



WORLD CROSSBOW SHOOTING ASSOCIATION

CROSSBOW COACHING

LOOKING AFTER THE DETAILS

Sir Dave Brailsford was extremely successful as the Director of British Cycling. As far as the UK is concerned he built the sport. But what did he do that was new? He says nothing. He simply concentrated on the details. This even included bed linen to ensure that his athletes rested properly. He applies the same ethos to Team Sky.

It's a message that all sportsmen/women and coaches should take to heart. Without going as far as the bed linen, let's look at some of the detail that should lead you to a better competition performance.

1. THE BOW

Excluding the strings, we can break this down into six areas. But don't forget to dry your bow thoroughly if you have shot in the rain. That means actively getting water out of it. Corrosion will come back to bite you just when it is most important. It's your problem. Do it with care and as soon as possible after shooting.

1.1 SCREWS

Your bow is held together with screws. Many of them are hexagon socket head screws. Some that the manufacturer does not mean you to

remove may have locking compound on the threads. In some cases self locking nuts may have been used.

You need to check **all** screws. Things do work loose, and they will catch you out at the most important time. In addition you should check for damaged heads and corrosion. Replace anything that is damaged or corroded.

Make sure that you can remove those screws that you may need to during a competition; e.g. to replace a trigger.

1.2 TRACK

Carefully inspect the track for damage. In some cases you may be able to dress out minor damage as a temporary measure. It is not essential that every fraction of the bolt is supported on the track. If the area extends under the string you have lost the track. The string exerts a downward pressure onto the track. It will therefore drop into any imperfections, which will disrupt smooth movement and damage the centre serving.

Remove any wax/dirt build-up. Use polymerising gunstock oil, such as BIRCHWOOD CASEY TRU OIL, as a coating for non metallic tracks. Some shooters lightly coat the track with petroleum jelly before each shoot. The practice is not advised. You do not know what it may do to the string, and the wax on the string is there in part to lubricate the track.

Some manufacturers advise putting oil on aluminium tracks. They also supply that oil. The problem is that the advice is usually to apply oil once a year. This statement is made on the assumption that the shooter is hunting. The number of shots made in a year will be small in comparison to our form of shooting. You need to oil the bevel on which the bolt rests to eliminate wear. If you can smell a metallic burning scent it's your bow and the track needs attention.

1.3 TRIGGER

Your trigger should be removed and cleaned on a regular basis. Remove any dirt and wax and ensure that there is a light, and I do mean light, covering of oil to protect against rust. Some manufacturers will supply oil for the purpose. You could use sewing machine oil, as suitable “gun” oil is rather expensive. An alternative is to wash the trigger with lighter fluid. Once the volatiles have evaporated a very thin film of lubricant left behind.

Use a hair drier to dry out a wet trigger. Don’t forget to replace any screws that are damaged.

1.4 BOLT RETAINER

In addition to ensuring that it is secure, check that the wear land on the retainer is no longer than 5mm. This is the maximum contact permitted. Make sure that you have spare bolt retainers. Change the retainer and shoot with it before you go to a competition. Also take spares.

1.5 PROD

Check the prod for tiny signs of the surface breaking up. Major damage is obvious, but you need to catch break-up of the laminates early.

This is particularly the case with solid fibre glass prods, which usually start to fail at the corners of the cross-section. The pieces that stick out from the prod are sharp and brittle, and therefore dangerous. You can dress out minor splinters, but these must be sealed with nail polish or something similar to prevent further degradation.

Ensure that the prod is securely seated on the prod block and that the retaining screws are tight.

1.6 SIGHTS

Inspect your sight(s) for damage and alignment. Do not try to take your scope apart. Many are gas filled and disassembly will wreck them. You will also allow in dirt and water vapour that you do not want in the scope.

If you shoot with rear and fore sight elements mounted in tubes you must take account of the distances(s) that are to be shot. Short range and long range Target shooting require different setups because differences in the height of the front sight mean that the tubes will not align when changing between short and long range. You should have one set up for 18 & 25m and another for the longer distances. For the three longest distances you should set your alignment for the middle of the three. Obviously this will not be optimal for the other two but the error will be minimal.

2. STRINGS

Check your strings for loose strands and ensure that the centre servings are in good condition. Occasionally re-wax the exposed strands. Ideally a centre serving should be replaced just before it starts to show evidence of wear. What constitutes wear depends on the bow you are shooting is its geometry, and its performance.

The serving performs a number of tasks. It protects the string material, provides a consistent surface for release from the trigger mechanism, reduces friction on the track, and protects the loaders fingers from potential damage by covering possible pressure points on strands of string material.

A breakage of the serving is dangerous. It can result in string breakage and will throw bolts off course. For any bow, if there is a fluffy mess in the centre then it's too late. Inspection of the serving

before, during, and after shooting is essential. Practice will tell the tale on when to change a serving.

