CAN STEEL DELIVER FOR FITASC

A QUESTION THAT HAS ARISEN FAIRLY REGULARLY OF LATE IS 'CAN STEEL PELLETS REPLACE LEAD #7s FOR FITASC TARGETS'?

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It is undeniable that steel shotgun pellets bring a lot of potentially contentious issues to the table. They do have their uses, where distance is not an issue, such as for Skeet and certain types of moderate range sporting clays where in my experience they have worked well enough. Regardless of personal or environmental views and from a purely objective standpoint, the current crop of steel #7 target loads are unlikely to succeed for serious FITASC sporting clay targets. There is simply no escaping the fact that the much lower density of steel shot pellets, when compared with lead, cripples their downrange prospects.

We first checked out steel performance in Journal 33 (Dec 07/Jan 08), but were concerned only with the potential for matching the performance of regular 1200 feet per second lead shot target loads with #8.5 pellets at relatively moderate ranges with 0.5ft/lbs of striking energy for face on targets. The endnote suggested that larger steel pellets and heavier loads would probably be needed for FITASC targets.

Higher 1300 feet per second velocities are regularly used for FITASC shells, as greater striking energy levels are required downrange. So in this issue, we are exploring in detail what would actually be needed to push the outer limits of steel performance for FITASC targets. Will it be ultra high velocities, larger pellets such as #6s or #5s, or even larger #4 pellets and much heavier loads?

Downrange Pellet Energy for 'Edge On' Crossing and Fast Outgoing Targets

Extensive firings and experience with top of the range 1oz lead International FITASC target loads have established that for consistent 'edge on' crossing target breaks, such as required for FITASC, a minimum of 0.75ft/lbs of pellet striking energy is required.

Faster outgoing 'edge on' targets will need rather more than this at 1ft/lb, to counter the draining effects of the target's own outward velocity (minus 0.25ft/lb) on the striking energy of the pellets. Typical fast outgoing target velocity is around 45mph, although it can be more (55mph) than this in some cases. It has been generally thought that by obtaining matching pellet energy levels with steel pellets when compared with existing lead pellets, that the downrange status quo will be maintained – but will steel be able to deliver?

FOR FITASC, THE DOWNRANGE PERFORMANCE OF THE CURRENT CROP OF 1300fps #7 STEEL TARGET LOADS IS SEVERELY LIMITED TO ALMOST 35 YARDS FOR CROSSING 'EDGE ON' TARGETS BY THE MUCH LOWER DENSITY OF THE STEEL PELLETS, (7/8 oz #7 SHELL PICTURED).

There are pellet size limits in the FITASC rules and #7s are the largest allowed. To better appreciate this issue, a comparison of the nominal total pellet numbers in the 1oz FITASC legal target shell reveals that with lead #7 pellets there are 297, but with steel there are 420 (41.4% more).

Pellet striking energy is the result of both the mass of the pellet and its retained velocity when it reaches the target. Lighter and slower pellets lose out twice here – with big drops in both areas.

The current steel target loadings top out at around 1300fps, but steel #7s fall behind the 1300fps lead #8.5 pellets after 20 yards. This is despite the higher initial energy of the larger and heavier steel #7 pellets.

The 'edge on' target pellet energy level for crossing targets is reached at 34.3 yards with the steel #7s and exactly 37 yards for the lead #8.5s. For high-speed outgoing distant targets, things are grim – the steel #7s top out at 27 yards.

