Additions for the 2nd edition of Shooting the Stickbow

Preface to the second edition

In the year that Shooting the Stickbow has been out, it has received a number of excellent reviews and compliments as well as well wishes from archers at all levels. While grateful and somewhat humbled by these, I'm even more grateful to the people who took the time to point out a number of typographical errors in the text and occasionally, the illustrations. Most of the errors were fairly commonplace and harmless, such as hyphens in the wrong place, missing words and yes, even spelling errors. Some few transpositions however, could lead to confusion if not read in context. It was also noted that some of the illustrations did not reproduce as clearly as they could have.

These "typos" were presented and corrected on the book's website, www.shootingthestickbow.com. After a while, it became clear that a revised edition was in order. Hopefully most if not all of the "typos" have been eliminated and a few of the illustrations replaced. In addition, approximately 40 pages of new material have been added to help clarify certain points and expand on a few topics. The feel and texture of the book have not changed.

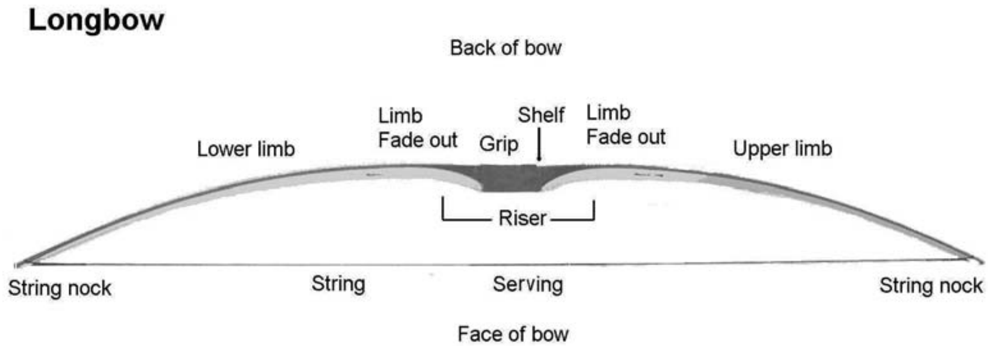
Again, I would like to thank the people who have supported me in this venture both pre and post publication and it is my hope that the material in these pages will continue to help new and even some experienced archers to more fully enjoy this sport.

All the best,
- Anthony Camera

The following are the additions and some of the typos, that in my estimation, needed correction.

Chapter 1

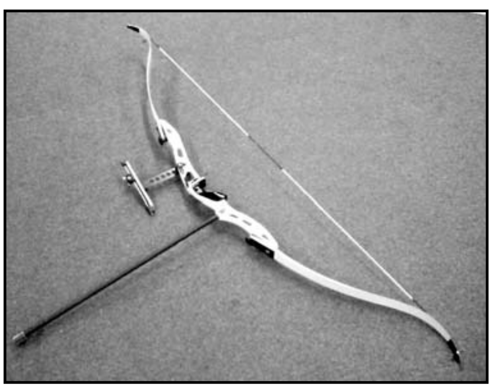
Page 3 – *This is diagram 1-1 as it should have appeared. There was an "editing error" in the illustration - can you find it?*



Page 24 – *In addition to the venerable Hoyt Gold Medalist, the KAP T-Rex and Hoyt Excel got an honorable mention:*

Viable alternatives to the venerable Hoyt Gold Medalist are the KAP T-Rex and the new Hoyt Excel riser and limbs. While aimed at entry and intermediate level target archers, they can be great starter bows or bows to return to for form practice (diags 1-28, 1-29). They both have most of the features of the higher priced models at a fraction of the cost.

1-28 T-Rex target bow with wrap around rest. This is a left-handed 66", 32# model.

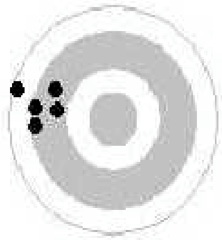


1-29 Hoyt Excel riser and limbs shown with basic target accessories.

Chapter 4

Page 58 – *There were a few additions to the things that can cause a left arrow. Here's the entire section:*

<u>Arrows grouping to the left</u> (diag 4-29)



You may not have the right arrows. An over-spined arrow will shoot left. If you believe this is the case as per the arrow/spine chart in Appendix B, then you may need weaker-spined arrows or need to tune the bow to handle the arrows (chapters 5 to 7). At this stage of your training, unless the arrows are so over-spined that they are striking the riser (you'll hear that as a definite slapping or cracking sound on release) you might not need to do anything. If the arrows are grouping well and the flight appears decent, just accept the left arrows. As we're dealing with instinctive shooting here, after enough shots, your brain should compensate and bring the arrows toward center.

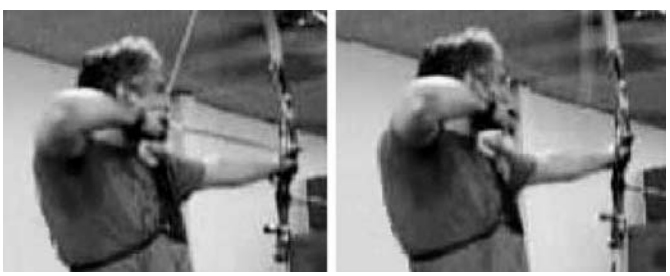
1. You're actually aiming left. A very simple way to check if you're doing this is to bore-sight or shotgun a few arrows. Draw and anchor normally, but instead of aiming as you normally do, look down the arrow shaft with your right eye (for a right-handed shooter). Make sure it's lined up with the center of the target (diag 4-30). If not, make whatever corrections are necessary. When you go back to focusing on the bullseye, your brain will correct the problem. If the arrow looks centered before the release but still impacts left, then weaker-spined arrows or different tuning is required.