Do not use “soft twist” for the centre serving. It is just that - soft. It will not wear well and will stretch allowing gaps to appear and the serving to move. You should use a “fastflite” style serving, and it needs to be put on tight.

Some shooters prefer to use monofilament nylon flatline, which maintains good circularity, for the centre serving. This is quite good, but when it fails it does so catastrophically.

The serving should be literally in the centre of the string, and it must be waxed. Paraffin (candle or drylube stick) wax is best. Bee’s wax will do but it is sticky and will collect dirt.

The better the performance of the bow the more important the state of the string becomes. Minor levels of wear that may not be visible will affect bow performance. If your shots start to go astray it could be down to the condition of the centre serving.

In general terms the higher the performance the bow the more frequently the serving should be changed.

My wife shoots an Ausbow Contender Target Crossbow. Our experience is that a serving, I use Diamondback 0.018, is good for a TC900 – 90 shots plus 12 sighting shots – and possibly a short training session of 3 dozen. After that there is a noticeable fall off in performance. The only thing I have been able to find on the string are the indents made by the claw. These indents I find by touch, I need good light to see them. If they are too pronounced there is a fall off in consistency. I know of no good reason for this affect, nor can I say with certainty that this is more than an indicator of something else. All I can say definitely is that the serving is good for about 140 shots.

2.1 STRING LIFE

My experience is with Dacron. With other materials the answer will be different.

You can use other string materials such as DYNAPLYTE. However, you need to be aware that in the event of a “dry fire”, the prod is more likely to suffer from irreparable damage.

On the basis of shooting two or three times a week, 60 to 90 shots each time, a dozen strings – shooting each in turn and replacing worn centre servings - are good for 18 months, possibly up to two years. In that time some strings will have been discarded as not performing, or as having loose strands, so not all will see the distance anyway. After that performance can become erratic. You will notice that groups get larger.

Dacron stretches under tension, but is to some extent elastic. It stretches during a shot but recovers when the prod returns to rest. However, after a shooting session the string will be longer. Check your string before you put it on and again when you take it off after shooting. The string will be longer after shooting, but will tend to recover.

Unfortunately, Dacron “dies”. It will eventually lose its elasticity and fail to recover. It has always been known to stretch and to reach a limit beyond which it will not go. Once this happens the string is useless. If left for a few weeks it will recover to some extent, but it will only be useable for a couple of dozen shots, if that. It is therefore essential to have more than one string for your bow.

Don't use a new un-shot string at a competition.

You should shoot at least 3 dozen with a string and replace the centre serving before you use it for competition. It will take this number of

shots to ensure that the strands have settled correctly and make the string consistent in performance.

To cater for the above effects you need several strings. The actual number depends on the life of the centre serving and how frequently you want to have reserving sessions. You may find that 3 or 4 strings are enough. Because I like to have a few weeks between serving sessions I start with a batch of 12.

You should go to a competition with one string for each day plus at least two spares, just in case.

3. BOLTS

Those who come to crossbow (horizontal bow) shooting from an archery (vertical bow) background will question what spine of shaft to use for bolts. After all, the draw weights are higher and there is quite a range. On the face of it this is a sensible question. When you look for an arrow chart to help you will find that you are out of luck.

To explain this we need to look at a bit of history, and skirt round the mechanics. Crossbows have been available commercially for some time. The Barnett Wildcat was available in the 60's. It had an alloy prod, and bolts could be made from doweling using a slip-over plastic fletching assembly. The really serious shooters made their own bows. In many cases these would be trackless using a "D" loop on the string and a bolt rest near the prod. These are the early Target bows. Bows had to be tuned using the arrow rest. Bolts were down to the individual to make including piles and nocks.

In the late 70's/early 80's the Spirit crossbow made its appearance out of the BARNETT stable. This was a tracked Target bow - that is to say that the shaft rested on the edges of a groove for most of its length. It is around this bow, and similar, that the WCSA standard specification for Target bows was written.

The bow was designed to accept 18/64" or 17/64" diameter shafts.

Just for those who don't know shafts are designated by two pairs of two digits; e.g. 1914 or 2016. The first two digits (19 or 20 in our examples) give the outer diameter in 64th of an inch. The second two (14 and 16 from the examples) give the wall thickness in 1000th of an inch.

Since commercially manufactured Target bows were in their infancy only a limited range of sizes of piles and nocks were available. That remains the case today. With a short shaft length bolts are incredibly stiff in relation to the maximum draw weight of 95lbs for a Target bow and the string travel limitation. Add to this the fact that the bolt is supported for most of its length tuning becomes irrelevant. All you can do is change the pile weight. Archer's paradox simply does not apply.

If you are using a trackless crossbow it could be argued that spine has some relevance, but that is probably a second order effect.

