Wooden Arrow Workshop.

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Photographs June Marshall of Brixham Archers.
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Contents.

Making Matched Wooden Arrows.

There are several reasons for making your own arrows rather than buying them from an archery dealer. But perhaps the most important ones are:-

Firstly
Economic, it's cheaper in the long run to make your own than to buy them.

Secondly.
Quality, the arrows you make are likely to at least to match the quality of those which you buy.

Thirdly.
The satisfaction to be gained from acquiring a new skill.

I can't judge the satisfaction you will gain.
Only you can acquire the skills.
Let's talk about the economics.

A set of 12 arrows from a dealer or Fletcher in which you have defined the details of fletch, nock and pile will cost you at the present time around £100.
You can buy the components to make a dozen arrows for less than £40. In order to assemble those components you will incur some "one off" costs for such items as fletching jig and a grain scale. In addition there will be other minor costs such as glue and varnish which mean that you are unlikely to show a monetary "profit" on your first dozen but you almost certainly will do so on your second.

Arrows are made up of only four components, shafts, piles, nocks and fletches, however each of those individual components have so many variations in size shape, material and colour that for someone facing the task of making up their first set of arrows then they can present an array of choices of such complexity that it seems that the easiest thing to do is to buy them from a dealer after all.

In the following pages I will attempt to lay out the differences between the different variations of each component and show how a set of matched arrows may be made.

Let's deal first of all with the shafts.

Arrow Shafts.

Arrow shafts currently are available in a number of diameters.

¼ inch.

This diameter shaft is available from only one source as far as I am aware and that is from Carol Edwards at Leathercraft, her contact details along with all the other suppliers mentioned are shown at the end of this article.

¼ inch shafts are meant for very lightweight bows and are intended through their light weight to be used to enable the archer to reach longer distances than they would be able to do so normally. They are available only in pine and Carol stocks only two pile weights to fit onto them. Additionally they are not spined to match any particular bow weight.

In spite of these drawbacks they are popular with ladies shooting very lightweight longbows since they do enable them to reach longer distance targets.

9/32nds

Available from Quicks, and Leathercraft, in pine only these are almost as light as the ¼ inch shafts and are also spined to match the bow weight. Piles with a range of weights are available which makes them the shaft of choice for lightweight bows.

5/16

These are one of the most common shafts available in both pine and cedar, they have a wide range of various nocks and piles to fit them. If a general purpose shaft is needed that will do just about everything then this is the one to go for. These shafts are generally available for with a spine range to match bows in the 35 to 50lbs range.

11/32

A slightly thicker shaft that is used for stronger bows, again a wide range of accessories are available. In general where weight is no a great consideration then I would always advise shooting the thicker shaft, if it is available in the spine required, since it will be more robust and less likely to fail n use. Spine ratings go from the mid 40's up to 65lbs.

3/8

This is the British Longbow Society "Standard Arrow" shaft and used for the society shoots when shooting heavyweight bows. There also exists a 32/64 shaft for use with very heavyweight bows.

For the average male longbow archer however the choice lies between the 5/16 and 11/32nds diameter shafts. Those with the heavier bows will tend to favour 11/32nds and those with lighter bows the 5/16. However it is a personal choice which is influenced as much by the availability of shafts of suitable spine rating and piles of the appropriate diameter as much as anything else. The lady archer will when shooting a lighter bow find the 9/32 and 5/16 shafts more suitable.

Feathers.

There is one general rule for feathers the function of which is to form the control surfaces for the arrow. And that rule is “Put them as far back along the shaft as possible”. Position them on the shaft so that there is just comfortable room between the end of the fletch when the arrow is place on the bow string to get the fingers round the string. It is common sense to put the control surface where it will have most influence on the flight of the arrow and that position is as far back as it will go.

The fletch contributes to the amount of drag on the arrow, it is in this that way it achieves its control. The larger the fletch then the greater the drag but the greater the drag the greater the stability, of the arrow and thus the greater the accuracy of the arrow in its flight.
Without going into the mathematics of it the degree of drag is related to the swept area of the fletch, the bigger the swept area then the greater the drag. The actual shape of the fletch seems to have little effect on the amount of drag cause, it is the swept area which counts.
How much drag then is there on the different lengths of fletch?
If we take a simple view then the fletch is for practical purposes a triangle and we know that the area of a triangle is “half base times height” so we can say that for instance changing from a 3 inch fletch to a 4 inch fletch of the same height will cause an increase in drag and thus control of the arrow by some 30%. And vice versa.

The above assumes that the fletch is positioned straight down and in alignment with the arrow shaft. Placing the fletch at an angle to the direction of flight and thus exposing the side of the fletch to the flow of air will cause an increase in drag which is proportional to the angle at which the fletch is placed. However since it also causes the arrow to begin spinning earlier in its flight this also results in an increase in accuracy.

From the above it can be seen that for an arrow used for indoor archery where the distances involved are usually quite small, typically 20 yards, then an arrow with large fletches placed at an angle on the shaft will be most suitable, since though it will be slow, it will also be accurate.
The exact angle at which the fletch is place on the arrow will be determined in practical terms by the length of the fletch and the width of the shaft and a little experimentation will soon show what are the practical limits in each case.