2. You're cross-eye dominant. Consciously or not, you may be looking at the arrow at full draw. If you're shooting right-handed and left eye dominant, you will be holding left and hitting left. Bore-sight a few arrows, as previously described; making sure that you're bore-sighting with the eye that's over the arrow. Cross-eye dominance is discussed in the aiming section.

3. You're torquing the bow. Even if you're shooting with a completely open hand, it's possible to do a slight grab on release. Even a little thumb pressure can cause torque, and that will be enough to give you a left arrow (diag 4-31). It can happen so quickly that you may not know you're doing it, and only an experienced observer will be able to see it happening. To correct this, you'll simply need to practice shooting with a relaxed grip and not grab the bow. One thing a lot of target shooters use is some type of sling. There are finger slings, wrist slings, and slings that attach to the bow (diag 4-32a-c). These will allow you to keep an open hand and not have to worry about dropping the bow on release. Another trick is holding the bow with only the thumb and index finger, or having the tips of the thumb and index finger touching each other and curling the other fingers into the palm (diag 4-33). (If you recall, we suggested placing the arrow rest directly over the deepest part of the grip, so if the hand does torque the grip, its effect on the arrow will be minimized.)

4-30 Bore sighting an arrow for diagnostic purposes (left).
4-31 Torquing the bow grip is usually seen as the bow twisting to the left from the shooter's perspective (next right).
4-32 Slings: The three pictures on the right show a finger sling, wrist sling and bow sling
4-33 Bow grip with thumb/forefinger curled into the palm of the hand (bottom-right).

4. You're collapsing on release. If your drawing hand is moving forward, even slightly, instead of back on release, there may be a number of problems happening at the same time. If they're very minor, like torquing the bow, you might not be able to see or feel what you're doing. Again, you'll need someone to watch what you're doing and then to go back to the basics and work on the anchor position, alignment and the follow-through positions (diags 4-34 & 4-35).



4-34 & 4-35 Example of "collapsing" prior to release. Notice how the draw arm moves slightly forward just on the release.

A time-honored method for dealing with these types of form problems is "blank bale" shooting or the "watch the arrow" exercise, from the last chapter. Set yourself a few yards away from the target, and practice shooting without aiming, focusing only on the correct form and feel of the shot, or focus on the tip of the arrow as it leaves the bow.

5. You may be anchoring away from your face. By moving the rear of the arrow to the right, you are effectively moving the point of the arrow to the left. Review the diagrams in Chapter 3 and make sure your hand is solidly "anchored" against your face.

6. You may be "reverse-canting" the bow. If the top limb of the bow is tilted to the left (counterclockwise), the tip of the arrow will be displaced to the left. This is usually due to torquing (twisting) the bowstring out of alignment with the vertical axis of the bow.

7. The bowstring is hitting your clothes or chest (ouch) in the first part of its travel. Note that a slight arm guard hit or "buzz" from the bowstring will not have the same effect.

8. You may be trying to see the arrow in flight, also known as "peeking". While we're all somewhat enchanted by the magical fight of an arrow, breaking form to sneak a peek may do more harm than good. If you move your head, bow arm or any body part to give you a clearer view of the arrow, there's a chance you may be doing so before the arrow has left the string

and therefore altering the forces on the arrow. It’s imperative to stay out of the bow’s way during the entire shot sequence or until you hear the arrow hit the target.

While the effect of peeking is usually similar to a collapse, resulting in a left arrow, depending on exactly what you are doing to see the arrow, the arrow may be deflected in any number of directions.

To illustrate an extreme case, at our local indoor range we have the ability to shoot 40 yards. Since lighting isn’t the greatest, a wireless TV camera was set up so we could see the arrows in the target. It’s always interesting to see new shooters turning their heads toward the TV monitor as part of their follow-through, typically with less than stellar results!

Page 62 Thought I’d make this a little more complete:

Other indoor NFAA (National Field Archery Association) rounds

We’ve been discussing the NFAA “300” round consisting of 12 ends of 5 arrows each, shot from 10, 15 or the regulation 20 yards. These rounds are divided into three “games” of four ends each. While this might seem odd at first, it allows each game to total 100 points for a perfect score; I guess the NFAA likes nice round numbers. The “300” is a good benchmark of your shooting progress, but there are other rounds that may help your development.

In fact, there are a number of sanctioned “indoor” rounds that can be used to help hone your shooting ability. Each has its own target face or faces, but for this exercise, the ones I’ll discuss can be shot using the same 40 cm, 20 yard blue face, scored 5, 4, 3, 2, 1.

The Freeman round

This round also consists of 12 ends of 5 arrows each.

- The first game consists of three ends at 10 yards and one end at 15 yards.
- The second game consists of three ends at 15 yards and one end at 20 yards.
- The third game consists of four ends at 20 yards.

A perfect score is 300 points.

The Freeman round was discontinued as an official NFAA round in 2007, but still serves as an excellent training round for instinctive shooters.

The indoor Flint and Mini-Field rounds

Since urban archery clubs rarely had access to outdoor field ranges, the NFAA scaled down a field type match to be shot at a maximum distance of 30 yards or the more standard 20-yard indoor range. For the 30 yard course of fire, 12” targets were used at longer distances, 6” targets were used for the shorter distances, and for the 20 yard match, 8” and 6” targets. All targets were black and white and had only two scoring areas, a 5 for the bullseye and an outer 3 ring. We’ll just use the “300” blue targets, as they are readily available.

