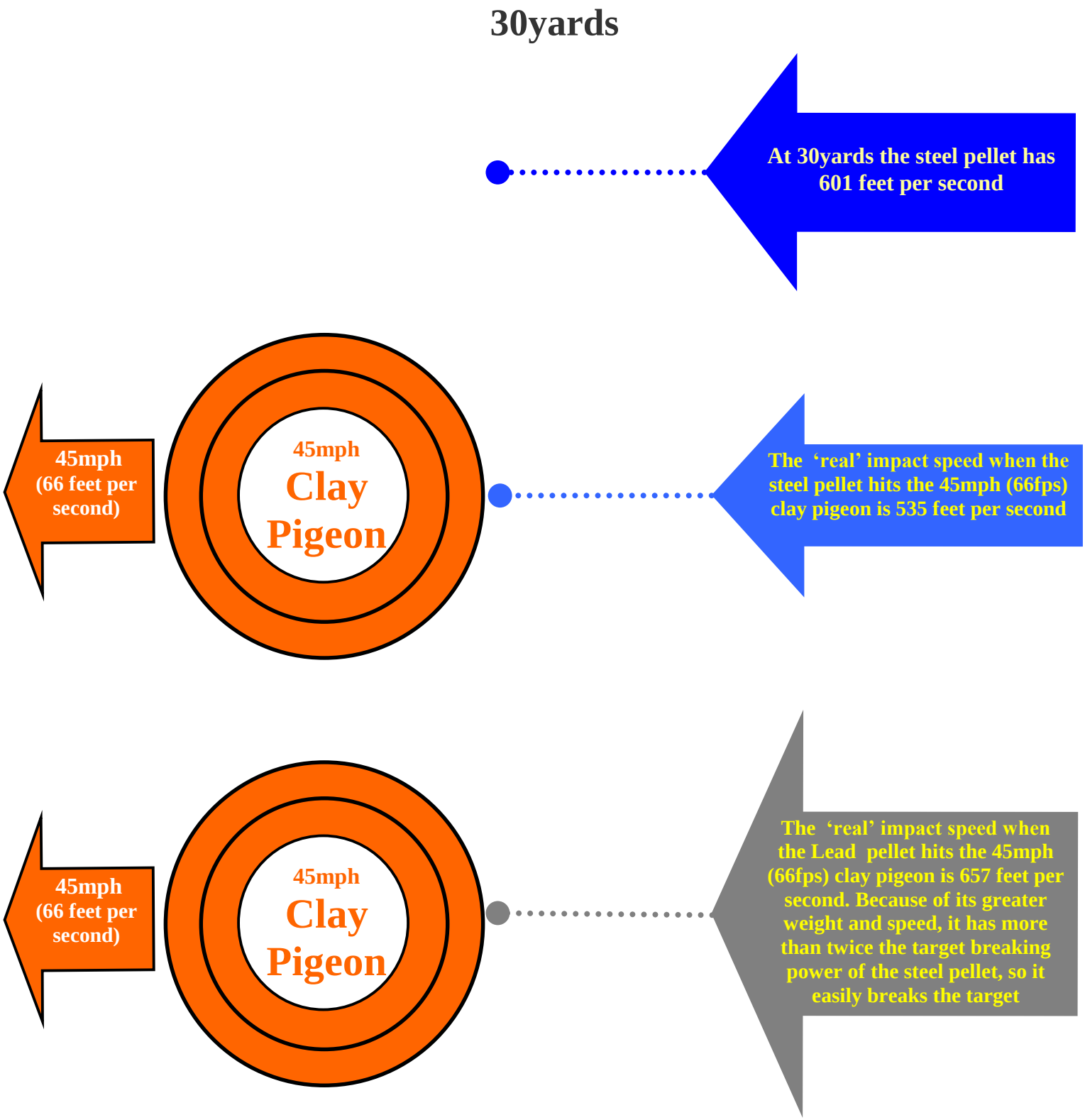
The difference is that the lead pellet still has far more hitting power than it needs, so that even a single pellet strike on the thickest part of the clay pigeon is most likely to break it.

The pellet may distort a little upon impact due to its softer makeup and then continue its flight after breaking the clay pigeon.