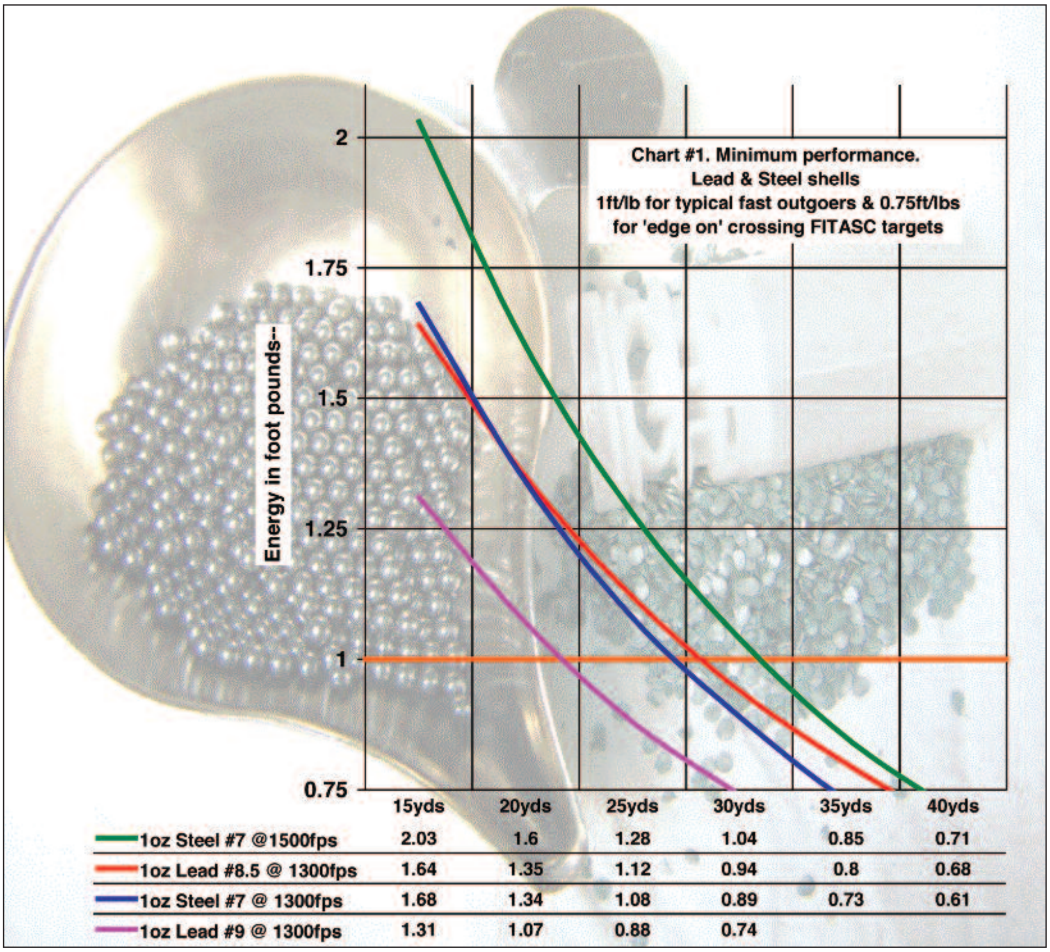
Higher Velocity

If the velocity of the 1oz steel #7 load is increased to 1500fps, then we can see that it has considerably more energy at the closer ranges. The range for fast outgoing targets is increased slightly by 4 yards to 31 yards (1ft/lb energy line). For crossing targets the 1500fps steel #7s gain only a 3 yard advantage (38.3 yards) to the 0.75ft/lbs pellet energy line over the slower 1300fps pellets (34.3 yards).

Additionally, at the 0.75ft/lbs line, the 1500fps steel #7s are only 1.3 yards (38.3 yards) ahead of the 1300fps lead #8.5s at 37 yards. But again, the lack of steel pellet density erodes this situation as the range draws out – the 1300fps lead #8.5s gain a slight advantage at 50 yards over the initially much faster steel #7s (not shown).

Increased Frontal Area

It is important to appreciate that with a nominal 420 pellets to the ounce, the individual steel #7s are 29.3% lighter than lead #7s (1.47 grains), but heavier (1.04 grains) than their lead #8.5 counterparts (0.9 grains) with a nominal 484 pellets. But it is the greater diameter and 35% larger frontal area of the steel #7s, when compared to the lead #8.5s, together with a reduced density, that is their Achilles' heel in the downrange performance stakes.