The use of Sporting Crossbows for field shooting or hunting has been increasing in many countries – especially the USA where hunting is legal in most states and is considered the norm. This has resulted in the development of a large range of off the shelf (Sport) bows – many with high draw weights intended originally for hunting.

The business is mostly driven from the USA and the industry standard has become a track width set for a 22/64" diameter bolt to give the correct contact between string and nock. Since bows are tracked tuning is, again, irrelevant – you just need the shaft to withstand the acceleration.

Bolts for Sport Crossbows are commercially available. Easton offer three grades of crossbow bolt. All are 22/64" diameter and are available in 20 or 22" lengths. In some cases they give the wall thickness. Bolts are available from other manufacturers in 16, 18, 20

and 22" lengths, but all in 22/64" diameter. The only variant is the 21/64" diameter shaft marketed by Excalibur (Canada).

In general Target bow bolts are not commercially available as off the shelf items. Some suppliers will make them.

You are liable to find parts or ready-made bolts in the sizes 1714, 1716, 1814, 1816, 2114, 2216 and 2219.

Realistically these break down into 1714 for Target bows and 2216 and 2219 for Sporting bows.

3.1 BOLT MATERIAL

There is then the question of aluminium or carbon shafts. This choice will be down to what form of shooting you about to undertake, and what type of bow.

If you shoot a Target class bow then you will use aluminium shafts. Carbon shafted bolts have been tried with Target crossbows but experience suggests that it is difficult to achieve consistent bolt grouping over a range of distances.

Both types of shaft are available for Sport bows.

The carbon shaft bolts that are available for Sport bows are good. They are light, and therefore fast, and produce tight groups. They are better not shot at straw butts. Deceleration is fast on straw – which makes it difficult to retain piles. Glues do not work well with carbon fibre. In addition there is a high tendency for the shafts to break during extraction. They are however good for Forest and 3D rounds where the buttresses are foam or foam filled. In addition, their flatter trajectory is an advantage when shooting unmarked distances.

Aluminium shafts can be used on straw butts without problem. For unmarked distances you can use lighter piles to flatten your trajectory. In terms of which particular shaft to use it comes down to the

properties of the alloy. The higher the draw weight the more you should pay to get better properties. In some cases you may also get a better result anyway if you use higher quality alloy – say X7 rather than XX75. Note that X7 and XX78 are made from the same alloy. Do not use lesser grades than XX75.

3.2 BOLT LENGTH

Bolt length must conform to the Rules of Shooting.

If you buy carbon shafts then you will be restricted to the lengths that are available. Beyond conforming to the above, keep the shaft as short as possible. The shaft length should ideally be such that: when the nock is placed against the latched string the pile, or pile and end of the screwed insert, are just beyond the end of the track.

The reasons for this are simple. Firstly it allows for possible eccentricity in the pile and insert and ensures that the whole shaft rests on the track. Secondly it ensures that the harder pile cannot rub on the track and cause undue wear, especially if there is eccentricity. A longer shaft is more likely to become bent as a result of shooting. Finally a shorter bolt is lighter and will give a better cast.

However, if you are shooting on “bag” targets, as are sometimes used for Forest rounds, then you may need to consider longer bolts to minimise vane damage.

3.3 BOLT WEIGHT

There is not much you can do about weight of the shaft, since you are keeping it as short as possible, or the nock. The rest of the weight is made up of vanes and the pile. Lighter bolts have a better cast. However, unlike arrows for vertical bow, you are using a relatively heavy pile to bring the balance point forward and much nearer to the pile. This is what gives the bolt stability and leads to consistent groups.

For Target bows the pile should be about 225 grains. A lot of work has been done on this by shooters in America. This has shown that a weight around 225 grains gives the best result.

However you should be wary. Commercially available Target crossbow piles will vary in weight and need to be weighed and trimmed in order to achieve consistent grouping.

In just about every case Sporting bow shooters will use screw in piles. There are only three weights available – 100, 125, and 150 grains. The advice is that you should use 125 grain piles target shooting. The choice is yours when it comes to Forest & 3D. The distances are shorter so you can sacrifice a little stability for speed and therefore cast.

If you are using screw-in piles remember that the rules require the use of the parabolic/bullet shape rather than field points. This is better for butt wear.

3.4 FLETCHING

There is no valid ballistic based reason to have vanes on a bolt. The situation is simply that the rules require that vanes be fitted.

By virtue of the fact that they are there vanes will impart some spin to the bolt. Theoretically this will give some added stability. This is however marginal.

Do not be tempted to spiral fletch as archers do. Helical, or spiral, fletching can result in the vane catching in the track, and will throw the bolt off course.

Taller profile vanes have more effect, and are longer and heavier.

In addition the more the bolt spins the more energy is lost from that imparted by the prod and the shorter the cast will be. However, the larger the shaft the more energy it takes to spin the bolt.

