Review –
FIRST BIRD CRAFTS
Bamboo Arrow Shafts

By Dennis La Varenne

PURPOSE
To provide as detailed and accurate an assessment of these shafts as possible using common standard criteria used in the assessment of arrow shafts. The supplied shafts are 1000mm long and are stamped at a nominal 60-65 lb.

EQUIPMENT USED

1. Spine Jig
The spine jig used is calibrated for AMO deflection. On this particular spine jig, the distance between the end support rests is 27 inches (685.8mm) instead of the standard 26 inches (660.4mm). Because of the greater distance between centres, the weight has been reduced from the standard 2 lbs (907 grammes) to 1.97 lbs (894 grammes). This mass reduction calibrates this particular jig to read to AMO deflection standards and it has been checked for accuracy.

The arm extension of the needle pointer where the test mass is loaded on the shaft being tested and upon which the tested shaft actually rests is 343mm (13 ½ inches) from the supports at each end of the jig.

2. Digital caliper
The digital caliper used was set to read in millimetres instead of thousandths of an inch. Neither millimetres or thousandths of an inch converts readily to the standard arrow shaft diameters which are fractions of 1/8 inch. There are no calipers which measure in fractions of 1/8 inch units that are known to the tester. Readers can do their own conversions if they need to. Whatever the units of measurement used, it is the variations and degree of variation which are important in a test of this nature.

Other units used are standard AMO units so far as possible, i.e. shaft mass and spine deflection which is in thousandths of an inch.

This particular digital caliper used has been checked by the author against his calibrated Mitutoyo dial caliper and found to be as accurate. Some cheaper digital calipers can be quit inaccurate.

METHOD

1. Shaft selection
Twelve shafts (12) were selected at random from the newly opened package just as it arrived. None were examined for any kind of damage or malformation prior to commencing the test.

As the test progressed, one of the selected shafts (originally No 5) was found to have a severe dog-leg malformation which would have prevented any kind of meaningful straightness reading to be taken. It was also found to have a significant circumferential crack near the dog-leg which extended almost 2/3 of the way around the shaft. It broke when the shaft was flexed at that point. That shaft was discarded (including its statistical data) and another was picked at random from the package that replacement shaft became the present No 5 of the test batch.

2. Diameter measurements

The supplied shafts are 1000mm in length or 39.39 inches, so there is plenty of room for cutting them to best suit usage which I will address a bit later. These shafts do have a large end and a smaller end, but the taper is not so much as you may think. It does however make for an interesting phenomenon not available in milled wood shafts.

Diameter measurements were taken at each extreme end and at the exact middle of the shaft. Because the shafts are NOT round, being a naturally occurring tube, I have given two measurements at each of these positions – the largest and the smallest diameter. These shafts are NOT true-round as one would expect in any coppiced shaft material.

All measurements are in millimetres.

For those who need to know, the following standard arrow shaft diameters are given in millimetres to two decimal places –

5/16 in – 7.94 mm
11/32 in - 8.73 mm
23/64 in - 9.13 mm
3/8 in - 9.52 mm.

These conversions will allow anybody to surmise how close to the standard AMO arrow diameter sizes each of the tested shafts were at each measurement position.

3. Spine readings

Each shaft is stamped with the manufacturer's spine rating very close to the exact centre of each shaft. In the case of the shafts under test, the nominal spine rating was 60-65 lbs.

The Spine Jig arm upon which the shaft rests and where the standard weight is suspended is in the centre of the jig between the end supports. The distance from each end support to the arm of the deflection pointer is 343mm (13 ½ inches).

The first reading was always taken with the manufacturer's spine rating stamp in the UP position. This position is designated 0 in the spine data table below. The second position is 90^0, the third is 180^0 and the fourth is 270^0 corresponding to the degrees of rotation for each reading.

There is a benefit in this method in that it allows any scrutineer to assess the changes in spine reading along a single axis of each shaft at each of the four readings and to see by what amount deflection changes as the readings move from the smaller end to the larger end.

This may have benefits for those who have an interest in bare-shaft testing of their arrows so far as trimming bits off the ends of shafts in attempts to match dynamic spine between shafts.

Spine readings were taken at three (3) positions along each shaft. These positions were as follows –

SMALL END
A reading was taken with the tip of the smaller end resting on one end as close to the tip as possible without falling off whilst the other end overhung for the rest of its length. Four (4) readings were taken each at 90 degree intervals with the shaft laid on the jig and rotated away from the tester.

MIDDLE
The same readings were taken at a point 500mm from the ends of each of the tested shafts. Readings were taken at 90 degree intervals as the shafts were rotated away from the tester.