Diameter, frontal path area (in mm²), pellet count per oz and weight comparison
For Steel #7, Lead #8.5 & Lead #7 pellets

Diameter

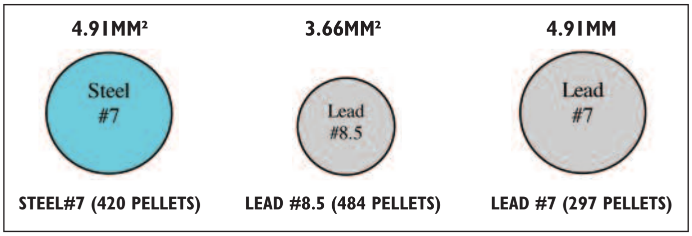
Steel #7	Lead #8.5	Lead #7
2.5mm	**2.16mm**	**2.5mm**

The #8.5 pellets are 13.6% smaller in diameter than the #7s

Individual pellet weight

Steel #7	Lead #8.5	Lead #7
1.04 grains	**0.9 grains**	**1.47 grains**

The steel #7s have a 35% larger frontal area then the lead #8.5s, but are only 15.5% heavier. Conversely the lead #7s have the same frontal area but are 41.5% heavier than the steel #7s.

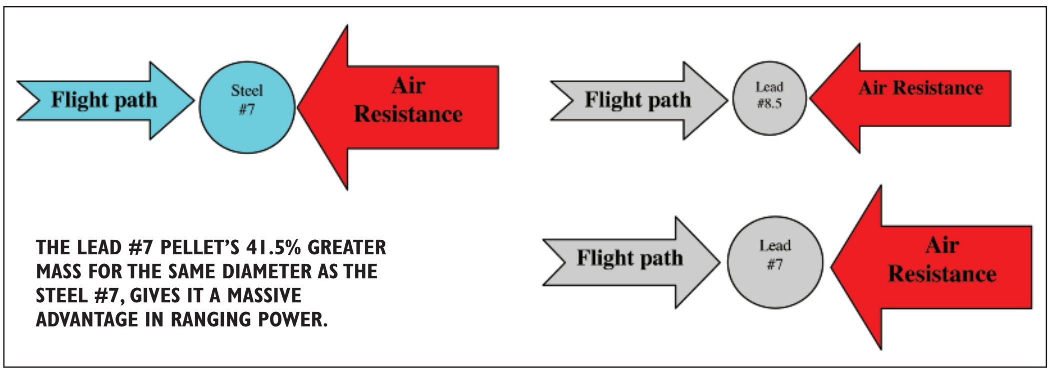


Individual pellet weight and diameter is critical for retained striking energy downrange. Even with a weight advantage (+15.5%), the 35% larger frontal area of the steel #7 pellet is slowed down much faster than the smaller but denser lead #8.5.

Target Impact

The impact footprint area of the #8.5 pellet on the target is considerably smaller than that of the steel #7. It will then have much less work to do to this smaller area to bring about the destruction of the target. The impact footprint of both types of #7 pellets is the same, but the substantial 41.5% increase in the mass of the lead pellet means that it is able to transmit far more power to the target at any given velocity.

1300fps original velocity with 678 feet per second retained downrange velocity.
#7Steel: Range 25.5 yards, 1.06ft/lbs of remaining pellet energy
#7 Lead: Range 36 yards, 1.5ft/lbs of remaining pellet energy