This is because it has an excess of striking energy, far more than is needed just to break the clay pigeon.

Figure 2

The reducing effects of the 45mph outgoing clay pigeon's speed on the striking speed and energy of the number 7 Steel pellets at 30yards range (Lead number 7 also shown)



Figures 3 and 4, show typical ricochet scenarios with 'Steel' shot pellets and outgoing 45mph clay pigeons.

Figure 3 shows the actual point of impact upon the angled sloping ridge of the Clay Pigeon, meaning that a ricochet, and not a break is the most likely result.

Even though the portion struck by the ‘Steel’ pellet is thinner and theoretically easier to break, both the Clay Pigeon and the ‘Steel’ pellet have relatively hard and smooth surfaces.

Meaning that in this instance the ‘Steel’ pellet is unable to transmit its full potential energy to the Clay Pigeon’s raised shallow angled section, but has ricocheted off in a different direction with somewhere around a 450 feet per second velocity.

The actual direction and speed of the steel pellet’s continuing travel after the ricochet, depends on how much of its striking energy was transmitted to the clay pigeon and where it struck it; **t**his will be highly variable

Figure 3

Bird’s eye view of a raised section ricochet scenario, distance 30yards.

Having struck the outgoing 45mph Clay Pigeon 30yards out from the shooting stand, the ‘Steel’ number 7 pellet, then ricochets off of the shallow angle of the outgoing raised section (blue arrow), having only been able to transmit approximately half of its ‘real’ striking energy to it.