Unlike plastic vanes which can spin in either direction a feather will only spin one way dependent upon which wing of the bird it comes from. Feathers from left hand wings will spin the arrow anti-clockwise and right hand feathers will spin the arrow clockwise. If an arrow is inadvertently fletched with two feathers from one wing and the third feather from the other wing then it will never fly properly.
Personally I always use left hand feathers since the best fletches in my view are supplied by “Trueflight” and these fletches which are sold by Quicks and Eagle Archery among other suppliers are all left wing feathers. If you wish to experiment with right wing feathers then they can be obtained from Carol Edwards at Leathercraft.

It is important though if you intend to angle the fletch on the arrow that it is positioned correctly for the direction of spin. A left hand feather should always be positioned with the front of the fletch angled off towards the left when viewed from the nock end of the arrow and a right hand fletch angled off to the right. It is worth mentioning that positioning a left hand fletch at an angle off to the right will cause the arrow to duck and sway in flight and is not recommended.


Angled fletch with left hand feather.

Nocks.
I favour the use of Bjorn nocks supplied by Quicks partly because I used them on my first set of arrows and found no reason not to continue but mostly because they have a little sprue on one side of the nock. As you will see later I use this feature to line up the cock feather when fletching the arrows. For the colour of my nocks I invariably choose fluorescent green since in low light conditions the colour shows up more than most other colours. But in terms of colour the choice is entirely yours. The important factor in choosing nocks is that the internal shape of the nock holds onto the string sufficiently but not too much.

Piles.
There are a bewildering range of piles available, for someone making their first set of arrows the situation must be very confusing.
Piles can be divided into two main types depending on their internal shapes. Parallel or Tapered fitting. For some reason in general brass piles have tapered fittings and “field” or steel piles are generally parallel fitting.

Tapered or Parallel. Which do you choose?
How do you make a choice and more importantly Why?
If you look at a well used longbow arrow you will see just behind the pile a series of small cracks on the surface of the shaft running at right angles to the length of the shaft. These are caused by the arrow whipping from side to side immediately after striking the target when the front of the arrow, the pile, is held firm in the target. If the shaft survives long enough this is where it will eventually break, usually when it has missed the target and stuck to leg of the target stand or some other relatively hard object. When the arrow strikes the target the shock of the impact is absorbed by the end of the shaft, the smaller that area the greater the shock on each individual portion of the area. With a tapered pile this shock is absorbed by a cone of wood and with a parallel pile by a circle of wood. For shafts of equal diameters the area of a cone will always be greater than the area of a circle and so I believe that the shock of impact is better absorbed by using tapered piles and that is a positive reason for preferring them over a parallel pile.

My other reasons for preferring tapered piles over parallel ones are negative ones concerning parallel piles.

Shaft diameters are fairly accurate, but they do not come with a guarantee, and it may be that the end of the shaft does not fit exactly into the particular parallel pile set you have chosen. If the shaft diameter is too small, or the internal pile size is too large, then the difference can only be made up with excess glue. Similarly a shaft that is too large, means that it must be reduced by scraping wood from the end of the shaft until it fits.

If wood is removed by scraping the end of the shaft then it is quite possible that it will no longer be parallel to the line of the shaft and the pile will be set on the shaft crooked and set at an angle, not a good start to making a set of matched arrows, or indeed any arrows at all. Nor can it be corrected, once it is done you're stuck with it.

These comments particularly apply to parallel piles advertised as "flush fit" which actually require the end of the shaft to be shaped with a shoulder in order that the outside line of pile exactly fits the line of the shaft itself.

The troubles with parallel piles do not end here. If the pile is an exact fit to the end of the shaft then as the shaft is pushed into the pile so glue is pushed ahead of the shaft into the bottom of the pile, where it does no good at all. The only way to prevent this is to cut a groove in the end of the shaft and allow the excess glue to escape along the groove. It all just too much trouble in my view when compared with the simple process of fitting a tapered pile, and I will tell you exactly how to do this later.

Arrow Spine.

Earlier on when dealing with shaft diameters I mentioned arrow spine.
The “Spine” of an arrow is simply a measure of its flexibility.
Arrows need to be flexible to bend round the handle of a longbow, the thicker the handle then the more they needed to bend. I do not intend to go into an explanation of “The Archers Paradox” here, sufficient to say that as a bow shape such as an American flat bow with its cut out arrow shelf or a conventional reflex bow moves more and more towards a centre shot position then the spine of the arrow shot from such a bow becomes less and less important. But for a longbow then matching the spine of the arrow and thus its flexibility to the strength of the bow is a most important factor in assisting good shooting.
Arrow spine is measured under the American USA (AMO) system by measuring the deflection in inches of the arrows centre pint when it is supported at two points 26 inches apart and with a 2lbs weight applied to its mid point.
The shaft is then classified into the poundage of the bow for which it is considered most suitable.
The deflection distances are as follows.

Deflection distances 0.5 inches= 50lbs bow
0.4 inches= 60lbs bow
0.6 inches= 40lbs bow

Shafts are generally sorted by 5lbs increments, thus 30-35lbs, 35-40lbs 40-45lbs etc.