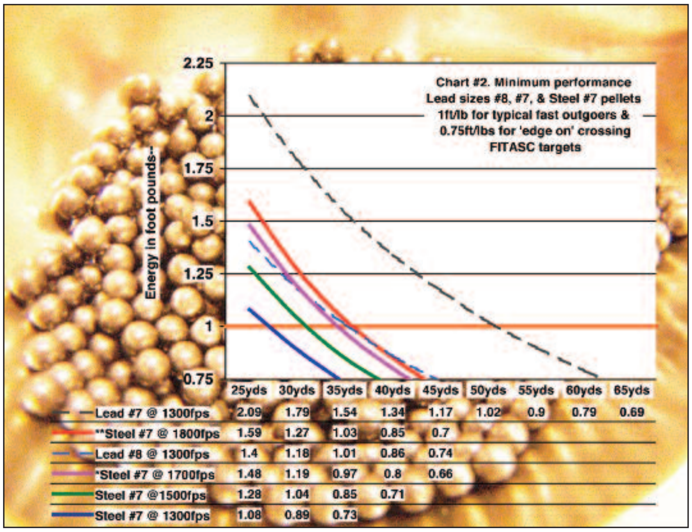
To match the steel pellet's 1.06ft/lbs energy level at 25.5 yards, the range of the lead #7 has to be extended to 48.6 yards (plus 23.1 yards), with 568fps for 1.06ft/lbs of remaining pellet energy. Clearly pellet density is of vital importance downrange.

Is higher velocity the answer?

We can see in Chart #2 that with identical frontal areas the steel and lead #7s behave very differently downrange. The lead #7s are 41.5% heavier, with the same frontal area being much better placed to maintain their downrange velocity and striking energy. It is also clear that higher velocities are never going to be a lasting solution for FITASC with 1oz of steel #7 pellets. Crossing 'edge on' targets: From the 1300fps loading and its 34.3 yard range, even with large and then huge increases in their initial velocity to 1500fps (38.3 yards) and *1700fps, (41.7 yards) respectively, the steel #7s have gained very little in real terms downrange. (*See the recoil chart for 1oz of Steel @ 1700fps).

For fast edge on outgoing targets ranges are much reduced to 27 yards @ 1300fps, 31 yards @ 1500fps and 34.25 yards @ 1700fps. An even faster (but lighter) loading with 1800fps would extend these ranges to 43.3 yards (edge on crossing) and 35.74 yards (fast outgoing).

(NB European loaded steel shells are limited to about 1400fps at the muzzle by the C.I.P. proof regulations. This would not technically restrict US loadings, but might well be an issue at European FITASC International competitions.)

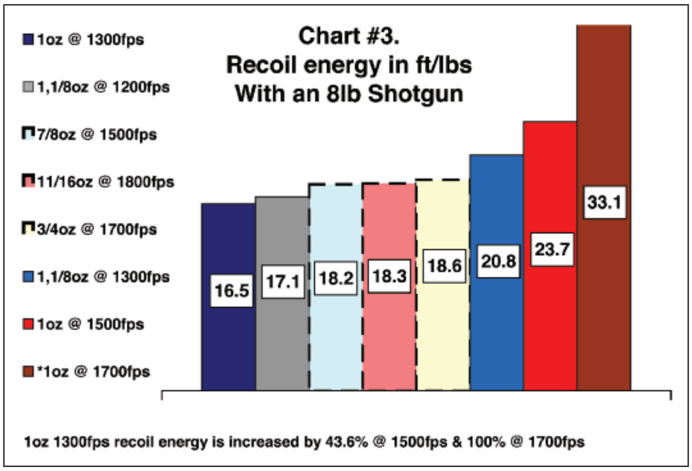


	25yds	30yds	35yds	40yds	45yds	50yds	55yds	60yds	65yds
Lead #7 @ 1300fps	2.09	1.79	1.54	1.34	1.17	1.02	0.9	0.79	0.69
**Steel #7 @ 1800fps	1.59	1.27	1.03	0.85	0.7				
Lead #8 @ 1300fps	1.4	1.18	1.01	0.86	0.74				
*Steel #7 @ 1700fps	1.48	1.19	0.97	0.8	0.66				
Steel #7 @1500fps	1.28	1.04	0.85	0.71					
Steel #7 @ 1300fps	1.08	0.89	0.73						