The Mini-Field consists of 14 or 15 ends of four arrows each (target size included, in case you have access to regulation faces):

Target Number	**30 Yard Flint**		**20 Yard Flint or Mini Field**	
	Distance	Target Size	Distance	Target Size
1	25 yards	12”	50 feet	8”
2	20 feet	6”	20 feet	6”
3	30 yards	12”	60 feet	8”
4	15 yards	6”	45 feet	6”
5	20 yards	12”	40 feet	8”
6	10 yards	6”	30 feet	6”
7	30, 25, 20, 15 yards (one arrow at each distance)	12”	60, 50. 40, 30 feet (one arrow at each distance)	8”
15 (optional)	30, 15 yards (two arrows at each distance)	12” at 30 yards 6” at 15 yards	60, 30 feet (two arrows at each distance)	8” at 60 feet 6” at 30 feet

Repeat ends one to seven.

Additionally, some clubs added a 15th end so the total possible score would equal 300 to match the other standard rounds. The 15th end consisted of 2 arrows at the longest distance at the large face and 2 arrows at the midpoint at the small face.

Variations on the Flint and Mini-Field courses included Hunter-type rounds using the same distances but solid black faces with white aiming dots in the center. An indoor Animal round was also used with paper animal targets, either following the above course of fire or occasionally making random distance changes to keep shooters on their toes.

By regularly shooting these rounds, the new archer quickly becomes accustomed to varying, albeit close range, distances.

Page 63 – *An additional thought on “Additional items to bring to the range”*
Most archery ranges have bow racks of one type or another. If your range is your backyard or you’re using a local field, a simple folding chair or stool may work. While it’s OK to rest a bow on end during a shooting session, resting it in a horizontal position is a bit safer.

Chapter 5

Page 67 – *Section on "To correct for a weak arrow", the last line stated*:

Therefore a 29" arrow that spines to 40# **with** spine to about 35# if cut down to 28".

And it should read:

Therefore a 29" arrow that spines to 40# will spine to about 45# if cut down to 28".

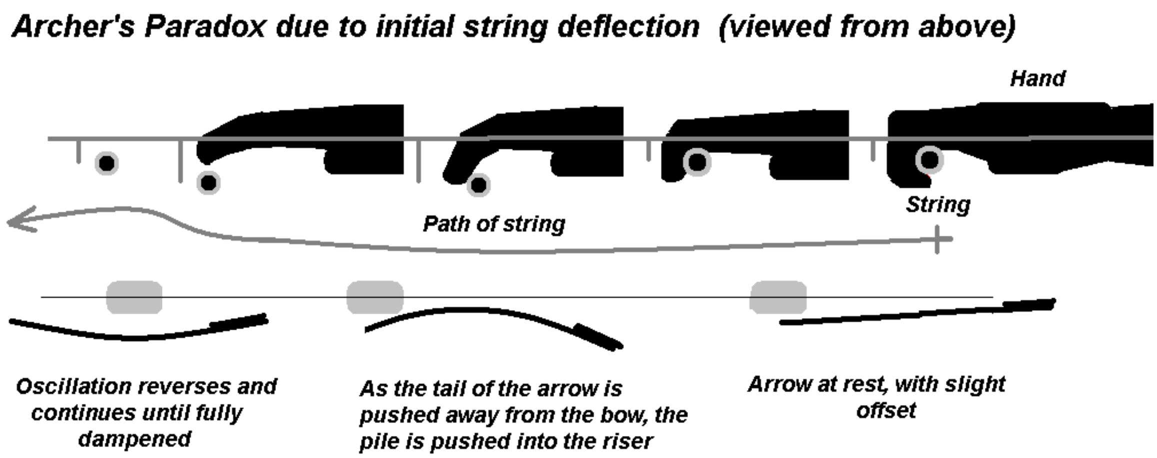
Page 71 – *Confirming tuning data*

If you know that your target media is not altering the nock kick-out, then there’s a built-in verification scheme. Nock kick-out will always be opposite to the bare shaft impact relative to the fletched shafts. For example, for a right-handed shooter, a stiff arrow will bare shaft left of the fletched arrows, but will show a right nock kick-out (the nock will be to the right of the pile). Likewise, a low nocking point will bare shaft higher than fletched arrows, but will show a low nock kick-out. If these parameters do not coincide, then either the target material is directional or there’s something else going on that needs to be resolved before trusting the data.

Chapter 6

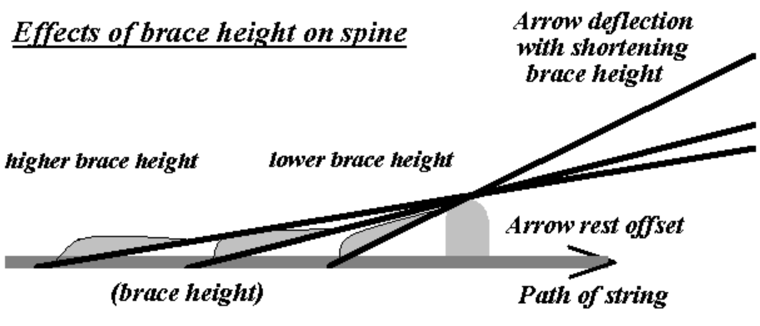
Page 75 – *The section on Paradox has been changed/enhanced slightly:*

When a bowstring is released using the fingers (as opposed to using a mechanical release device), the string must deflect around the fingertips, even though the string begins in the first joint or deeper and the release is technically clean. That deflection about the fingertips as they uncurl initiates the paradox or flexing of the arrow as it's launched, initially pushing the arrow tail end away from the riser, and therefore pushing the tip INTO the riser (diag 6-2). Unfortunately, we can't exert the same force of deflection every time. That's why we induce a buffer of sorts by positioning the arrow off center on the rest.