LARGE END
The same process was repeated with the large end suspended on the end supports as close to the tip of the shaft as possible consistent with it not falling off. The rest of the shaft toward the smaller end overhung for its length. Readings were taken at 90 degree intervals as the shaft was rotated away from the tester while in position on the jig.

4. Mass
All sampled shafts were weighed on a digital arrow scale set to grains.

5. Centre of Balance (CoB)
All sampled shafts were balanced and tested for centre of balance. A positive reading indicates a CoB towards the thicker end and vice versa. Surprisingly, two shafts had negative readings which were surmised to be the consequence of a denser node just behind the actual middle of the shaft.

6. Rotation
Using the above spine jig, the amount of 'out of straight' of each of the tested shafts was examined by laying each shaft in position on the jig as if to take a spine reading and then rotated a full circle whilst the needle moved against the dial.

A good estimate of how much individual shafts were crooked can be seen by the amount of waver shown on the dial when the needle moves up and down against the dial.

The total range of movement shows how much the shaft is out of straight can be read as thousandths of an inch at that position along the shaft.

Readings were taken in the same places at which spine readings were taken and tabulated as THIN (meaning 343mm from the thin end), MIDDLE (meaning at the 500mm position) and THICK (meaning 343mm from the thick end).

THE DATA
Data from the test have been tabulated into the following three tables below –
Thickness data;
Spine Rating;
Mass, Centre of Balance and Straightness.

DIAMETER DATA - Table 1

Standard AMO diameters are as follows to allow diameter comparisons.

5/16 in –7.94 mm
11/32 in - 8.73 mm
23/64 in - 9.13 mm
3/8 in - 9.52 mm.

SHAFT NUMBER	SMALL END	SHAFT MIDDLE	LARGE END
1	8.59/8.65	8.59/8.68	8.81/8.84
2	7.95/8.09	8.30/8.57	8.27/8.53
3	7.79/7.85	8.22/8.45	7.94/8.08
4	7.45/7.54	8.41/8.46	7.66/7.84
5	7.59/7.76	8.64/8.71	8.08/8.17
6	7.52/7.71	8.30/8.42	8.72/8.83
7	7.46/7.62	8.79/8.82	8.21/8.42
8	7.46/7.62	8.34/8.46	8.40/8.61
9	7.30/7.40	8.49/8.73	8.37/8.44
10	7.43/7.50	8.20/8.28	8.01/8.15
11	8.19/8.25	8.08/8.33	8.60/8.65
12	7.59/7.62	8.14N/8/52N*	8.28/8.45

*N stands for Node. This is the only reading which occurred over a node on any shaft.

SPINE RATING - Table 2

Shaft No.	343mm from small end				Exact middle				343mm from thick end			
	0^0	90^0	180^0	270^0	0^0	90^0	180^0	270^0	0	90^0	180^0	270^0
1	460	490	480	480	400	440	400	440	380	370	370	360
2	420	400	400	390	410	400	400	390	350	380	350	370
3	400	390	400	390	400	380	390	390	410	410	450	400
4	350	350	350	360	350	340	350	330	350	350	350	350
5	380	370	380	360	380	350	360	350	350	320	330	310
6	410	430	420	430	400	390	390	390	340	340	340	340
7	350	350	360	360	320	330	330	350	320	330	320	320
8	360	360	370	350	360	350	350	350	320	320	330	330
9	430	420	430	400	390	380	400	380	380	350	380	360
10	390	370	390	360	360	370	380	350	370	350	370	350
11	360	360	360	360	360	360	360	360	370	350	380	350
12	420	400	430	400	350N*	390N*	370N*	400N*	330	370	320	360

*N stands for Node. This is the only reading which occurred over a node on any shaft.

To reprise the earlier explanation at 3. on page 2 above, readings were taken at **343 mm in from each end of each shaft as described above as well as at the exact middle of the shaft**. Four readings were taken, each at 90 degrees rotation to the last. The base reading of 0 was taken with the manufacturer's stamp in the upward position. Each reading was taken as the shaft was rotated away from the tester whilst on the jig.

Therefore, each reading can be compared to a reading further along the shaft on the same axis. The tester considered that this would assist in assessing by how much the stiffness (spine) rating changed as the shaft diameter increased.

Mass, Centre of Balance (B) and Straightness - Table 3

Shaft No.	Mass (grains)	Centre of Balance (mm)	Straightness (x 0.001") per 360^0 rotation		
			Thin	Middle	Thick
1	502	+23	70	40	40
2	510	+25	70	20	50
3	514	-15	80	30	30
4	562	-10	50	50	30
5	536	+25	50	40	20
6	536	+40	40	20	40
7	542	+20	40	40	50
8	572	+15	30	30	30
9	560	+20	60	10	60
10	550	+20	30	30	20
11	470*	+17	30	30	20
12	610*	+25	30	50	40

*These two shafts were significantly outside the mass range of the tested shafts. Excluding these two shafts, the remainder was within a mass range of 70 grains for 10 shafts, with 8 falling within a 36 grains spread.