Increased Recoil

The faster 1oz steel loadings come with their own price – as there will be a significant increases in recoil energy. (+ 43.6% @ 1500fps, + 100% @ *1700fps, as shown next page). Consequently, the 1700fps 1oz loading would be unshootable for most competitors. As one of the main aims of the reduced payload of the current crop of 1oz FITASC loadings is to reduce felt recoil, this would most certainly be a retrograde step.

inevitable. Relatively slow burning powders would be needed to keep breech pressures at reasonable



Extreme Measures

Going to a totally extreme 1800fps velocity, but then using a much lighter 1 1/16oz load of steel #7s to lower the potential recoil, would be the absolute limits of steel #7s performance. The upside is that with 288 pellets this #7 steel 1 1/16oz load would be very close match to the 297 of the lead 1oz #7 shell. The downside is that the recoil would be slightly more than a 2 3/4 dram 1 1/8oz target loading. But even with the extra 500fps of this earth shattering velocity, only 8 yards of extra range will be gained for crossing 'edge on' (43.3 yards) and fast outgoing targets (35.75 yards).

Increased Noise

The other potential pitfall of higher steel velocities will be significant increases in noise. In the case of 1800fps the #7 steel pellets would leave the muzzle around 700 feet per second faster than the speed of sound. They would remain above it for the first 15 yards of their flight, so a much louder 'sonic crack' would be levels at this extreme velocity. Their burning characteristics would also add considerably to the muzzle blast effect. As noise is already a problem at some shooting facilities, these would not be positive attributes.

Going Large?

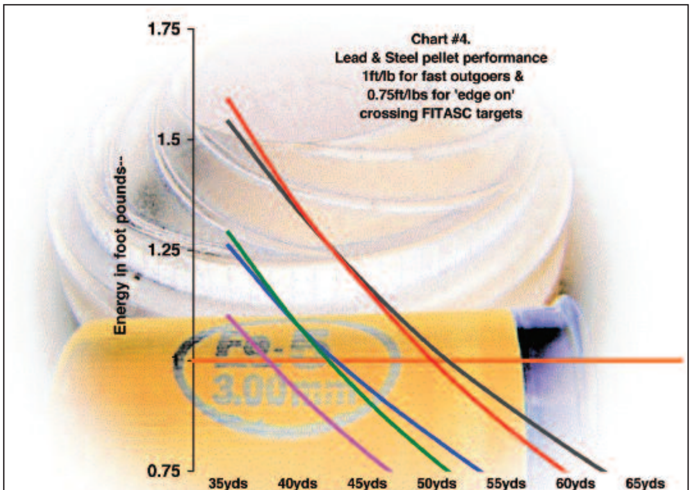
The likelihood of ever successfully using the current crop of 1300fps 1oz steel #7 loads for FITASC is clearly now a 'Dead Duck', unless target range was reduced to 35 yards or so.

With the appreciation of the limitations of steel #7 pellets for extended range work out to 60 yards (precisely such targets as encountered in FITASC), there has also been speculation regarding the potential use of larger #6 (2.8mm) steel pellets. The basis of the argument was that going larger to the steel #6s would solve the downrange target-breaking problem. But of course the FITASC rules expressly forbid the use of such large diameter pellets. So any potential advantage of this theory would have to remain just that – a theory. However, as an exercise in establishing their practicality, larger sizes of steel pellets have been used to establish their performance parameters in this appraisal – but still keeping to the 1oz FITASC payload limits.

The origins of the '#6 steel' concept emerged after a disappointing attempt to hold a European FITASC International Sporting Clays event with the then current crop of #7 steel target loadings. To say that it was not a resounding success would not be overstating the facts – with serious issues for longer-range targets.

As #6 is two sizes larger than the ever popular lead #7.5 pellet, the idea is that this will be sufficient to deliver in at least a like for like manner when compared to the lead #7.5 pellet at the same velocity of 1300fps. To enhance steel #6s further, it has also been suggested that a velocity hike (such as to 1500fps) over and above the usual higher speed target loadings of 1300fps would be sufficient to match up with lead #7s. Unfortunately, it is here that the Steel #6 concept falls into error.