Page 80 – *Added a neat diagram!*

Less intuitive is that a taller brace height will WEAKEN the dynamic spine of an arrow and a shorter brace height will STIFFEN the dynamic spine. With a taller brace height, the weakening effect is due to the increased draw weight at full draw resulting in a faster initial push, and the decreased angle of offset as the arrow's nock leaves the string. The faster initial push of the bowstring causes greater flexing of the shaft and the decreased angle of offset lessens the amount the shaft needs to flex. Conversely, the decreased draw weight and increased angle of offset will STIFFEN the arrow's dynamic spine. It's a tough concept to grasp, but may be proven using the tuning methods in the previous chapter while adjusting brace heights. Diagram 6-10 to the left shows the effects of brace height in relation to arrow offset. While clearly an exaggeration, it may help to clarify the principle.



6-10 Effects of brace height on spine due to arrow offset.

Page 85 – *Mathematical typos corrected below… (You can compare these numbers with those in the book, and no, I wasn't drinking when I wrote it the first time …)*

The formula is: (BPL – OAL/2)/OAL

Where:

BPL = Balance Point Length (measured from nock groove to balance point of complete shaft)
OAL = Overall Arrow Length measured from nock groove to Back Of Point or (BOP)

Example 1: 28" arrow with a balance point 18" from the nock groove.

(BPL – OAL/2)/OAL = FOC
(18" – 28"/2)/28" = FOC
(18" – 14")/28" = FOC
FOC = 4"/28" = 14% (approximately)

Example 2: 28" arrow with a balance point 16" from the nock groove.

(BPL – OAL/2)/OAL = FOC
(16" – 28"/2)/28" = FOC
(16" – 14")/28" = FOC
FOC = 2"/28" = 7% (approximately)

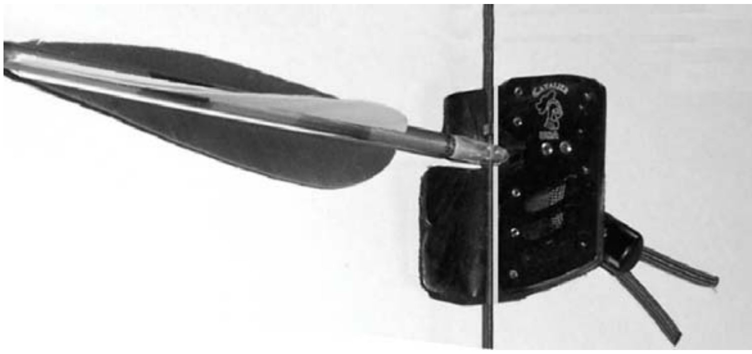
Page 86 – *Slight addition*

As you've probably already guessed, there is a point of diminishing returns. As you increase the FOC, you increase the overall weight of the arrow; not only does that yield a slower arrow, but the arrow tends to drop, or nose down faster after it's expended its energy from the bow.

Today, people are experimenting with EFOC, Extreme Front of Center, arrows using very heavy heads or weighted inserts behind the heads. As with most theories, each camp has its devotees. While experimenting with EFOC arrows sounds intriguing, it's been my experience that it's of little benefit anywhere besides in a laboratory setting.

Page 93 – *Additional "tab" stuff*

Tabs with thick metal plates



6-37 Cavalier Elite finger tab demonstrating string position butting against the back plate (Plate edge highlighted for clarity)

Olympic style shooting tabs such as the Win&Win 360 are quite popular, but many archers favor a tab such as the Cavalier Elite or similar tabs with thicker metal backing plates (diag 6-37). In addition to adding rigidity, the thick plate allows you to butt the string against the edge, ensuring constant string placement and degree of finger hook. Additionally, these tabs usually come with an optional "chin rest" or "shelf" that can give the archer a solid resting point when used with a below the chin anchor. While still used by some Olympic archers, they have pretty much fallen out of favor in recent years.

Chapter 7

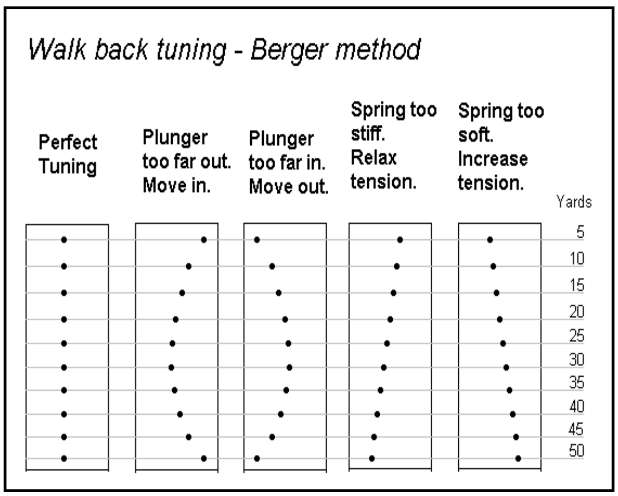
Page 99 – *Details, details …*

On plunger tuning:

While the above is the recommended procedure for cushion plunger tuning, for experienced archers I usually set the tension somewhere near the middle of its range and adjust the plunger to allow for arrow offset of 0 to 1 arrow diameters to the left of the bowstring. For new shooters, I set the plunger fairly stiff and use it as an adjustable strike plate. That removes one variable for a new shooter. Paper or bare-shaft tuning is then performed as described. While not the standard procedure, I've found it perfectly adequate for my level of shooting. Which method is right for you? That is for you to decide!

So, how do you decide it's time to start playing with spring tension? As your shooting improves and you begin extending your shooting range, you might find that slightly different settings or "tunes" are necessary for different distances. That's when it's time to start fine-tuning the plunger tension, and that's done with walk-back tuning, which I'll discuss next!

Page 100 – *Addition to walk back tuning*



7-9 Walk back tuning. These are generalized schematic patterns, yours, while similar, may not be identical. Also, expect the spacing to be farther apart at each consecutive distance.