But nothing is simple in archery, particularly longbow archery and since the Spinning system is American based then it is calculated for American flat bows not for British longbows. As I mentioned above American flat bows usually have an arrow shelf which allows for a more centre shot than the British Longbow. For Longbows the rule of thumb is that the spine of the shaft should be some 10lbs less than the weight of the bow indicated by the spinning system. Given that the weight of the bow is calculated at the draw length of the archer concerned.
Thus to match a Longbow which is rated at 50lbs at 28 inches and is actually drawn to that distance then shafts of 35-40 rating will be generally suitable. But remember this is a general rule and a bow with a rating of 35lbs may well shoot shafts of some 25-30 rating. This is where the Quicks catalogue comes in useful Page 78 shows the relationship between spine rating and bow weight and if you follow this then you will not go far wrong. One of the things one can do before taking the giant leap and putting your money down for a dozen shafts is to test what spine rate is best suited to your particular bow and your individual draw length. I have made up a set of test arrows all hopefully identical apart from the spine ratings, these I will make available for club members to shoot and see which fly the best out their bow.

Changing Spine Ratings.

Once shafts have been purchased though there are things which one can do to change slightly the spine rating of an arrow. For a right handed archer, one who holds the bow in the left hand, then an arrow with too high a spine rating will tend to go off to the left, but an arrow with too weak a spine rating will not necessarily go to the right, it will however fly erratically and may strike the side of the bow as it leaves.

If you have made a mistake over the spine rating of your shafts what can you do to correct it?

Spine problems may be corrected as follows:

With shaft length. Increasing the shaft length by footing it will weaken the spine, shortening it will make if stiffer.

With Pile Weight. Increasing the pile weight will cause the spine to be weakened, decreasing the pile weight will stiffen up the spine. This is the most common, the easiest and the effective method of changing spine weight once the arrow has been made and shot.

With Fletch size. Increasing the fletch size will stiffen up the arrow spine, but not very much, the idea is that the larger fletch will straighten up the arrow more quickly in flight and give the effect of a stiffer spine.

With Fletch Angle. Angling the fletch will increase the arrow spine, it acts in much the same way as does a larger fletch.

With Shaft Taper. Tapering the shaft seems against all logic to make the spine stiffer, But how do you control the degree of taper, and how much taper? Unlike the other methods shown above once it is done then it is done and you cannot alter it.

This is very much the last resort in the methods of altering the spine of an arrow.

Arrow Straightening.

I mentioned that arrows may be straightened and this is done using a very simple tool, which as far as I know is not available in any shop and which you must make at home. This tool which I will call an arrow clamp consists of a length of wood drilled with a hole along its length equal to the arrow diameter. Once drilled the wood is cut again along its length and through the hole thus producing two matching halves with straight groves running along their length which match the width of the shaft.
To straighten an arrow simply heat it along the bend over a source of heat, this can take a time since to straighten the arrow permanently one aims to heat the wood right through to the centre. The wood should be heated to as high a temperature as possible without charring and its best to wear a pair of heavy gardening gloves to hold the wood.

Arrow straightener

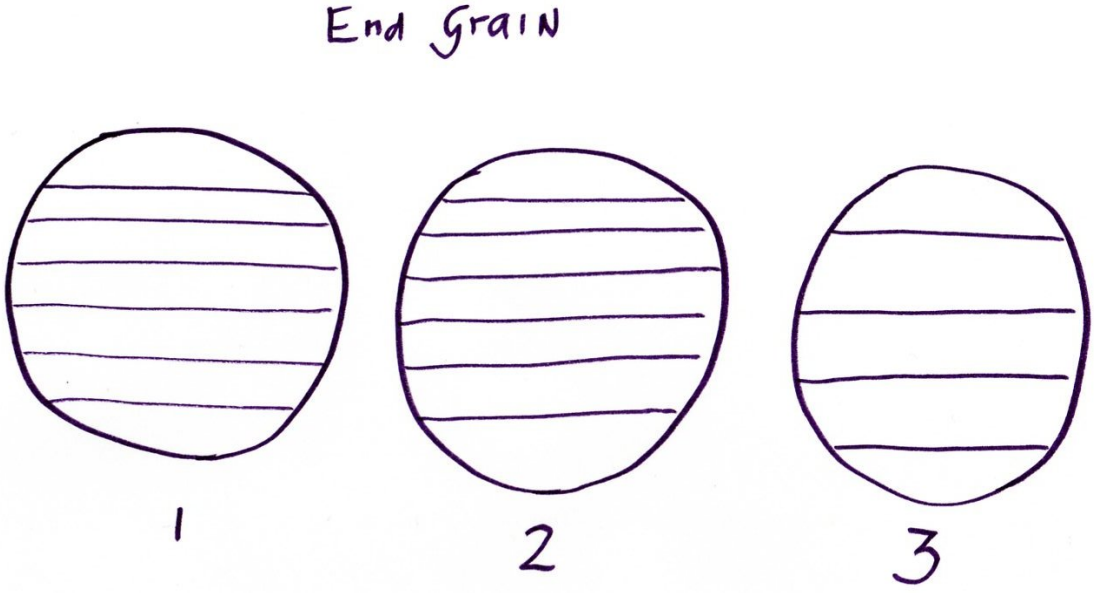
Once hot enough then the arrow is placed in the groove of the clamp, the other half of the arrow clamp is then placed on top, firmly clamped into position and left there cool. This treatment can be repeated as many times as necessary in order to achieve a straight arrow. One practical difficulty is to obtain a wood drill of the necessary length, more than say four or five inches but these are available from specialist shops. I have several of these arrow clamps which I have made at various times and I find them useful for such things as holding arrows in a clamp or vice when I want to work on the shaft.