If, in Chart #4, we compare the residual pellet energy of steel #6 pellets with lead #7s in a similar manner to Chart #1, we can see that the steel #6 pellets are never going to be able to perform as well at longer ranges. The 0.75ft/lbs preferred pellet energy level (as shown by the orange line) is reached at 62 yards for the 1300fps lead #7 pellets. At the same velocity the steel #6s can make this 46.5 yards, but the 1300fps lead #7.5 pellet achieves this same energy level at 53 yards (plus 6.5 yards). For fast outgoing targets this 46.5 yard range is reduced considerably to 37.75 yards. The lead #7.5s are comfortably ahead of the steel #6s all of the way downrange.



	35yds	40yds	45yds	50yds	55yds	60yds	65yds
Lead #7 @ 1300fps	1.54	1.34	1.17	1.02	0.9	0.79	0.69
Steel #5 @ 1300fps	1.59	1.35	1.16	0.99	0.85	0.73	
Lead #7.5 @ 1300fps	1.26	1.08	0.94	0.82	0.71	0.62	
Steel #6 @1500fps	1.29	1.08	0.91	0.77	0.65		
Steel #6 @ 1300fps	1.1	0.93	0.79	0.67			

If 1oz of steel #6s are pushed to 1500 feet per second, their range is extended by only 4 yards to 50.6 yards for 'edge on' crossing targets, and by 4.5 yards to 42.25 yards for 'edge on' outgoing targets. However, big increases in noise and felt recoil will somewhat dampen this relatively small gain in range. The idea of these high speed #6s delivering in the manner of lead #7s for downrange FITASC targets is destroyed by the fact that even the 1300fps lead #7.5s out run them after 40 yards.

There is no way of escaping the fact that the lead #7 pellets have a very big ranging power advantage. It is this higher pellet energy level that is needed to ensure consistently broken 'edge on' crossing targets.

The only likely workable steel #6 load would be 7/8oz at 1500fps. The recoil would be more tolerable (see Chart 3), but the pellet count would be 7% lower – from 315 (1oz) to 276 (7/8oz) with 21 fewer pellets than the lead #7 1oz load (297).

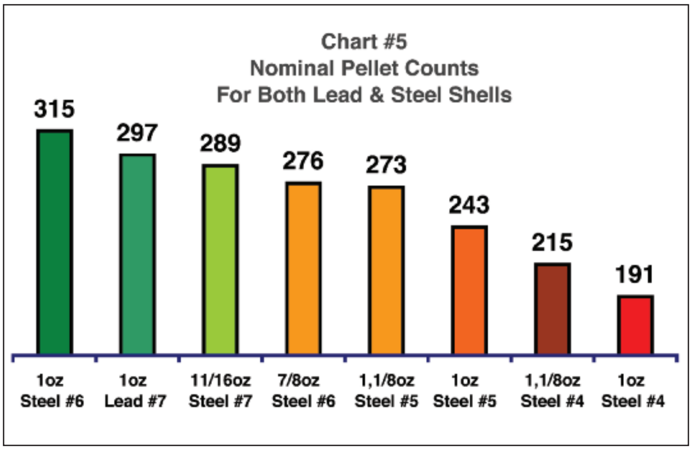
As can be seen in Chart #4, steel #5s at 1300fps have a much more realistic chance of working out, with 49.75 yards for fast outgoing targets and 59.3 yards for edge on crossers. Although still not quite the equal of the lead #7s at full ranges they do however raise other issues.

'Going larger' with steel pellets is the only other option open to us, but this has severe limitations. As the pellet sizes increase, the pattern density just falls away when compared to the lead #7s. To stay within the payload limits for FITASC shells of 1oz, going larger with steel pellets reaches the point of diminishing returns after steel #6s.

