Fellow Villagers,

Last night's discussion about the various aspects of arrows got me to thinking of a conversation I had with Rick McKinney at last year's National Outdoor Target Championship. Rick does a lot of work with Carbon Tech and Win&Win, not to mention all his Olmpic and World Championship awards, so I regard him as an archery expert. The Carbon Tech Arrows site was down, but here's a pasted copy of the article Rick McKinney did years ago.

Arrow Spine, Weight and Straightness

Unraveling the Secrets

As many more companies are attempting to build arrow shafts it gets more and more confusing as to what makes a good arrow. Since most companies do not actually build their own arrows and others who may build arrows are not archers of any length of time, it becomes more and more critical to explain the mechanics of an arrow and why it is important to choose arrows that are truly the quality you should expect.

There are three specific areas that determine a good arrow which are spine, straightness and weight. These three items are discussed by many but it appears that they are a little misunderstood. Let's dissect each one and determine what makes them critical. Obviously, we could go further in talking about other reasons for good arrows as to surface finish, durability and ease of use (bonding adhesion and pulling out of targets), but we will stick with the areas that may be difficult to tell without the proper equipment.

Weight:*
Since weight is the easiest category for most consumers to determine accuracy of an arrow, companies focus their attention on it. Let's face it, anyone can purchase a simple grain scale and then check out the weight of each arrow. However, the weight of an arrow shaft only gives you a hazy picture at best when you have to add glues, vanes, nocks and points/broadheads. How many people weight their broadheads? Few at best. When you switch the broadheads, do you really think they are exactly the same? However, the weight of the arrow shaft is critical? To a point, yes, but if you learn to weigh the broadhead or points and the complete arrow with vanes, nocks and inserts installed, you can get a dozen arrows close to 2 grains apart with no trouble at all.

A simple test is to take the heaviest and lightest arrow in a group of 12 arrows. Without knowing which is the heaviest and which is the lightest, mark them as 1 and 2. Then go to 20 yards or even 50 if you want to and shoot them. Plot their impacts and do this about 5 or more times. Then go weigh them to determine which one is the heaviest and which is the lightest. Usually if the arrow is 7 or 8 grains difference you will probably not notice much impact difference at 50 yards, unless you are one of the top 50 archers in the world. Thus, the gimmick of weight deviation is just that, a gimmick to scare you into believing weight has a huge difference on impact. You can't even aim good enough to determine the weight differences!

Straightness:
The second most highly talked about category that many manufacturers push is straightness tolerances. It's funny that several years ago, when there were no carbon arrows, arrow straightness was constantly being drilled into our heads about how important it was to have super straight arrows. This may be true with aluminum arrows and aluminum and carbon mixed. But when it comes to all carbon arrows it is

not as factual. In the late 1980's AFC and I ran tests to determine how straight does the arrow need to be in order to carry a 3 inch group at 50 meters or 55 yards. We used a recurve, fingers with a speed of near 200 feet per second. We found that .010" T.I.R. (Total Indicator Reading) was the maximum in order to keep a 3 inch group at this distance.

Although when you spin a .010" T.I.R. arrow you would freak out, it proved to me that the impact is the key, not just physical observations. Thus, if you shoot an arrow of .005" plus/minus, you actually have a .010" T.I.R. and it will group exceptionally well. However, those 50 top archers of the world will argue on this point, and rightly so. They are the 8 hours per day training athletes and demand accuracy of the highest nature. Over 90% of the population will not even notice this deviation or I should say that they may use it as it really is, an excuse and not the real reason for poor performance!

There are many ways to determine straightness and since there is no consistency in the industry, it makes it very difficult to determine what companies are really saying in their advertising. Most give you a number but may not state that it is a T.I.R. If you see a plus or minus type statement, it means that it is half of the T.I.R. Thus a .003" plus/minus is actually a .006" T.I.R. Now you have to find out what distance do they measure this reading. Some use a 14" reading while others use 28" and anything in between, thus again you need to find out just what they are really stating. Straightness has some effect on shooting performance but not as much as one would think.

The question still comes up about why carbon straightness is not as critical as aluminum straightness. Let's look and see why aluminum straightness is so important. There is a frequency vibration occurring when launching an arrow. When you have a straight arrow, this frequency is fairly consistent and the shooting impact is very good. However, when the arrow becomes bent, the frequency of the arrow changes, thus causing the oscillation to change as well.

This causes bent arrows to not impact in the same place as straight arrows. The all carbon arrow cannot be bent. It can be bowed but not bent. A straight all carbon arrow and a bowed all carbon arrow have the same frequency. Thus, the frequency harmonics do not change and the impact of the arrow does not change. Now, can we say if an aluminum arrow is slightly bowed, would it have the same frequency as a straight one? Yes. However, bows very seldom occur in an aluminum arrow. You may even have heard some people commenting that depending on where the arrow is bent it still may fly into the group. Generally this is a "bowed" aluminum arrow. Does an aluminum/carbon arrow have the same characteristics as an all carbon or a 100% aluminum? It has more qualities as an aluminum. Thus, keep an eye on those aluminums. You can straighten the all aluminum, but it is almost impossible to straighten a carbon/aluminum by the average person.