Note that while the purpose of the exercise is to have the arrow tuned correctly at all required distances, that simply may not be possible. In that case, the archer is advised to optimally tune for the average distance he intends to shoot and accept a compromise for other distances. For example, an indoor spot shooter will optimally tune for 20 yards/18 meters, while an outdoor FITA/Olympic archer may choose to optimally tune at 70 meters.

Pages 104 to 107

<u>The bow quiver as a stabilizer</u>

In chapter 1 we briefly mention the bow quiver's use on hunting bows. Although this is not a book on bow hunting, the effects of a bow quiver are relevant to this discussion (diag 7-24).

Since the bow quiver adds weight, it can also act as a stabilizer as it increases the bow's inertia. In that regard, bow quivers can be quite effective, so much so, that I know a number of archers who always use bow quivers stuffed with the heaviest arrows they can buy when shooting at local matches. Some of these guys don't even hunt!

The other side of the coin is that since the bow quiver is typically offset to one side, the increased weight can and does increase the torque potential, especially if the archer is using a relaxed or open bow hand and a slight cant. Simply, the offset weight will cause the bow to rotate in the hand as the shot is executed.

In my younger days, I hunted one season with a Howatt Hunter, equipped with a bow quiver. It didn't have a stabilizer insert, so I used a tape-on stabilizer, similar to the one shown in diagram 7-13. Not liking the torque, I taped a second one on the side opposite the quiver to offset the weight of the quiver. The bow was nicknamed "the Obscenity" due to the number of protrusions and the camouflage bow socks (limb covers), but talk about a bow being dead in the hand!

7-24 Bear snap-on bow quiver on a 1973 Bear Super Kodiak hunting bow. Also notice that this picture clearly shows the Super Kodiak is cut slightly past center shot and despite this bow's age and considerable use, the limbs are perfectly straight (as evidenced by the bowstring perfectly bisecting the limbs and riser – look closely)!

A few additional comments on Doinkers…

There is a minor debate in some circles as to the efficiency of the vibration dampener being used at the distal end versus the proximal end as with the previous TFC configurations. Again, it will be up to the archer to determine what works best in his particular case.

…and Limbsavers

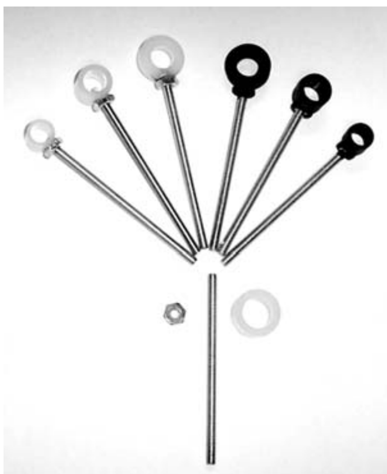
Therefore they not only reduce the vibration felt by the shooter, but may serve to deaden certain sounds the bow might make or change the frequency of the sounds. As with anything added to the string, anything added to the limbs will reduce performance. In the case of limbsavers, the farther from the fade-outs, the more dampening effect they have at the cost of performance. Maximum dampening would therefore be obtained as close to the limb tip as possible without interfering with the string on shock. The archer needs to evaluate the pluses and minuses of each change.

Page 108 – ***Just a small addition here with regard to consistent draw length (#7 if you need a hint):***

To reiterate, it is imperative that:

1. ***The anchor point is well defined and reproducible.***
2. ***The drawing arm is rotated the same degree every time.***
3. ***The bow shoulder is aligned the same way every time.***
4. ***Bow hand position must be consistent every time.***
5. ***The string grip must not only begin in the exact same position for every shot, but must either stay in the same position throughout the draw or change reproducibly every time.***
6. ***The head must remain vertical and not be craned forward to meet the string or back in an attempt to extend the draw.***
7. ***The head must have the same degree of rotation (towards the target) every time.***

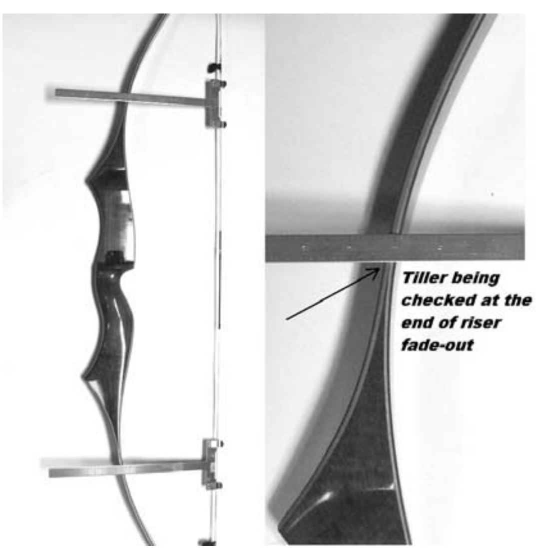
Page 112 – ***Thought you'd like to see a few homemade apertures!***



As will become readily apparent when using an aperture, the farther the sight is from the eye, the smaller the aperture will appear and vice versa. For this reason some archers are very careful about choosing the most advantageous aperture size and placing it at the correct extension point. Iris type adjustable apertures are also available in case more than one size is needed.

Finally, aperture color and configuration may need to be factored in. I find that on dark targets or at ranges with poor lighting a light colored or white aperture is easier to see. On light colored targets or in bright light conditions, dark or black apertures have an advantage. Some apertures have cross hairs or dots centered in them for greater precision. However, unless your eyesight is very good and you have a very steady hold, these are best avoided.

Page 115 – ***A note on checking the tiller on a one-piece bow.***



One-piece bows do not have tiller adjustments and tiller is created at the factory or by the bowyer. Still some folks find it necessary to check a bow's tiller. The same principles apply to wooden bows as to adjustable metal riser takedown bows. The standard measuring point is at the very end of the riser fade-out (diag 7-38a). The manufacturing standards vary from company to company and from bowyer to bowyer. Some use the brace height measured at the fade-out point plus a point midway down the length of the limb, while others may measure the brace height every few inches along the length of the limb.