Making a set of matched arrows.

Making a set of matched arrows begins with the selection of the shafts.

Arrow shaft selection.

If you can select your own arrows then it is obviously best to do so. Everyone knows that to check for straightness one can roll the shafts on a flat surface, if they “clatter” then reject them and try the next one. However since we are looking for a matched set it is equally if not more important than straightness, (since arrows can be straightened by heating them) is to check the end grain of the shafts and try to select a set of arrows which have an equal number of end grains showing. This tip was given to me by Chris Boyton who since he supplies pine shafts to many archers in this country as well as making fine bows, knows what he is talking about.



As you can see the end grain on shafts 1 and 2 nearly match one another while the end grain of 3 shows less growth rings and is likely to be less dense than the other two.

One may control the length of an arrow and its width but the density of the wood is beyond control, however arrows showing an equal number of end grains in the same width are more likely to share a near common density due to the equal number of heavy and light growth rings in the grain.

But most of us must rely upon a dealer to supply our shafts by post, if you can find a good dealer then stick to them. I buy pine shafts from Carol Edwards at Leathercraft, she supplies pine shafts by Chris Boyton at £15 a dozen, and will for an extra £3 a dozen match the spine between the 5lb limits. She does not however supply Cedar and these shafts I buy from Eagle Archery.

The first thing to do with a set of shafts received by post is to inspect them for straightness and if necessary clean them up. Then coat them with a 50/50 mixture of white spirit and polyurethane varnish. Use “Interior Grade Polyurethane” since this seals completely, exterior grade is permeable to water vapour. With pine shafts this has the effect of bringing up the “hairs” in the wood and once the varnish is dry these can then be smoothed off with “scotch pad” or wire wool. It may not be necessary with Cedar but it does no harm.

If you now roll your shafts and find a shaft which is bent then carefully inspect it to find where exactly the bend is. I always find it difficult to identify the source of a bend but laying the shafts side by side on a flat surface will help in identifying the source of the bend as well as any other method. If the bend is towards one end of the shaft then it may be possible since the shaft if it is to be shortened to the individual archers draw length to cut off the bent portion. If this is not possible then this is the best time to straighten the shaft using arrow clamps as previously described or indeed any other preferred method.

Next inspect the shafts and have a look at the grain particularly on what will be the underside of the shaft, this is the part of the shaft that will pass over the hand so it is important to see if there are any “break outs” on the grain underneath the arrow, if there are then turn the arrow round so that any breakouts point towards the back of the shaft and away from the hand. This will determine which is the front and which the back of the arrow.

Grain breakout on the shaft of an arrow.

Have a look at the end grain again and now put a pencil mark on one side of the shaft from the nock end and in line with the end grain. You are shortly going to put a taper on the end of the shaft and this will make the direction of the end grain more difficult to see, as you are going to put the cock fletch on the shaft in alignment with the end grain this makes end grain position more easily identified.

Number each shaft in pencil and then using the appropriate taper tool taper them for the nocks.

The taper tool is a very simple device rather like and old fashioned pencil sharpener and is used in exactly the same way. Taper tools as far as I am aware are only made in the two most popular arrow sizes, 5/16ths and 11/32nds. For smaller shafts than these wrap the shaft with masking tape until the diameter is up to one of these two sizes and use in the normal way. The taper of 11 degrees is the same for both piles and nocks of both sizes.

Next glue on the nocks with the sprue of the nock parallel to the grain at the end of the arrow and in alignment with your pencil mark. I use fletching cement to glue the nocks to the shaft others use wood glue.

The reason for numbering the arrows is that it enables you to begin each stage of the assembly process on the same arrow every time. We all make mistakes, and we are more likely to make a mistake the first time we do anything, numbering the shafts means that if you are going to make any mistakes then hopefully they will all be on the same arrow each time and not spread over several arrows. Better to have one really bad arrow than several which are dubious.

Now cut each arrow to a length appropriate to suit yourself and your draw length, as a general rule if you cut the arrow some two inches longer than your draw length then you will be safe. There is a school of thought that recommends the arrow be cut to a length which allows the end of the pile to be just on the knuckle of the hand at full draw, The reasoning behind this is that any wood over this length is wasted in excess weight and the lighter the arrow then the further it will fly. This is fine if you are an experienced archer but you will not do any harm making the arrows a bit longer and if you wish to do so then you can always shorten them later, personally I like my arrows to have a bit of length, not only is it safer but a long arrow is inherently more accurate than a short one.
When cutting the arrow shaft I find it is best done with a “junior” hacksaw with the blade reversed so that it cuts on the pull stroke, there is not a lot of wood to be cut through and doing so on the pull stroke is much more precise than doing so on the push stroke, it just takes a little longer since less power is applied to the sawing action.

Next taper the front of the arrow with the taper tool.

Now so far we have done nothing that is in any way unusual or different from conventional arrow assembly. Apart from being careful in our selection of components.

Now we begin the matching process.

Without the pile being fitted weigh all your numbered arrows and make careful note of the weight of each arrow.