For target bows 25 or 35 mm long vanes seem to give the best results. However, do not use standard archery vanes. The vane profile is too tall. Get your vanes from a specialist supplier, or be prepared to make a jig and spend hours trimming vanes to size.

Sporting bolts are larger in diameter and longer and so can take a larger vane. Most shooters seem to use 3 or 4 inch standard archery vanes. There is no reason why smaller vanes should not be used.

The variety of vane colours available and their combination does usually make it easier to determine who each bolt belongs to.

3.5 ALUMINIUM SHAFTS

If you are using aluminium shafts you need to consider how the tubing is made.

The aluminium is extruded through a die over a target pin. The shaft then goes through a number of straightening processes. This means that the shaft appears to be uniform and straight.

The problem is that all this work is done on the outside. In the extruding process the target pin can wander. Therefore the specified wall thickness is only nominal. The variations will be small. But if you plug the ends of your un-built bolt and set it to float in a large tub of water you will find that it will tend to always float the same way up. One side will be ever so slightly heavier and turn to the bottom. The lighter side, top side as floated, should carry the cock vane and thus be placed in the track; so that when the string applies a load the shaft is deflected down into the track, remembering that the string should strike slightly above the shaft axis.

From the practical point of view there is no sense in attempting this. It's fiddly and difficult to do, and it would not guarantee that your bolts would group together. In addition the effect is reduced for longer shafts because the target pin "wander" evens out.

Assuming that you shoot all bolts in exactly the same way they will hopefully group reasonably(ish). The trouble is that you will not be able to make exactly the same shot each time. So was the bad shot you, the bow, the bolt, or a gust of wind? And are you shooting three bolts that group together?

If one bolt starts going off in the same direction the problem is the bolt. Otherwise, during a shoot you can't tell unless you know a lot about that bolt. You need to test your bolts, whatever the shaft material.

3.6 BOLT TESTING

Put a number on each of your bolts. The archery suppliers will have decals, or write the number on the vanes. If you have more than 12 bolts use a letter decal as well to identify each set of 12, or simply keep on with the sequence on the vanes. If you use decals place them on the bolt on the side opposite the cock vane. Always place the bolt in the track that way up. **THIS IS IMPORTANT.** You must always place the same vane, the cock vane, in the track. If you place a different vane into the track the bolt will shoot differently. Then you need to bench test your bolts - or as close as you can get.

Use a camera tripod to give added support to the bow under the prod block. Adjust it so that you are as close as possible to your normal shooting stance at the longest distance you shoot. Try for calm weather, or at least a period when the breeze is light and coming from a constant direction.

After a few sighting shots set your sight and leave it alone. Shoot your bolts in a known sequence and record where each one goes. You need to do this at least three times for each bolt. This way you can identify which bolts group together, and where. You will also find out which ones are totally erratic. It is not uncommon to find that some bolts

which otherwise appear to be identical and straight will not group with their peers.

Here are pictures of four ends of bolts.

The first thing to note is that 6 lines have been drawn onto the face to give the “hours” to aid with describing bolt position: e.g. 9 at 9 o’clock etc.



Picture 1



Picture 2



Picture 3



Picture 4

Picture 1 includes sighter shots.

You should already be able to see that there is a tendency for bolts to group in the 9 o’clock 8/9 area or 6 to 7 o’clock in the 9. So you should understand what we are talking about.

Pictures 1 & 3 are showing the same bolts – remember the sighter shots. Picture 2 shows another set of bolts. In Picture 4 the bolts are as for Picture 2, but the number reduced to prevent damage.

The best way to record these is for one person to shoot and a second to spot, watching as each bolt goes in, and record each shot. You can then swap over using a second face. Spotting for your own bolts becomes a problem after 4 or 5 shots – trying to remember which one is which. You can walk up and record at the target, but this is tedious as the spin of the bolt usually means that it is difficult to read the numbers.

3.7 RECORDING BOLTS

Here are two ways that you can record the bolt values and position.

Use small diagrams showing the rings 10 out to 7. An example is shown in Appendix 1. On the sheet shown there are four diagrams, arranged vertically, for each bolt. Record one shot on each diagram.

The other option is to use a numeric system. Assume that a cutter is the whole score. Then clean just inside the line is score + 0.25, half way on the ring is +0.5 and so on.

Starting at 7 this gives values of 7, 7.25, 7.5, 7.75, 8, 8.25, 8.5, 8.75, 9, 9.25, 9.5, 9.75, 10, 10.25, and 10.5. Anything inside the archery “X” ring counts as 11.

Do the same thing for the hours of the clock. Realistically you will only use the hour or half hour once you get to a value of 10. Inside the “X” ring time may not exist – that’s up to you.