30yards

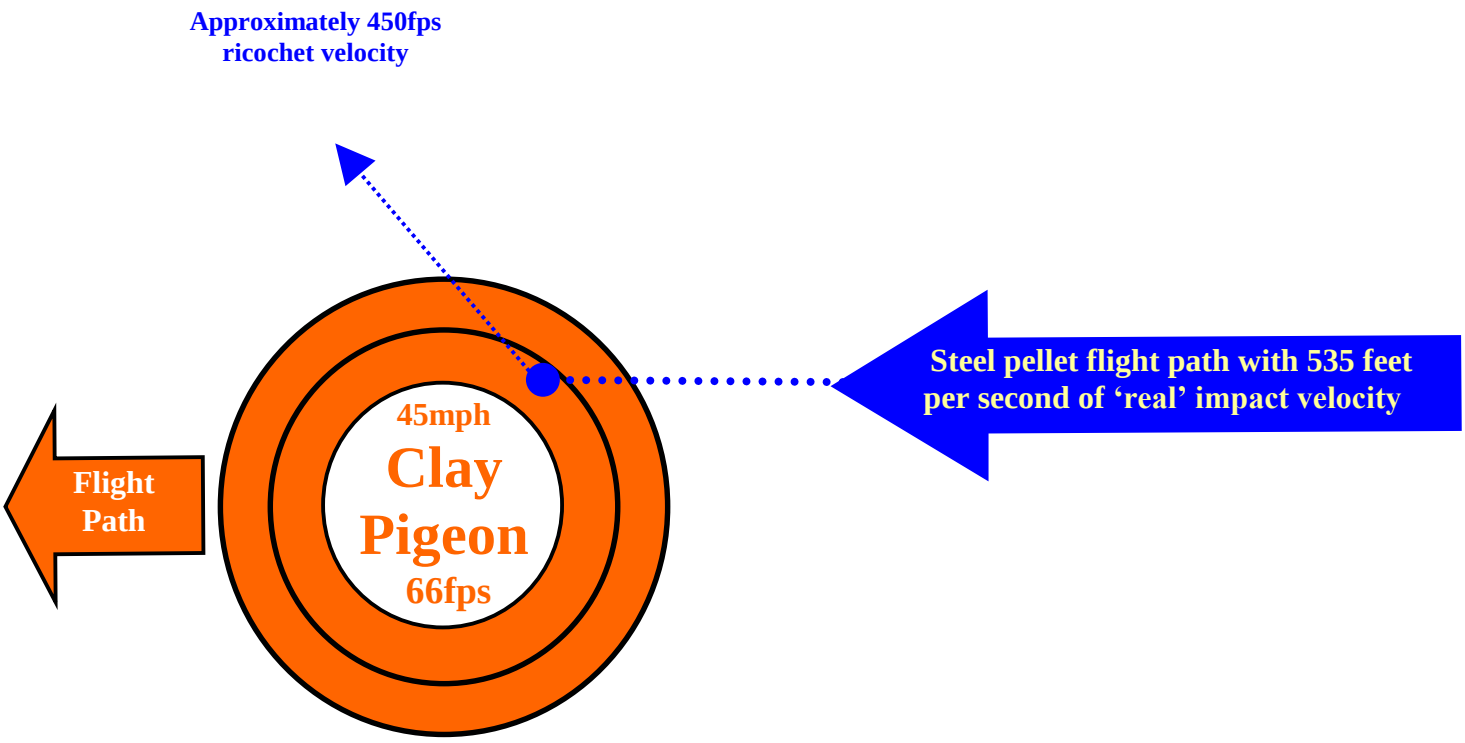


Figure 4

Bird's eye view of a backwards off of rim ricochet scenario, distance 30yards.

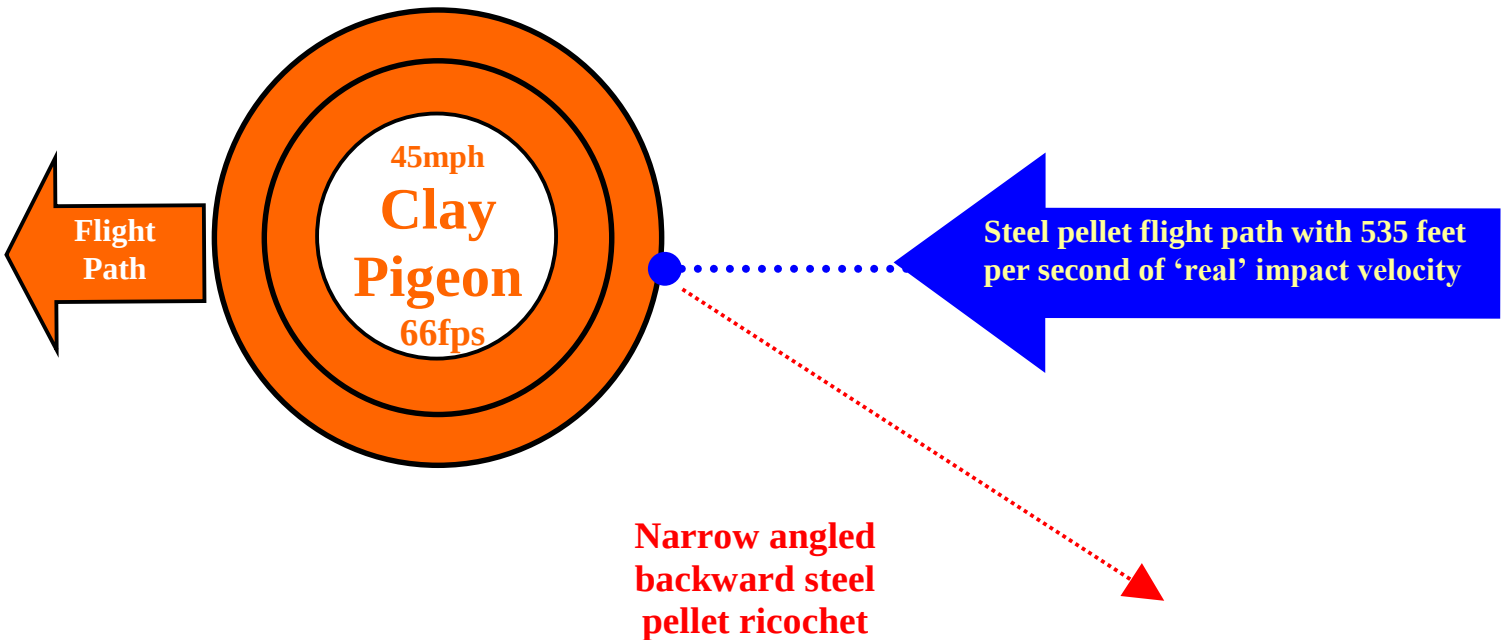
Having struck the outgoing 45mph Clay Pigeon rim 30yards out from the shooting stand, the 'Steel' pellet ricochets backwards off of the much thicker, stronger and harder rim at a shallow backward angle to its arrival (red arrow), having only been able to transmit a small percentage of its striking energy to it.