Next weigh your piles, surprisingly I have found that some sets of piles unlike nocks seem to vary quite a bit in weight, if you find yours do then match the heaviest shafts to the lightest pile.

To do this of course you must use an accurate weigh scale. There is a weigh scale available from Quicks (page 70 in their present catalogue) which is accurate to the nearest grain, a grain being approx 1/15th of a gram but in practice it is sufficient to weigh to the nearest 5 grains.

As a sanity check a 5p piece weighs 50 grains.

Archers weigh scale.

I want at this point to divert slightly in order to make a point concerning modern arrows which if not lost exactly does not have a high profile simply because modern recurve and compound bows are so much more efficient than Longbows. How much more efficient, well using a modern recurve bow with a weight of say 38lbs an archer can achieve and make an aimed shot at 100 yards without too much trouble. You cannot do this with a longbow, trying to reach 100 yards with a 38lbs Longbow is possible but it is more like flight shooting than any sensible aiming process. To reach 100yards the average longbow archer needs a much heavier bow than 38lbs.

Essentially Longbow archery is a search for power and efficiency.

Power comes primarily from the bow, the efficiency comes from the arrow.

One of the ways in which an arrow can be made to be efficient is to control the way the arrow 'sits' on the air as it flies, or in other words to control the angle at which it travels through the air. The most renowned archers from long distance shooting were the Turks who obtained very long distances (over half a mile) by using special arrows.
In 1903 Sir Ralph Payne Gallwey whose work "The Crossbow" still seems to be the standard reference work on the subject examined more than 200 Turkish flight arrows and all were close to the following dimensions.

Length 25 ½ to 25 ¾ inches
Pile end 1/8th of an inch Nock end 3/16ths of an inch. Weight 191 grains
The shafts were barrelled 5/16ths at the greatest diameter and 1/8 inch smallest.
Balance point 12 inches from nock.
This balanced point gives a balance figure of 47%
i.e. 12/25.5 x 100 = 47%

We know that barrelled arrows fly further than straight ones.
Lightweight arrows fly further than heavy ones. The Turkish arrows are light at 191 grains 230 to 300 grains would be more typical of a Longbow arrow today.
Naturally if you want to shoot a long way you will use small fletches with little drag.
But most importantly

The Balance point of an arrow is important.

It is so important that some Turkish flight arrows had three small holes drilled into the nock end of the arrow behind the fletches and tiny amounts of mercury inserted in them order to balance the arrow correctly.
Remember these nocks were only 3/16ths of an inch in diameter in the first place.
You do not undertake the task of drilling holes in something 3/16ths of an inch in diameter and putting tiny amounts of mercury into those holes unless you regard it as very important indeed.

The point of balance of an arrow decides on how the arrow sits on the air during its flight.

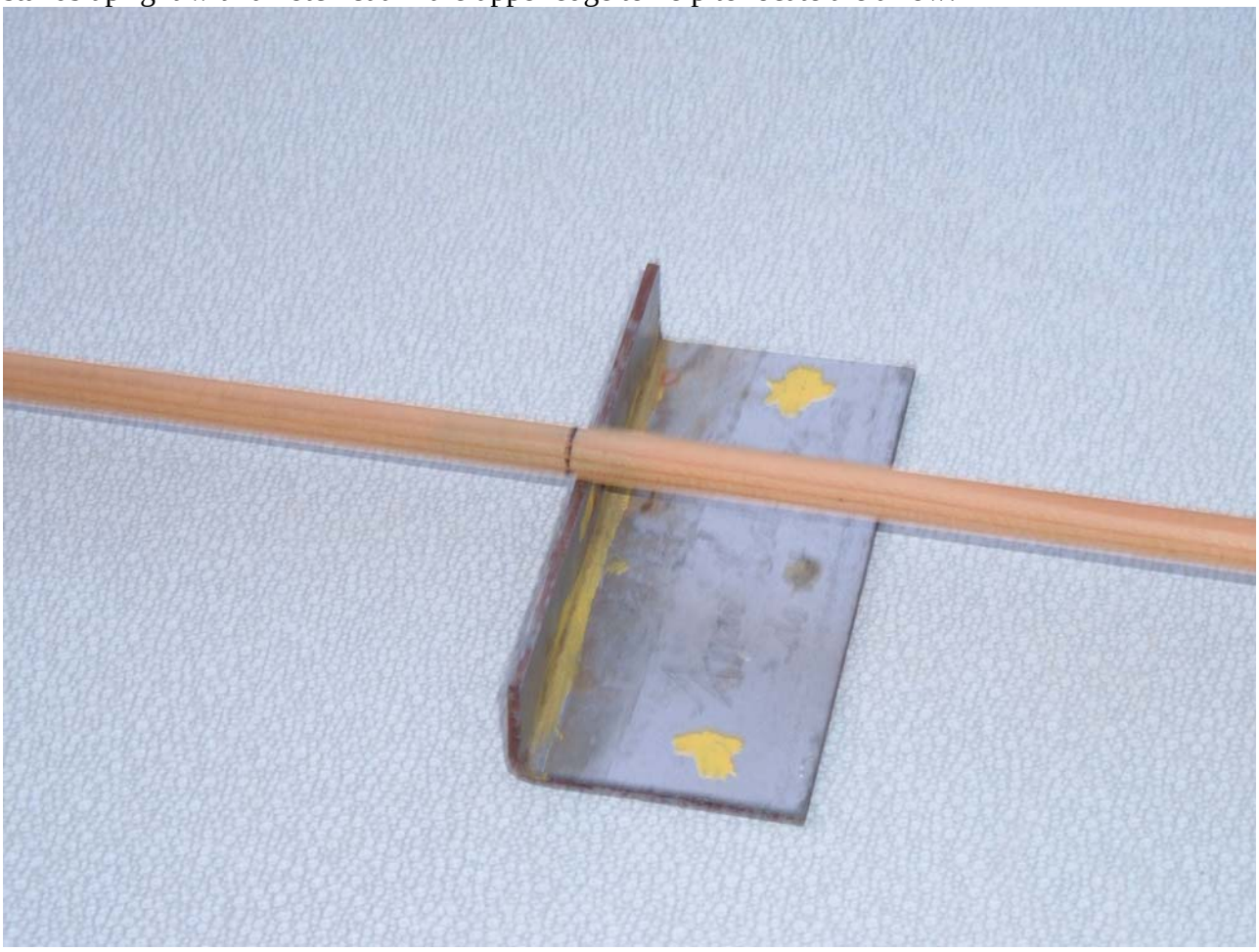
Now I should say that at this point the vast majority of longbow archers who make their own arrows simply fit the piles and fletches. Usually they will fit heavy piles (say 125 grain)and long fletches (say 5 inches) to arrows intended for short distance work or light piles (say 50 grain) and short feathers (say 2 inches) to arrows intended for long distance work. Or if just making general purpose arrows they will use 100 grain piles and 3 inch fletches. And that will be good enough, and some will fly well and some badly but in general they will shoot the results of their work and enjoy the shooting and after all that's what it's all about and there is nothing whatsoever wrong with it. Just as there is nothing wrong with you following their example and completely ignoring the following advice on balancing your arrows in order to make a matched set.