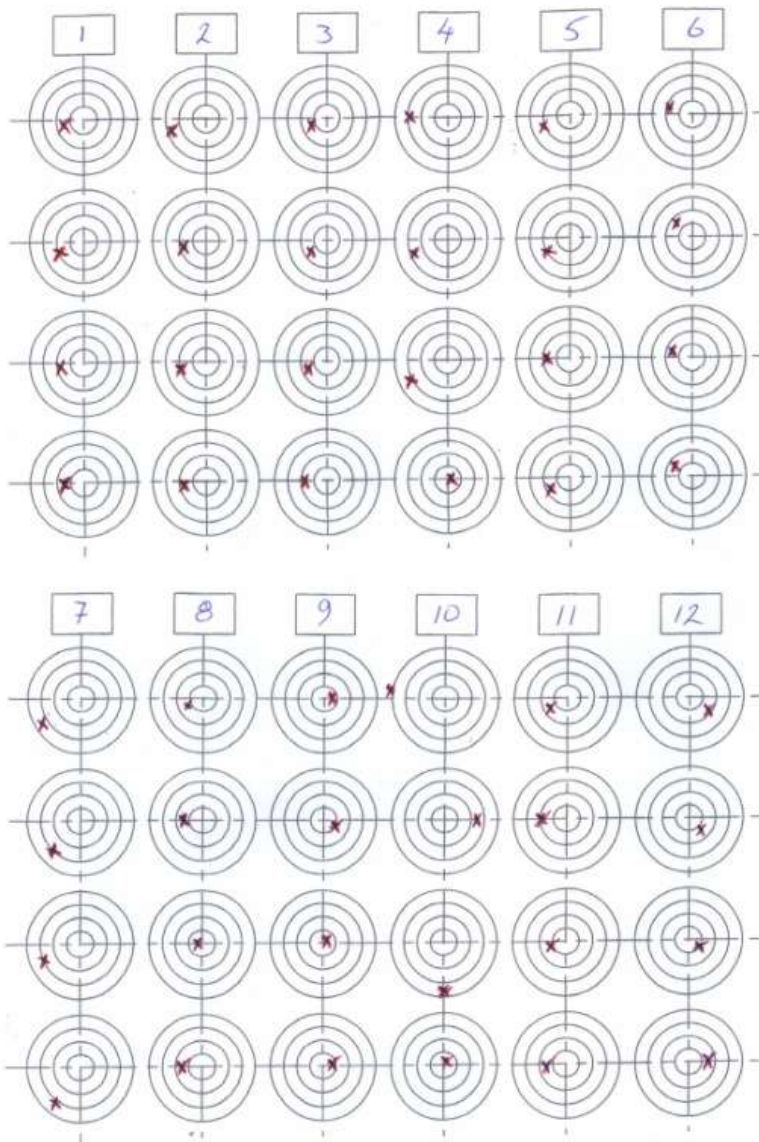
Which system you use depends on what best suits you, both from the point of view of making the record and for analysis.

3.8 ANALYSIS OF BENCH TESTING

Here is an example of the same record made using the two systems of recording. It is simplified as it has been created to demonstrate the point, and it is only for 12 bolts.

Bolt 10 is obviously not consistent in the result it gives, so we will discount this bolt.

The fourth shot for bolt 4 is significantly different to the other three. Something happened to throw this shot off. Discount this shot and check the bolt for damage.



| BOLT | SHOT 1 | | SHOT 2 | | SHOT 3 | | SHOT 4 | |
|------|--------|-------|--------|-------|--------|-------|--------|-------|
| | SCORE | ANGLE | SCORE | ANGLE | SCORE | ANGLE | SCORE | ANGLE |
| 1 | 9.50 | 8.75 | 9.00 | 8.50 | 9.25 | 8.75 | 9.50 | 9.00 |
| 2 | 8.25 | 8.50 | 9.25 | 8.75 | 9.00 | 8.50 | 9.25 | 8.75 |
| 3 | 9.75 | 8.50 | 9.50 | 8.00 | 9.50 | 8.25 | 9.25 | 9.00 |
| 4 | 8.00 | 9.00 | 8.25 | 8.00 | 7.75 | 9.00 | 11.00 | 3.00 |
| 5 | 8.75 | 8.00 | 9.00 | 8.00 | 9.25 | 9.00 | 9.25 | 8.00 |
| 6 | 9.25 | 9.50 | 9.75 | 10.00 | 9.50 | 9.50 | 9.50 | 9.75 |
| 7 | 7.50 | 8.00 | 8.00 | 7.50 | 8.00 | 8.00 | 7.75 | 7.25 |
| 8 | 9.75 | 8.00 | 9.50 | 9.00 | 11.00 | 9.00 | 9.50 | 9.00 |
| 9 | 10.25 | 3.00 | 10.00 | 3.50 | 11.00 | 2.00 | 10.25 | 2.50 |
| 10 | 6.50 | 9.50 | 8.50 | 3.00 | 7.50 | 6.00 | 11.00 | 1.00 |
| 11 | 9.50 | 8.00 | 9.00 | 9.00 | 9.75 | 8.50 | 9.50 | 8.75 |
| 12 | 9.25 | 4.00 | 9.75 | 4.50 | 10.00 | 4.00 | 9.50 | 3.00 |