7-38a Measuring tiller on a one-piece laminated bow.

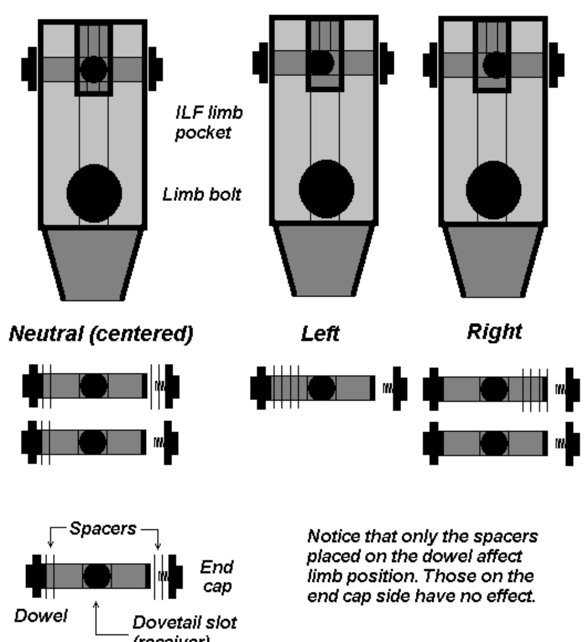
Page 115 – *Added a trick to make tiller adjustments easier.*

On Olympic style bows, tiller is adjusted by tightening or loosening the limb bolts. If the tiller of a limb needs to be shortened (made more positive), turn the LOWER limb bolt clockwise. Naturally this will slightly increase the draw weight. If you need the weight to remain the same for tuning purposes, then loosen the top limb bolt (turn counterclockwise) the same amount as you tightened the lower one.

For some reason, a lot of people, myself included, get confused over which way to turn the limb bolts to increase or decrease tiller. An easy solution is to leave the bow strung and the bow square in position as shown in diag 7-38 while tightening or loosening the bolt. Once the desired tiller and weight are achieved, remember to lock the bolts in place with the lock nuts.

And some notes on lateral limb adjustments for some ILF rigs

Lateral limb adjustments (ILF limbs)
Cast magnesium risers were fairly rigid and therefore stable with regard to torsional forces. When aluminum replaced magnesium as the material of choice for risers, the effects of torsion and therefore the idea of stress relief (both during manufacture and in use) was only partially understood. That resulted in a number of early aluminum risers coming from the factory with, or subsequently developing, longitudinal twists.



Diag 7-39

To correct this, Hoyt developed a lateral limb alignment system (diag 7-39). The purpose was to allow the shooter to correct minor riser twists by offsetting the limbs in their pockets. The system also allowed the correction of a slight limb pocket misalignment. It is important to understand that these adjustments are used *ONLY* to correct riser and/or limb pocket misalignment and not to correct for limb twist. (Limb twists will be discussed in Chapter 17.)

On risers equipped with this system, the ILF dovetail sits in a transverse mounted dowel at the distal end of the limb pocket. That dowel could be shifted laterally by the use of thin rings or spacers. If the limb does not appear to be centered in the pocket, or the limb tip deviates to one side or the other, the dowel may be adjusted in the opposite direction to compensate. As with tiller adjustments, this will be a trial and error process until the situation is resolved. With current properly manufactured risers, it should not be necessary to play with the lateral alignment dowel.

Note: a number of methods have been suggested to check for limb alignment. The simplest way to do it is with the bow strung; position yourself facing the face of the bow so the string appears to bisect both limbs and the two limb adjustment bolt back-ends. If the limbs and bolt ends are perfectly bisected, the limbs are aligned; if not, some adjustment is required.

No micrometers or lasers necessary!

To differentiate a limb alignment issue from a twisted limb, note the variance at the limb root where it exits the riser. Typically, limb twists will be more evident at the distal ends around the area of the recurves.

As stated, lateral limb adjustments should not be used to correct twisted limbs.

Page 118 Bet ya didn't think about this one?

Bare shaft shooting as a silent coach

If you recall, we said in the beginning of this section on tuning that you can tune only as well as you can shoot? Well, that hasn't changed, but you may not have thought about bare shaft shooting being used as a training aid. The reason bare shaft tuning works is because without feathers, there's little to dampen equipment or shooter error. If we assume that you've successfully tuned your bow and arrows, then the only thing left to cause an errant shot is you!

Once your shooting is fairly consistent, "bare shafting" can be used as a silent coach. By shooting a number of unfletched arrows, an archer who understands what effect specific shooting errors will have on shot placement and their angle of entry into the target, can use bare shafting to diagnose subtle form flaws. For example, an occasional bare shaft flying to the right, for a right-handed shooter, might suggest a pluck. A left bare shaft might be due to a slight torquing of the bow grip or even a collapse.

It's not uncommon for an advanced shooter to shoot entire practice matches with bare shafts. Once the bare shafts are hitting with the accuracy of the fletched ones, he knows his form is solid.

Chapter 8

Page 132 – *This is just a little rewording of the original text.*

Note: Olympic style limbs are subject to the same rules as our virtual bows. While increasing the reflex increases the performance of a given limb, it may also make the bow more critical to shoot (less forgiving to shooter error). However, it is unlikely that most shooters will be able to tell the difference, providing that the limbs have not been over-stressed.