But my task is to give you information on how to make a matched set of arrows that will fly well.

So let's go back to making our matched arrows, having understood that the balance of the arrow is important.

Now jamb on the piles without gluing them in position, and use a balancing tool find the balance point of each arrow and mark it on the shaft by putting a pencil mark round the shaft.

What is a balancing tool? It's simply a knife edge on which the shaft may be laid in order to find the point of balance. I have made on up from a simple piece of metal bent at a right angle so it stands upright with a notch cut in the upper edge to help to locate the arrow.



Arrow balancing tool.

We have now come to a point where your own skill and judgement come into the process.

Where on your arrow should the balance point be? We know where it is, but where should it be?

Somewhere in their technical literature Easton say that for their aluminium arrows the balance point should be 78% along the length of the arrow from the nock. But their emphasis is on arrows shot from efficient bows which do not need to glide through the air, they do not need to concern themselves so much with distance but rather with accuracy.
Turkish flight arrows have a balance point at about 47% along the shaft i.e. behind the centre point of the arrow. But they were not concerned with accuracy at all only with distance.

For a long time I have based my arrows balance point on an article which I read in "The British Archer" a magazine which was published at a time when most people still shot wooden arrows. The article contained calculations which indicated that the optimum balance point to be somewhere around 58% to 62% of the arrow length.

To put this in perspective these figures give a balance point for a 28 inch arrow as between 16¼ inch and 17.1/4 inches along the arrow shaft from the nock.

The further back the balance point the further the arrow will travel but the less accurate it will be since it will tend to more affected by wind and also more sensitive to a bad release. A balance point which is biased to wards the front of the arrow will be more accurate and more tolerant of the conditions but it will also not fly as far. So if you as a Longbow archer are making long distance shafts to use at 100 yard with small fletches and small piles as we have discussed then you will tend to use a balance point towards the nock of the arrow. For short distance shafts with big fletches for use with indoor archery and maximum accuracy then you should tend to have he balance point towards the pile end of the arrow.

For general purposes aim for balance point between 58 and 62% of arrow length.

And if your balance points do not fall within this general area then this is the time to change the piles until they do.

This is the reason that we jammed on the piles without gluing them, it makes them very easy to change.

Now you cannot move balance points all that much by changing piles, for example changing from 100 grain to 125 grain will move the balance point by somewhere between ½ and ¼ of an inch. Note that we have not yet attached the feathers you will see why in a moment.

Now that you have got your balance point in something like the right position you can glue on the piles. I always use “Ferrule-tite” hard glue. Hot melt glue sold for use with glue guns is not strong enough and araldite being hard will not stand the repeated shocks of the arrow hitting the target.

Using a gas ring or similar, you can use a candle if you have to but you will find it leaves a smoky deposit on the end of the arrow, melt a dab of Ferrule-tite onto the taper at the front of the shaft. Next hold the pile in the flame with a pair of fine pliers for a while to heat it up at the same time holding the end of the arrow with its dab of glue about six inches above the pile in the flame, the pile will heat up and at the same time you will see the Ferrule-tite begin to bubble.

Now quickly put the end of the taper into the pile twist it round in order to spread the glue evenly and most importantly push it down hard into the pile. I have made up a very simple tool to help with this which consists of a small nut embedded in a piece of wood, the internal diameter to the nut is small enough to just fit onto the front end of the pile to locate it and assist in holding it in position whilst bearing down on the arrow shaft. The arrow shaft needs to be pushed in really hard. It is as well to have on hand a wet cloth or similar to cool down the pile and assist in the hardening of the glue. The excess glue which emerges from the top of the pile can almost immediately be cleaned off the shaft with a knife edge and wire wool.