| BOLT | SCORE | ANGLE |
|------|-------|-------|
| 9 | 11.00 | 2.00 |
| 9 | 10.25 | 2.50 |
| 12 | 9.50 | 3.00 |
| 9 | 10.25 | 3.00 |
| 9 | 10.00 | 3.50 |
| 12 | 9.25 | 4.00 |
| 12 | 10.00 | 4.00 |
| 12 | 9.75 | 4.50 |
| 7 | 7.75 | 7.25 |
| 7 | 8.00 | 7.50 |
| 7 | 7.50 | 8.00 |
| 7 | 8.00 | 8.00 |
| 4 | 8.25 | 8.00 |
| 5 | 8.75 | 8.00 |
| 5 | 9.00 | 8.00 |
| 5 | 9.25 | 8.00 |
| 11 | 9.50 | 8.00 |
| 3 | 9.50 | 8.00 |
| 8 | 9.75 | 8.00 |
| 3 | 9.50 | 8.25 |
| 2 | 8.25 | 8.50 |

| BOLT | SCORE | ANGLE |
|------|-------|-------|
| 1 | 9.00 | 8.50 |
| 2 | 9.00 | 8.50 |
| 3 | 9.75 | 8.50 |
| 11 | 9.75 | 8.50 |
| 2 | 9.25 | 8.75 |
| 1 | 9.25 | 8.75 |
| 2 | 9.25 | 8.75 |
| 1 | 9.50 | 8.75 |
| 11 | 9.50 | 8.75 |
| 4 | 7.75 | 9.00 |
| 4 | 8.00 | 9.00 |
| 11 | 9.00 | 9.00 |
| 5 | 9.25 | 9.00 |
| 3 | 9.25 | 9.00 |
| 8 | 9.50 | 9.00 |
| 1 | 9.50 | 9.00 |
| 8 | 9.50 | 9.00 |
| 8 | 11.00 | 9.00 |
| 6 | 9.25 | 9.50 |
| 6 | 9.50 | 9.50 |
| 6 | 9.50 | 9.75 |
| 6 | 9.75 | 10.00 |

The next table shows all the shots listed and sorted by the angle at which they struck the target.

The green acceptance zone has been set for an angle of one hour. That is a very narrow angle, considering that the proximity to the centre of the target and the shooting distance. Taking into account the score values we are looking at an area 60 mm wide by about 20 – 25 mm tall.

This suggests that bolts 6, 9, and 12 do not group with the others. Bolt 7 could be used as a back-up, but it will shoot slightly low and left.

Bolts 1, 2, 3, 4, 5, 7, 8, & 11 make a set of eight. Make your own selection from these, but bolt 4 looks like it should only be used as a reserve. On this basis 1, 2, 3, 5, 8, & 11 are the set to use. Bolts 4 and 7 would be used if there are problems.

If you open the acceptance angle then 6 comes into the group, which covers two rings of the target. 7 still looks like back up only. You can take it on from there.

When you do this for real you need to end up with 6 to 8 bolts, to allow for damage, that you would be happy to shoot at a competition. For a two day competition you need more bolts.

Ideally you should do this for every shoot, because shooting has an effect on bolts. You may not be able to do this, but it does need to be done reasonably frequently.

Just as for strings, bolts can become “tired” with age.

Know your bolts. Remember that testing is not the end of the exercise. Be prepared to recognise that a bolt is not performing in competition as you expect and replace it.

You will find that there are some bolts that you never take to competition, or even use for practice. Have separate sets for indoors and out.

You should have as many bolts as you can afford, within reason. I suggest two dozen as a good compromise, but more would be better.

Every two years I make 72 bolts for my wife to shoot. These will quickly be reduced to 20 to 30 to be used outdoors, and 20 to be used indoors. That leaves about 22 that may never be used in anger, but will go into the set for routine testing. There may also be 4 or 5 that are simply discarded.

3.9 BOLT INSPECTION

Inspect your bolts regularly, before, during and after shooting. You should check for the following:

1. Loose vanes.
2. Damaged vanes.
3. Damaged piles – an indicator that the shaft might have become bent.
4. Piles that have moved: i.e. there is a gap between the pile, or insert, shoulder and the shaft, or piles that have unscrewed.
5. Damaged nocks.
6. Scratches and gouges in the shaft.

Loose and damaged vanes can throw off the shot. The rules also require that you have the same number of vanes on each bolt, so if a vane comes off the bolt is unusable.

If a nock has a chip removed directly opposite the cock vane, then there is the possibility that the string may “jump the bolt”. Replace damaged nocks or in an emergency, rotate the nock so that the damage is adjacent to the cock vane.