Larger pellets require much heavier payloads to redress the imbalance. With 191 pellets to the oz, steel #4s are unusable in this regard, as even 1 1/2oz would only have 287 pellets. The 243 pellets of 1oz of steel #5s have a serious shortfall of 54 pellets when compared to the 1oz of lead #7s 297 – so pattern density and pellet distribution at full ranges would be the main issues. The velocity of the steel shot charge, the boring of the barrels and the taper of both the chamber cones and chokes would all be vital. This would be to maximize its downrange potential, as excessively high velocities and or inappropriate chokes do not tend to tighten patterns downrange.

With a 1 1/8oz load, steel #5s would have 273 pellets, which might be sufficient under ideal conditions.

The recoil at 1300 fps would be higher (see Chart #3) with an 8lb shotgun than the 1300fps 1oz load, but slightly less than a 1500fps 1oz steel loading.



There would need to be a further increase to a 1 3/16oz load and 289 pellets to better close the gap, but the 1oz FITASC payload and shot size limits prevent this. Steel pellets are rather like the ballistic equivalent of 'Catch 22'; you may eventually obtain sufficient pellet energy to break the target reliably, but the pattern density is going to be severely reduced beyond the point of consistently reliable target hits. This is going to be more of an issue for edge on type targets than others.

On the plus side, steel is known to pattern reliably due to the lack of deformation to the shot pellets caused by set back forces when the shell is fired, but even this cannot compensate for greatly reduced pellet counts, even with a consistent 100% pellet participation in the useful part of the pattern – which is unlikely.

Conclusions

(Assuming future FITASC rule changes regarding pellet sizes and velocity would allow these loads.)

For matching pellet energy: Edge On Crossing Targets = EOCT (0.75ft/lbs), Fast Outgoing Targets = FOT (1ft/lbs). 1300fps 1oz Lead #7 baseline figures are: EOCTs 62 yards and FOTs 50.75 yards. The recoil baseline = 1oz @ 1300fps (16.5ft/lbs).

1oz 1300fps Steel #7s
The targets will have to be a lot closer, to a maximum of 34.3 yards for an EOCT and 27 yards for FOTs. This would be needed to ensure consistent breaks for a variety of target types and construction variations for competition use.

1 1/16oz 1800fps Steel #7s
This velocity and a lighter payload would be the maximum possible practical steel #7 load.

The recoil would be 10.9% higher. The shot count is close to the lead #7s, but the effective ranges would be 43.3 yards for EOCTs and just under 35.74 yards for FOTs. This is an 8 to 9 yard improvement over the steel #7 1300fps load, but the muzzle blast and noise levels would be extreme.

1oz 1300fps Steel #6s
1oz at 1300fps would be limited to 46.5 yards for EOCTs and 37.75 yards for FOTs – only 2 to 3 yards better than the 1800fps #7 loading.

7/8oz 1500fps Steel #6s
A better choice would be a 7/8oz load at 1500fps, with 50.6 yards for EOCTs and 42.25 yards for FOTs.

The recoil would be 10.3% higher. Pellet count is down slightly at 276, but maybe a better overall choice than the 1800fps 1 1/16oz #7s.

1 1/8oz 1300fps Steel #5s
The load would be better with 273 pellets, but the recoil would be 26% higher, with 59.3 yards for EOCTs and 49.75 yards for FOTs.

1oz 1300fps Steel #5s
With the same pellet energy range as the 1 1/8oz shell, the main issue here is the pattern density. Could it be relied upon to deliver consistent patterns for tricky distant targets?

Tricky Decision

So, for edge on crossing targets we could go to 1 1/16oz of steel #7s at 1800fps and drop 18.7 yards of range. We would have fewer pellets with 7/8oz of steel 6s at 1500fps but lose 11.4 yards, or come within 2.7 yards with steel #5s at 1300fps but risk big holes in the pattern.

Clearly when attempting to match pellet energy there are no easy solutions with steel for FITASC, so let's hope that it is never thrust upon us. If it is, the only conclusion must be (because of down range performance) that course setters will be forced to keep target range at about 35 yards. Hardly FITASC! ■