Pile fitting tool.

Now arrange you arrows level and in parallel with each other with the farthest balance point at one end and the nearest at the other.
What you do next is to draw a straight line across all the arrows using a non-permanent coloured fibre pen at what you consider to be your optimum balance point.

Arrows lined up showing optimum and actual balance points.

But where is your optimum balance point?

Since you cannot move the balance points all that much by removing wood from the arrow and so changing the weight so as long as it was within the range of 58% to 62% I tend to draw the optimum line at a point nearest to the majority of the balance point marks already made. Always bearing in mind that it the arrows are intended for long range work then it should be towards the back of the range and if for short range work towards the front of the range.

Close up of balance points.

Now weigh your arrows.
And list them as shown.

	First weighing.	2nd weighing.	
1	350	350	
2	360	360	
3	395	380	
4	360	360	
5	400	385	
6	385	380	Arrows so marked have had wood removed.
7	385	380	
8	355	355	
9	370	370	
10	345	345	
11	385	375	
12	360	360	

By removing wood from the appropriate part of the arrow. The range of weights has been reduced from 50 grain to 30 grain and the actual balance points moved closer together and nearer to your chosen optimum balance point on the arrow shaft.

Now you know the weight of each arrow take the heaviest arrow and remove wood by scraping the arrow with a Stanley Knife blade at a position on the arrow which will to bring the balance point towards the optimum balance point at the same time as you are losing arrow weight. Remember that wood taken from close to the nock or pile end of the arrow will have a greater effect on the balance point than wood taken from the centre of the arrow. You should remove wood from the end of the arrow on the balance point side of the optimum balance point mark.

What you are really interested in is the range of arrow weights and the range of balance points.

Work your way through all the arrows, removing wood only from the heaviest ones, weigh them again as necessary and re-balancing each time to check your progress, write down the results each time until you have all the arrows within the range of say 30 grains difference between top and bottom weight and the balance points as near to one another as possible.
As you will see from my example, which is taken from a real set of arrows, it is only necessary to remove wood from the heaviest arrows in the set in order to reduce the total range of weights.

You may find you have a rogue arrow, in terms of its weight or balance, at this stage there is nothing you can do about this. If it is too heavy then there is a limit to the amount of wood you can scrape off without distorting the arrow or significantly changing the spine value. If it is too light then give it an extra couple of coats of varnish at the end.

A thick coat of varnish only weighs about 2 to 3 grains but every little helps.

But before you do so then wipe off the non permanent fibre pen marking the optimum balance point. Now gently and carefully smooth off the arrow with either wire wool of scotch pad to remove any scratch marks left by the Stanley knife.

Now fit the feathers.

If you do not have a fletching jig already and cannot borrow one then buy the most substantial one you can afford and which can accommodate feathers up to 5 ½ inches long as well as being capable of angling the feathers on the shaft. Follow the instructions for your particular jig and set the feathers as far back along the shaft as possible using fletching cement.

Fletching jig. Note the length of the fletch holder and ability to handle angled fletching.

The fletches should always be set as far back as possible because they are the control surfaces of the arrow and the further back they are then the greater the control effect they will exert.

I always use the same type and colour for all the fletches, identifying the cock feather with a dab of paint behind and in front of it. This prevents any possibility of the cock feather by being a different colour, being from a different batch of feathers to the others and the possibly of being a slightly different shape or type.

Sealing the Arrows.
Arrows which have not been sealed will absorb moisture when shot in wet conditions, when they dry they can warp due to uneven drying, and that does not make for good shooting, so it is best to completely seal the wooden surface of the arrow.
Now you can seal you arrows using either Danish Oil or very much thinned Polyurethane varnish and give them the first real test, by shooting them.
Danish oil is used in the catering industry to seal wood where it is in contact with food, as such it seals the arrow surface completely, it dries much more quickly than polyurethane varnish and because it is thin does not form "runs" if too much is used. It is much easier to use than varnish. However because it is "thin" it will not fill in any imperfections in the surface of the arrow. Once dried it can be polished with a soft cloth.

The only practical test of a set of arrows is to shoot 'em and see how they group.

My practical test is very simple, if they all go on the boss at 60 yards then its good enough for me. You may have your own more rigorous test than this but it is important to shoot your arrows at a distance at which they can reasonably be expected to hit the boss. You should repeat this exercise several times and note the positions of each numbered arrow on the boss, every time. Only by inspecting the position of the numbered arrows on the boss can you begin to identify any problems which might exist. Arrows which miss will not tell you much.

Sort out any rogues and if necessary re-weight/balance and shoot then again.
Now take your numbered arrows and put on any other information which you think is necessary or helpful. I always put on the date of manufacture since it is a useful way of identifying the arrows and also the one piece of information about them that will not change but is easily forgotten, the spine of the arrow.
That done they can be finally sealed with thinned out polyurethane varnish before polishing with furniture polish.

Repairing Broken Shafts.

You can actually repair a broken shaft using the same technique as used to foot a shaft, however it is simpler and easier to do so using another shaft and this simple tool.