The narrow angled backward ricocheting number 7 steel pellet can easily travel back the 30yards towards the general direction of the shooting stand, and still have 300 feet per second velocity when it arrives.

Even at this speed it can penetrate 1/5 of an inch of ballistic test media or an equivalent amount of human flesh — a very dangerous proposition.

Even when they are down to a much lower 169 feet per second (the equivalent of the remaining velocity 96 yards from the gun muzzle), ricocheting UK number 7 steel pellets can still break the skin, draw blood from bystanders and cause lasting eye injuries.

30yards



The realities of ricochets

Picture 5: Steel shot must <u>NEVER EVER</u> be used in a woodland environment, as the dangers of ricochets off of tree trunks and branches are very real indeed.

At this point it must be made clear, that the potential for injuries caused by ricocheting steel shot pellets are real and have occurred, in some cases they have caused permanent sight loss.

One pertinent issue is that just because someone has used steel shot for a considerable period, without (knowingly) having had an incident of it, it is sometimes assumed that the ricochet problem does not exist.

The chances are that there have been many occasions where ricochets have occurred, but luckily no one (so far) has been standing in the way of the pellets' revised flight path.

This potential rearward ricochet scenario can be much more dangerous when using the smaller steel pellet sizes at relatively close ranges.

This is because it is not the range of the target from the shooter that causes the ricochet, but the lack of striking power of the pellet in question.

A so called steel ‘9’ pellet will have the same ricochet potential as the steel number 7, but at a much closer range. The downrange steel pellet energy situation will be explored in detail in a following part of this series.

Picture 6: This English rules Skeet shooter is using number 9 Lead shot (2.03mm) from station seven. The shot cloud can be seen on its way to breaking the clay pigeon but with relatively little overall spread. Small sized steel pellets can be prone to ricochets in these circumstances.

At relatively close distances such as Skeet station 7, the shot cloud has very little time to open up its spread. This is when there is a much greater chance of the following pellets running into the front ones when the clay pigeon is struck, when ricochets can result. Steel pellets are particularly susceptible to this problem, especially the smaller sizes, such as the so-called steel ‘9’s that are actually larger in diameter than lead 9’s (2.2 to 2.25mm), but have similar numbers in the 28gram load.

They slow down much more quickly and run out of individual breaking power at much closer ranges, when compared to lead 9’s and are much more of a ricochet risk at these closer distances because of this.

If steel has to be used, it is better to use the largest 2.5mm steel pellets, known as FE 7 or UK6.5, to reduce the risk of ricochets at closer ranges when skeet shooting.

As well as the potential for a ricochet from the clay pigeon's rim at close ranges, ricochets have also been recorded where the following steel pellets in the shot string, have ricocheted off of the forward pellets at wildly divergent angles, after they have slowed down when striking the clay pigeon.

These rearward steel pellets can literally bounce off of the back of the front ones, as they have slowed due to their impact with the clay pigeon. The angle of their deviation from their original flight line can be extremely varied and potentially hazardous. This pellet on pellet ricochet phenomenon will be fully explained in a later instalment of this series, as these effects can also cause issues with steel pellets at both the chamber cone and the choke.

Conclusion

The dangers of steel pellet ricochets from a multitude of surfaces and objects are real, which severely limits their safe applications for clay pigeon shooting.

In the USA the dangers of steel pellet ricochets are well known, with strictly enforced rules insisting that elaborate, (and in many cases expensive) precautions have to be taken when steel shot is used, with any possible surface that can promote a ricochet being covered with a material to prevent this effect.

Without these elaborate precautions, the likelihood of steel pellet ricochets causing injury is perhaps rather akin to playing Russian roulette.

A cartridge can be placed in a revolver cylinder and it can be spun and the trigger pulled, with the hammer dropping on to an empty chamber many times without incident, but sooner or later, the hammer is going to come down on the loaded chamber.

Why would anyone knowingly want to take that risk?