Finish on shafts

There is some kind of clear lacquer finish on these shafts which appears to be a semi-gloss of good quality. On opening the parcel, there is a distinct odour of thinners. There are no observable runs in the finish, so some care has gone into its application.

Nodes

It is noteworthy that the nodes on these shafts are not prominent above the surface as normally found on bamboo shoots. Wild growing bamboo has prominent nodes. By some process, the diameters of the nodes on these shafts have been reduced to that of the shaft on each side of the node point.

One process was explained to me by a friend who is an 8th Dan Kyudo practitioner who makes his own bamboo shafts.

He explained that the heated shafts are rolled between two flat surfaces at the nodes whilst compression is applied. This simple process reduces the diameter of the nodes without breaking the full length bamboo fibres, maintaining strength and integrity which would not be present if the nodes were reduced by sanding or scraping them down to surrounding surface level.

Spine

Spine readings were taken at 90^0 intervals by rolling the shaft in situ on the spine jig in a direction away from the tester. Results were tabulated in Table 2.

Readings were taken at three positions along the shaft – 343 mm from the small end, 343mm from the thick end and in the exact middle to see how spine changed as the shaft diameter increased.

In Table 2, each of the columns has been colour coded to enable comparisons of spine reading along the same axis at each reading from thin to middle to thick end of the shaft.

With one anomaly, No. 3, none of the shafts decreased in spine reading as the shaft diameter increased along any axis. What was noticeable was the overall consistency of spine, not only along each axis, but across axes. Four of the twelve tested shafts fell outside the majority and into the nominal spine grouping, but the rest went into one grading higher.

No. 3 was the only shaft which actually weakened toward the thicker end. Its negative Centre of Balance (Table 3) suggesting a possible decrease in wall thickness.

Closer matching could be obtained by the simple expedient of cutting to length from either end depending upon what spine grading was desirable. And because the average mass of these shafts falls within a fairly narrow range which is remarkable for a natural material, it is anticipated that this small variation would have little actual effect on the accuracy levels of the average or even a reasonably good archer.

Straightness

In Table 3, the straightness of the sample shafts was tested using the spine jig as an oscillometer. Each shaft was loaded onto the jig at each of the three positions used to test spine and rotated a full 360^0 with the shaft resting in the normal position on the pointer arm. In this position, the amount of oscillation was observed as movement on the dial over a range of thousandths of an inch. The dial face is calibrated in increments of 10 thou.

It can be seen that all of the sampled shafts is out of straight by up to a maximum of 80 thou at the small end of shaft No 3, and a minimum of 10 thou in the middle of shaft No 9. Overall, oscillation ranges within 50 thou at all positions on these shafts, which is remarkably consistent for a natural material presumably factory straightened. This equates with very high standards of straightness in very high quality finished arrows which this tester has examined under the criteria for the Arrow Craftsman and Master Fletcher awards at the old Australian Longbow Musters.

Mass

Of the twelve shafts tested, eight were within a 36 grain spread and 10 were within a 70 grain spread. Two of the shafts tested well out of the middle bunch by 30 grains at either end at 470 grains (No11) and 610 grains (No12).

All the remaining ten ranged from a low of 502 grains up to a maximum of 572 grains.

To put this spread of mass in perspective, this tester's batch of 6 Rudderbows bamboo arrows (one of which is now broken) with 125 grain field points ranges from a low of 432 grains to a maximum of 549 grains (a spread of 117 grains) will shoot into an average dinner plate circle at a measured 40m using a point-on aiming method. The centre of the group is close to 30cm below the aim point.

At hunting ranges from 15m to 20m, groups shrink to tennis ball size but strike much higher of course. (I did not think to measure the amount of rise and actual group diameters at the time because I did not anticipate writing this review back then.)

Centre of balance
Preponderantly, the centre of balance of the tested shafts was toward the larger diameter end within a range of 17mm to 25mm ahead of the exact centre of the shafts with one whopper going 40mm ahead but two shafts going toward the smaller end by 10 and 15mm. This is consistent with the normal tapering found in bamboo shafts.

Inherent in these shafts therefore is some degree of Forward of Centre. However, because of the distribution of mass over the length of these shafts because of the inherent taper, it would be difficult to make use of this effect in predicting where to cut the shafts in order to maximise this effect.

However, having said that, wherever these shafts are cut, there will be SOME degree of inherent FoC effect.

Roll test
In addition to the straightness test done in Table 3, all of the supplied shafts (except for the one which was broken) were removed from the delivery package and rolled across a flat table top as a simplified straightness test.