I will tell you how to foot an arrow later because it does produce a better repair to a broken arrow, but this is the simplest way to repair an arrow shaft.

Arrow Joining Jig

Push the fletch end of the broken arrow into the top end of the jig and cut it by sawing along the already existing saw cut right through the shaft which lies at the bottom of the saw cut.. Remove the arrow and push what will become the pile end of the arrow into the bottom end of the jig and again cut down the existing saw cut. You have now got two exactly matching angled cuts on the ends of each shaft. Put ordinary wood glue on the matching surfaces, bind with masking tape and clamp the arrow in an arrow clamp.

Arrow joining jig with arrow showing angle of cut.

Making tapered shafts.

Tapered shafts will fly much further than none tapered shafts.

This is the simplest way to make a tapered shaft, but bear in mind tapering a shaft will also stiffen it so if making a whole dozen new shafts then buy them at a lower spine rating than you normally would.

There is no point in making a tapered shaft unless one has the relevant components to accommodate the tapering.

In practice you are limited to what you can do by the range of components available to you.

The easy way to make to make barrelled shafts is to fit 9/32nds piles and nocks onto 11/32shafts.

The angles for the piles and nocks are exactly the same.

Taper the shaft itself as we did when matching the shafts by removing wood from the shaft in the following manner.

Before fitting the fletches.

Take a soft pencil and mark a point two inches from each end of the shaft, then scribble pencil marks all over the area, between your mark and the end of the shaft. Next scrape off the scribble marks using a knife blade. Then make marks at 4 inches from the ends again scribble between the mark and the end of the shaft scrape off all the marks. Mark at 6 inches and repeat and if necessary at 8 inches at each end of the shaft. You will now have removed the end wood four times from the first two inches, three times from the first four inches, twice from the first six inches and once from the first eight inches. Thus you have ideally achieved a taper on the shaft and blended into the shape of the shaft both the pile and the nock.

Note that your tapering need not be symmetrical, indeed if it is your intention to make a flight arrow then taper the back end of the shaft less than the front since this will help with moving the balance point towards the rear of the shaft.
Leave the middle of the shaft un-tapered. Since this helps with dealing with total weight of the shaft and the positioning of the balance point.

I notice that Quicks now have in their catalogue a quarter inch pile but note that these are parallel fit and only weigh 20 grains so if you want a real challenge and a very tapered shaft you could try using use these.

Making Footed shafts.

I am not a great fan of footed shafts, they look really good if the footing is made of wood with a contrasting colour to the shaft and have the advantage is that since the footing is made from hardwood then they are stronger and less likely to break just behind the pile.
The difficulty is getting a source of hardwood in order to make the footings and once made matching the shafts within the set of arrows.

However the technique of making a footed shaft can be used to repair a broken arrow in a way which is more satisfactory than using the jig I spoke of earlier.

The essential tools are a spokeshave and either a hose clip or an ordinary clamp. That's all you need apart from your shaft and a piece of hardwood at least 6 inches long and some half inch square. Assuming your hardwood is of these dimensions then make a cut along its length four inches long.

Now take your arrow, and make a mark round the arrow four inches from the end. On the end of the arrow, make a mark half way across it and in line with the grain, (this will ensure that the pointed part of the footing does not lie across the hand when the arrow is shot).
Fix the arrow in an arrow clamp and close up in a vice.
Set your spokeshave up to as fine a cut as you can manage.

Now using the spokeshave cut a taper on both sides of the arrow down to the mark you have made across the middle of the end of the shaft. It is at this point where I always said I could not do this as my woodworking skills were simply not up to it, but in practice it is a lot easier than it seems, and frankly if I can do it then anyone can. It is slightly more difficult making the second taper cut than it is to make the first cut since the taper becomes very flexible but go slowly and it can be done.

Now we have a cut in the footing and a taper in the shaft. If we simply push the shaft into the cut in the footing then the footing will surely split. To stop it splitting simply put a clamp on the footing just below the cut and at right angles to it. Now the shaft taper covered in wood glue can be pushed into the footing, it's relatively easy to make sure it is all straight and once pushed home then the whole thing can be bound with masking tape to hold it in position overnight until the glue dries. When it has you will have an arrow with two "wings" out on either side where the taper has pushed the footing aside. Carefully shave the excess wood off using your spokeshave and at the same time round off the footing. It is a lot easier than it sounds. You now have a four inch footing on your shaft which is now two inches longer than previously.

Using exactly the same process one can mend a broken shaft but instead of using a square hardwood footing one can use another arrow. The only difference is that instead of using a clamp to prevent the footing splitting then a circular hose clip is used since this fits the arrow more closely.

Repaired and footed arrows.

Suppliers Mentioned in this Article.

Carol Edwards.
Leathercraft-Fletcher.
Craft Cottage,
Bookham Lodge Stud
Cobham Rd
Stoke D'Abernon.
Surry.
KT11 3QG. Tele 01932 865 181 www.carolarchery.com

Helen Simpson
Eagle Classic Archery
Unit 1
Thievesdale Close
Workshop
Notts
S81 0XS Telephone 01909 488111 www.eagleclassicarchery.co.uk
Quicks at Waterlooville
18-22 Stakes Hill Rd
Waterlooville
Hants
P07 7JF Telephone 023 9225 4114 www.quicks.com