Carefully check any scratches and gouges in aluminium shafts – use a magnifying glass. The scratch may hide a fracture of the shaft wall. This weakens the shaft and can throw off your shot. More important is the fact that the shaft could break when the string is released. There is no telling how dangerous this could be.

Between ends make sure that your bolts are clean. Straw boss construction includes latex which is used to help bond the straw into braids. This can be transferred to the bolts, possibly along with bits of straw, and will change how the bolt sits on the track. It is essential that all of this debris be removed.

3.10 STRAIGHTENING ALUMINIUM BOLTS

Much depends on the grade of alloy you are using for your shafts.

There is definitely value in straightening XX75 shafts. In relative terms the alloy is soft and can easily be bent and, therefore, straightened.

X7 and XX78 shafts are a different matter. The alloy is much tougher and it's brittle. The name X7 came originally from the number of straighten processes the shaft was put through by the manufacturer. You cannot reproduce those sorts of conditions. If you do straighten shafts made of this alloy it may very well be that the first shot taken will undo all your work.

If you can see an obvious bend in a shaft of this tougher alloy then the shaft is probably scrap. There is some possibility that with XX75 shafts you can recover the situation.

If you straighten bolts it must be done before you start the bench test process.

Checking straightness at a competition is just a matter of something to do. It's already too late.

The whole point of the bench test process and its' repetition is to find out how your bolts perform. Straightening a bolt at a competition changes its' shape from what it was for bench testing and you will not get the result that you expected. Trust your bench testing, even if the bolt is not straight. If a bolt is not performing as you expect put it aside for now and use an alternate.

4. PRACTICE

You should practice all distances, and you should practice shooting a round. However, you need more practice at the longest distance. Firstly, because if you can shoot this well you should carry the

stability of your shooting stance and style over to the shorter distances and secondly, because you will probably be able to shoot ends of six or more without damage – less walking in the long run.

General practice allows you to check on and improve your score. There are things that you should be looking at to help this process along. Your coach will help you with stance and style.

You should be looking for bolts that cease to perform as you would expect, and checking your sight arrangement as well as sight marks. Learn the effect of making a change to your sight.

In particular, check the alignment of the fore and rear sight tubes, and the size of the foresight element. You need to check these frequently to ensure that the way in which you see the target has not changed. You should also check the effects of filters if you have these available on your rear sight. Record the light conditions as well as distances, sight marks, and filters used. Changes in light will also have an effect that you need to be aware of.

Don't forget to get sight marks for your spare prod(s).

You will get 3 practice shots if you have to change a prod in competition. These will be wasted if you do not have a good idea of the relative performance of each prod. Prods are not identical. One relative to another will shoot high or low, left or right.

Be prepared so that you can make a first order adjustment, including some of the minor adjustment for the day's conditions, before you shoot the first bolt. You should then only be making fine adjustments during your additional practice shots. This will save you points on you next scoring end.

5. TARGET ROUND SCORES

You should have a clear idea of what score you anticipate achieving, and what that means for each distance. There are two reasons for this. It gives you small targets to achieve as you go. This can aid your concentration. Secondly, there is not always time in practice to shoot all distances. So if you go out and shoot one or two distances, then you have an ideal of how well you are doing.

Here's a suggestion of what you should expect for a variety of levels of performance firstly for Target and then Sport bows. Take these figures as a guide only. You may prefer to shoot at one particular distance and so perform better than suggested.

Target

| Target Score | 65 M | 55 M | 45 M | Total | Points in Hand |
|--------------|------|------|------|-------|----------------|
| 800 | 260 | 270 | 280 | 810 | 10 |
| 770 | 248 | 260 | 278 | 780 | 10 |
| 740 | 235 | 250 | 265 | 750 | 10 |
| 700 | 220 | 240 | 260 | 720 | 20 |
| 670 | 205 | 230 | 255 | 690 | 20 |
| 640 | 200 | 220 | 240 | 660 | 20 |
| 600 | 185 | 210 | 235 | 630 | 30 |

Sport

| Target Score | 55 M | 45 M | 35M | Total | Points in Hand |
|--------------|------|------|-----|-------|----------------|
| 520 | 173 | 180 | 187 | 540 | 20 |
| 500 | 165 | 174 | 185 | 520 | 20 |
| 480 | 156 | 167 | 177 | 500 | 20 |
| 460 | 146 | 160 | 174 | 480 | 20 |
| 440 | 137 | 153 | 170 | 460 | 20 |
| 420 | 133 | 147 | 160 | 440 | 20 |
| 400 | 123 | 140 | 157 | 420 | 20 |

In a competition you may have a good distance and achieve more than one of these score expectations. That's a bonus. Don't forget that a round is made up of scores for three distances. They all need to come close to the standard you have set. However, it is nice to see a higher score than you expected, and get some breathing space.