All of them rolled easily across a 200mm or so surface with a light flick of the finger. Seven of these shafts were observed to have a more noticeable oscillation than the rest when rolled, but still rolled easily.

When examined visually for straightness, all had some degree of very minor warping along their full length, but the warping appeared to revolve around a central axis which put each end and the middle of the shaft in a straight alignment. It was assessed that this was responsible for the ease with which the shafts were able to roll across the flat surface.

This level of warping is observed on the made-up arrows from Rudderbows referred to earlier. Those arrows fly as straight and true as any milled shaft used by this tester.

Durability
No durability testing was done as no completed arrows have been made from the supplied batch at the stage of this review.

Rudderbows reports on one of its YouTube videos that bamboo arrows are very resistant to breakage including when an shot animal rolls over on them or when it (Texas boar) runs off through the brush after a hit and you can hear the shaft clacking on the brush as it runs off, ostensibly it appears, to be recovered undamaged later.

Point and nock tapering
Once again on one of the Rudderbows YouTube videos on bamboo arrow making, the problem of hollow centres is easily overcome by the simple expedient of gluing a short length of bamboo kebab stick into the hollow after the shaft is cut to length and then tapered as usual.

Review summary
Following Jeffro's and Longbowinfected's comments on these bamboo shafts, I also decided to purchase some from the Chinese maker – Tiger brand. My order was placed on the 27th of December and they arrived yesterday, the 5th of January – 9 days.

The shafts were ordered via EBay and sold by one Mr Ting Shi whose email address is - Mr Ting Shi <stmm1968@yahoo.com.cn>

The URL to the Ebay site where these shafts can be purchased is http://stores.ebay.com.au/first-bird-bamboo-crafts?_trksid=p4340.l2563

As promised, the following is my review of these shafts.

Following the purchase of six bamboo shafted arrows from Rudderbows Archery in the US, and being rather pleased with their performance at the rather extended range of 40 metres in my backyard, I was interested to try making my own bamboo-shafted arrows.

Jeffro's thread "Bamboo arrows" in Traditional Crafts pages of Ozbow gave me the opportunity. I took a chance and purchased 100 shafts, 12 of which were the subject of this review.

The testing conducted showed that these shafts were remarkably consistent in spine, straightness and mass, although they tended to be one spine grading higher than marked.

However, if the data on spine rating in Table 2 is examined, it can be seen that if one were to cut shafts to length from the smaller diameter end, one could effectively go down one spine grading, or very close to it, whilst cutting to length from the larger diameter end could result in one grading higher spine.

Average straightness was within 50 thou of oscillation on a spine jig, which is very good indeed, and all of them rolled easily across a flat tabletop.

From the odour, the finish seemed to be some kind of semi-gloss lacquer which was very well applied with no observable runs or drips. Only one of the shafts had any observable damage and that consisted of a 2/3 circumferential crack near a dog-leg bend close to a node. It broke when subjected to bending and was discarded.

Thicknesses at each of the three points of measurement shown in Table 1 tended to be within 0.1 of a millimetre because natural shafts are not round. Unless this degree of 'out-of-roundness' results in such uneven mass distribution across the width of the shaft that it affects arrow flight, the tester finds no reason to be concerned about this phenomenon. It would be a remarkable archer indeed who could demonstrate such an effect from this degree of variability.

The average spine rating fell within a small range with one third of the tested shafts at nominal spine and the rest to one grade higher with the practical possibility that because these shafts are so long, simply by cutting to length from either end, closer spine matches could be achieved.

Overcoming the hollow tube problem for tapering for points and nocks, after cutting to length, just glue a short length of bamboo kebab stick into the hollow and taper as normal.

Elasticity

At a future time, a simple elasticity test will be carried out comparing a batch of good quality Port Orford cedar shafts of similar spine rating against the tested batch above.

The test will comprise hanging a yet-to-be-determined weight centrally from each shaft at rotations of 90 degrees over a set time and measuring the amount of set taken by each shaft after that time elapsed.

By rotating both the bamboo shafts and the POC shafts will allow for differences in elasticity due to grain orientation and hopefully preclude some inherent advantage of the bamboo shafts with their lack of growth rings and uncut full-length fibres.

Each shaft will be rested between measurements while all the other shafts are similarly tested, so No. 1 shaft will be tested a 0^0 then rested whilst No2 shaft is tested right through to No12 shaft.

Then No1 shaft of the POC sample will be tested similarly.

Following testing of all the POC shafts from No1 to No12, No2 of the bamboo shafts will be tested, and so on right through the range. All shafts will be allowed substantial recovery time from the bending test.

It is hoped that this test will give some idea of the resilience of bamboo shafts against paradox bending compared to an archery standard in arrow shaft material (POC) and show whether there may be any particular benefit in preferring bamboo to other arrow shaft materials.