In this chapter and in the chapter on Olympic tuning, we typically describe tiller as a measurement of limb strength, denoted by the relative brace height at the fade-outs. While the fade-out measurement is acceptable for most laminated bows, tillering may be a little more complicated when discussing selfbows, especially homemade selfbows. When a bowyer makes such a bow, he must be concerned with the tiller or flexing strength over the entire limb, meaning it must bend smoothly and progressively from riser to tip. This is accomplished by drawing the bow on a graduated tiller board and weakening any strong areas (areas with insufficient bending) by sanding or scraping. In that scenario, the tiller will need to be measured every few inches.

Before leaving this topic, a short discussion about draw weight is in order. To make a bow heavier or lighter the bowyer or manufacturer must make the limbs stronger. That is usually accomplished by increasing the width and/or thickness of the limb, assuming limb materials, amount of reflex and overall length remain constant. Increasing the width or thickness of a limb also adds mass. The additional mass can and will slow the limb's acceleration to some degree. While this can be minimized by proper design, it is still inevitable. Therefore, as draw weight increases, it is likely that efficiency will decrease. In other words, chances are very good that a 40# bow shooting a 400 grain arrow will be faster than a similarly designed 80# bow shooting an 800 grain arrow. Most bowyers know quite well what their optimum draw weight / arrow weight combination is for a given model.

Page 134 – *Decided to add something about rear mounted limbs and its most famous example:*

Another variation on the reflex/deflex idea is the rear mounted limb root. Introduced into mass production by the Wilson Brothers (Black Widow Bows) in the 1960's, setting the limb root behind the grip pivot point allowed for increased pre-load (allowing the limbs to be more fully stressed in the initial phases of the draw, and therefore maintaining stress throughout the power stroke). Its purpose was to make the draw smoother, increasing the maximum force on the arrow as long as possible while maintaining stability. The idea worked well, and is still being used today by Black Widow and several other manufacturers. However, in my testing, it was not superior to other designs of the era or those currently available. Bows of this design were available in both one piece wood and take down magnesium models, such as the model 1225 from the late 60's (diag 8-17).

8-17 Black Widow model 1225 showing rear mounted limbs on a heavy magnesium riser

Page 135 – *Details, details…*

Before we go on, a little clarification may be in order. We've been using the word stability in several different contexts. To an archer, stability has three separate and distinct meanings:

First, the bow must be stable with regard to change. That means it will not alter its shooting characteristics during a shooting session or over extended periods of time. It should also not show changes due to temperature, humidity or even exposure to light. Most modern laminated bows have this feature, but selfbows may not and that must be taken into consideration when they are used.

Second, is how stable the bow is in the hand. Does it point easily to the target and does it enhance the shooter's steadiness? Things like grip design and overall mass factor in here.

Third, is what's called torsional stability and is a feature or property of the limbs. Torsional stability in simplest terms is the limb's ability to resist twisting and therefore resist the effects of shooter errors, such as string and bow grip torque. It might seem strange that this would be the least important definition of stability, but it is because most modern laminated bows (limbs) have been designed and built with more torsional stability than most archers could ever exploit. That does not mean that all bows have this quality, but a lack of torsional stability is rare among the better limbs on the market today. When bowyers start making claims of torsional stability in their offerings, remember that with most quality limbs, most differences are minor and may only be detectable by the very best shooters in the world.

Page 137 – *Something about the thin grip thing:*

If you recall our discussion on shooting technique, grabbing the bow on release and twisting or torquing the handle usually has a negative effect on our shooting accuracy. The typical symptom is an otherwise unexplained left group or occasional unexplained left arrow for a right-handed shooter. This was considered so critical that by the 1960's some bow manufacturers designed both their metal and wood riser target bows with exceptionally small "torque-free" grip areas sometimes called broomstick grips, as seen in this Stemmler Proline Golden Eagle (diag 8-24).

Hunting bows were not immune to this trend either. The Bear Super Kodiak and Wing Archery Slimline series of bows were notable examples (diag 8-25).

8-24 The Stemmer Proline Golden Eagle sported one of the smallest grip areas on the market.

8-25 Bear Super Kodiak (left) and Wing Slimline bows (right) took advantage of the very small torque-free grip design.

Page 149 – *The section wouldn't be complete with mentioning a "Warf"!*

When is a compound not a compound?

8-41 An older Hoyt "Rambow" compound riser, Warfed to accept ILF limbs. Despite the added weight to the lower limb pocket, a short hunting stabilizer was added for even better balance.

As we discussed, decades ago the difference between a compound bow and a stickbow may simply have been what attached to the limbs. A while back a fellow named Bob Gordon out of Idaho got the bright idea of taking certain older compound risers and machining them to accept ILF limbs. The result was an inexpensive hunting or cruiser length bow with most of the shooting characteristics of a high-end target rig (diag 8-41). To expand on this idea, Bob added weight to the lower limb pocket to act as sort of a stealth stabilizer while keeping the bow legal for competitive classes that don't allow add-on stabilizers. These bows are fondly called "Warfs" and the process of creating such a bow called "Warfing", in reference to Bob's nickname (believed to be somehow related to the Star Trek character). More recently, a number of individuals have taken up "Warfing" as a part of the hobby and getting excellent results. It must be noted that not all compound risers can be successfully "Warfed", and some research needs to be done prior to undertaking such a venture.

Chapter 9

Page 153 – *This is an area of confusion and a more thorough explanation seemed in order (I repeated this in several places in the 2nd Edition):*

Note: AMO/ATA wood arrow (static) spine is the deflection caused by a 2# weight centered on a shaft supported on 26" centers (supports). This is in contrast to Easton's spine convention originally established for aluminum arrows which is based on the deflection caused by a 1.94# weight on a shaft supported on 28" centers. When comparing AMO/ATA spine deflections to aluminum or carbon spine deflections, wood will typically be about 1.25 times LESS. This means that a wood arrow will demonstrate a smaller deflection number compared to an aluminum arrow, even though the actual stiffness is the same.