Spine:
Spine is probably the most important part of the arrow shaft and the most ignored. I presume the main reason for this is because it is the hardest for a manufacturer to get right and keep consistent. Also, it is one that cannot be measured very easily by the average person. Let's determine what spine is and do not confuse it with spline! Spline is what the fishing industry uses in order to get sort of the "back bone" of the fishing rod.
This is sort of an overlap of material in order to get the stiffer side. Keeping this stiff side on the upper side makes it easier to handle when reeling in that big one! In archery you do not want a spline! You want an even consistent spine all the way around the shaft (circumferentially). Spine was established in modern times by Easton who uses a 29" arrow. You place this arrow on two posts measured out 28" apart. You then place a 1.94 pound weight in the middle of the shaft and measure how far the arrow shaft drops down. This gives you a static (non-moving) spine.

When an arrow is launched from a bow, the arrow flexes (dynamic spine). This flex needs to be a specific amount and stay consistent among all the arrows in order to carry a group. If the arrow flexes too much it becomes exceptionally critical. The smallest mistake made by the arrow increases substantially if the arrow is too weak.

If the arrow is too stiff it is not as critical, but does not give the best possible grouping. Thus it is far better for the arrow to be too stiff than too weak. That is why you may note that some companies fudge on the size arrow recommended towards the stiff side. This is far better than on the weak side. Since the arrow flexes upon being launched, you would want it to flex the same.

If the arrow is too stiff it will favor the left side while if the arrow is a bit weak, it favors the right side. Thus you will get lots of rights and lefts if you have lots of inconsistent spines in your arrows and that is exactly what you will get with many of the arrows on the market today. Since most of the archers do not know how to measure this spine, they are unaware of why they are not grouping so well. Also, you will note that most arrows that are sold in dozen groups, only 6 to 8 arrows will group and the rest will not. Again, this is due to the spine more than anything else. Sometimes they can get a few more arrows to group by moving the nock around the shaft a little in order to find a near correct spine.
Many companies do not keep very tight tolerances on spine consistency. This causes all types of problems for the archer and the dealer. Of course, since most archers are not very good or accurate, they do not realize that the arrow is making them look even worse than what they really are. According to tests that I have been involved with, the tighter the spine tolerances the more accurate the arrows become. Keeping them .005" plus or minus is what was set years ago with aluminum arrows and their accuracy has been proven over the years. Some companies have spine deviations of over .040" plus or minus! Thus, it would be like putting spines of a 2113, 2116 and 2119 all in one group of arrows and expect them to shoot well. It will not happen!

Part of the reason for having so many spine inconsistencies is due to the material used. Some companies look for the cheapest product they can find in order to keep costs down. This severely causes huge spine deviations. Also, how the arrow is manufactured will cause spine inconsistencies. Most companies put the spine determining material on the outside and then grind it down to get as close to the weight they can get. However, this causes spine inconsistencies and breaks down the fibers that actually determine the spine. Cutting the materials requires tremendous precision in order to get the exact spines and many companies use like a paper cutting device to get their patterns. This gives a lot of spine inconsistencies as well. It also gives them a "spline" as talked about in the above paragraph.

Now if you consider the inconsistencies of spine, the straightness factors and weight factors, you can see why there is so many discrepancies in arrow shafts. The degree of importance is determined by what material is used. With aluminum arrows, the degree of importance is straightness, spine and then weight. With all carbon it is spine, straightness and then weight. The spine of an aluminum arrow is normally very good to start with.

However, this spine breaks down over time. Depending on the wall thickness spines of an aluminum arrow can break down as fast as 10 shots! This has been proven time and again by some of the best archers world wide. Although the only American manufacturer of aluminum shafts disputes this, the "proof is in the pudding"! Top archers will replace these arrows very quickly without anyone knowing any different.

Most all carbon arrows start to loose their spine over several hundred shots due to wear. As the arrow

penetrates the target, the friction microscopically wears down the outer layer of carbon and since most companies have their spine determining layer on the outside, the spine gets weaker and weaker over time. The aluminum arrow breaks down for different reasons. The flexing of the shaft upon impact of the target, pulling the arrow out of the target and the launching of the arrow from the bow continues to flex the aluminum tube constantly and we all know what happens to metals when continuously flexing them back and forth.

Now you can understand some of the simple physics of what is happening to an arrow and why it is important to choose wisely when purchasing arrows.

I hope you all enjoyed this article. You might also want to check out a copy of Rick's excellent book from our club library, or better yet, buy a copy from Lancaster Archery or Amazon so you can mark up the good parts and reference it whenever the mood strikes you.

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