6. AIMING TIME

If you look steadily at an image for more than 15 seconds your retina will retain that image for an instant after you look away. You cannot tell that this has happened. If you hold your aim for more than 15 seconds you may actually move the bow off target and back on without knowing.

It is essential to aim for no more than 10, maximum 12, seconds. If you cannot make the shot in this time you must close your eyes, or deliberately look away at something else, and then return to aiming.

7. FOLLOW THROUGH

Aim until the bolt hits. The follow through is important. It ensures that you do not move the bow before the bolt has left the track.

Take the example of shooting at 18 metres, which is approximately 20 yards (60 feet). Bow speeds are usually quoted in feet per second. From a bow with a rating of 240 ft per second the bolt will take 0.25sec to cover the distance. Normal human reaction time is 0.25sec. Track athletes train and practice race starts just to reduce this reaction time. It's not going to work with shooting. If you are not still aiming when the bolt hits the target then the odds are that you moved before you pulled the trigger, or at least before the bolt left the bow. And if you moved then so did the bow.

If your head is up and you are looking at the target when the bolt hits it is certain that were not aiming when you pulled the trigger. So where was the bow pointing?

You should use the same practice indoors and out so that you have a consistent style. Hold the aim for 2 to 3 seconds after pulling the trigger. The bolt will then have hit the target, even at 65 metres.

8. BREATHING

Breathing is important.

We are trying to create a condition where the beat of your heart does not cause the position of the bow as you hold it to “pulse”. The two things that will result in this are energetic activity and holding breath in while taking the shot.

Everything you do on the shooting ground during practice or competition should be “measured”. Do not run, jog, leap around or even walk rapidly.

Give yourself plenty of time to get your equipment onto the shooting ground and prepared well before shooting is due to start. If you move bosses ensure that you have time to recover before shooting. At least 20 minutes. This way you keep your breathing rate and heartbeat steady and close to your rest rates.

As you approach the line to shoot you should deliberately take control of your breathing. Slow the rate at which you are breathing. In general terms if you slow your breathing rate you will also tend to reduce your heartbeat because the slow breathing rate is calming.

All your movements should be controlled and deliberate, also to slow your heartbeat, and keep you calm.

Breathe in to provide oxygen when you do something that will require the expenditure of energy. Hold the bow, aim and shoot with empty lungs. This minimises the transmission of the heartbeat to your bow.

You must work out a regimen that will suit you. It must be something that will become second nature, or at least a routine that you can follow with very little thought. As an example here is the routine that I use:

- Breathe slowly and slightly more deeply than normal as you approach the shooting line – calm yourself.
- Maintain this rate and settle yourself in position – more calming.
- Exhale as you bend down to span the bow.
- Inhale as you span the bow – this and the last point follow the movement of the body.
- Exhale as you move the bow to loading position.
- Inhale as you select your bolt.
- Exhale as you bend to insert the bolt.
- Inhale as you lift the bow to shooting level.
- Exhale as you settle into shooting stance.
- Inhale and exhale.
- Inhale half a breath.
- Exhale completely.
- Aim and shoot.
- Pause (follow through).
- Inhale and lower the bow to spanning position and repeat the process for the next two shots.

9. WIND

Shooting in the wind is an art that you will have to think about. Light wind will have minimal effect. Windage adjustment will be sufficient.

But what happens once the wind is stronger and variable in strength. Windage adjustment alone will not do the trick. Windage allows for a “static” set of conditions. If the wind varies in strength you have to use your ears.

There is no value in shooting when the wind is strongest, or when it is weakest. That gives you just one set of shooting conditions that is acceptable during the cycle of a gust, and you may have to wait far too long to meet those conditions. You need to listen and estimate a mid-point in wind strength, or wind blowing at a strength you recognise. That way you should have at least two chances in a gust when you have the conditions that you have allowed for. Considering the vagaries of the wind you are likely to have more than two opportunities. Be prepared to change to another set of conditions if it becomes necessary.

Some shooters aim off to compensate for wind draft. This practice is generally not recommended as in all probability the bolts will go where they are aimed! It is arguably better to maintain a constant 10 ring hold and wait for average wind conditions.

10. TIME TO SHOOT

Only 6, 7, 8, & 9 of the subjects discussed above have anything to do with the actual process of shooting. The majority is about preparation. So don't forget to ask your coach to check your stance, style and trigger action. You should also have a discussion about the position of your head in relation to your sight(s) and the process of aiming.

John S. Bingham
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My thanks go to John Clark for additional information, proof reading, and corrections. Sometime I get things down side up, or front to back.

APPENDIX 1

The next sheet is a blank copy of the bolt record sheet used on page 16. It shows the target rings 10 out to 7. If you cannot put a group in this area using additional support for the bow there is something drastically wrong, and you should talk to your coach.