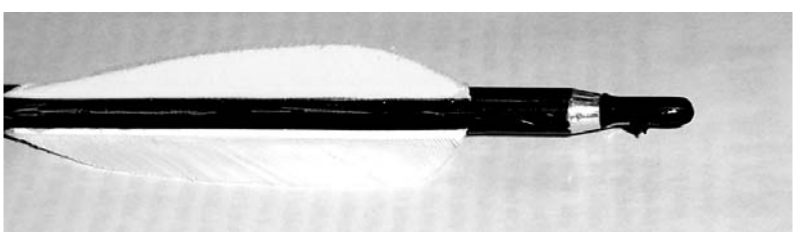
Many experienced archers who choose to shoot wood arrows buy their dowels in lots of a hundred or more, hand check each to find the dozen with the most consistent weight and spine and then confirm their finding by shot grouping in the target. Hopefully, there'll be more than a dozen in a given lot that match closely enough. Those shafts become the archer's primary or "best" arrows. Subsequent arrows are classified accordingly and any that don't make the cut are either culled out as practice arrows or simply used for firewood.

Page 164 – *And we can't forget the new nomenclature for old arrows:*

Over the last few years, Easton has begun converting to a spine nomenclature for some of their aluminum arrows. The black anodized Gamegetter XX75 shafts are now offered in 500, 400, 340 and 300 sizes, which correspond to 2016s, 2117s, 2315s and 2317s. The XX78 Superslam shafts, now called Digital Superslams, are offered in 10 sizes from a 510 (2114) to a 300 (2317). While similar to carbon shaft designations, the new designations may not provide the consumer with the same amount of information about the shaft itself.

Pages 165 and 168 – *More info on "G" (and UNI-Bushing) nocks*

Note: "G" nocks must be closely examined every time a hit is suspected. The typical damage will be a spur near the throat (diag 9-28a). In addition to weakening of the nock leading to failure, the sharp edges may eventually cut the serving or string itself. Occasionally, the entire external nock may be shot off. In that case, a screw must be turned into the remaining shank in hopes of pulling it out or the insert must be removed and the shank pushed out with a rod of appropriate size.



9-28a G nock damage with a sharp spur

Page 174 – *OK, another math mistake (How many of you caught that?)*

The most popular feather or vane shape is called "parabolic", as it describes the shape of a lop-sided parabola, a mathematical plot given by the general formula $y=x^2$ (diag 9-52). (equation reversed)

Page 177 – *Thought this might help…*

Feathers in the rain

As can be imagined, natural feathers and water do not get along very well. Water can cause feathers to matte fairly flat and add weight to the rear of the arrow. When an arrow with soaked fletching is shot, three things happen, none of which are good:

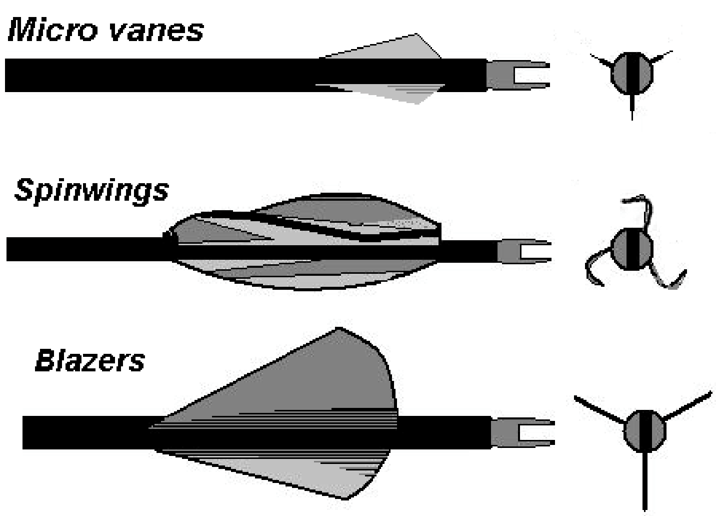
1. There is diminished steering due to the reduced air resistance
2. The dynamic spine is stiffened due to the increased weight of the water soaked feathers
3. The shooter is typically sprayed in the face with water as the arrow goes through paradox and leaves the bow

In the case of some outdoor target events which are held rain-or-shine or a long awaited hunting trip, soaked fletching can turn into a literal wet blanket.

There have been a number of products over the years that could be sprayed or sprinkled on feathers to waterproof them, but most are of limited efficacy or duration. If you believe that you will need to shoot in wet conditions, the safest bet would be have a set of arrows made with plastic vanes and tune them to shoot the same as your feather fletched ones. In some cases, using plastic vanes exclusively is a prudent option. The only requirement to consider would be an elevated rest.

Page 176 *…and just to be a little more complete:*

Plastic vanes and Olympic style archery



9-62 Small, light plastic "flight" vanes.

Spinwings and Kurly Vanes are thin Mylar vanes used in Olympic style competition.

Blazers (bottom illustration) are short, high-back stiff plastic vanes generally more suited for use with compound bows

As we noted earlier, plastic vanes are not new and are very popular with compound shooters and even some stickbow people. While standard vanes have a similar parabolic profile to feathers, several styles have appeared in recent years that are shorter in length and height and made of very light materials to decrease wind deflection and flatten trajectory. Newer additions are Kurly vanes or Spinwings. These, in addition to being very light and relatively small, have a longitudinal curl. When applied properly to barreled composite arrows, such as X10's or ACEs, they have proven to provide a distinct advantage, especially in windy conditions (diag 9-62). Blazers are light, thin, high-back vanes, not really suited for recurve or longbows due to clearance issues.

Chapter 10

Page 184 – *On fletching: Neat trick, huh?*

So you want to use glue instead of tape but are afraid of getting glue all over the clamp? Not to worry, most of us are klutzes at one time or another. A little trick is to line the jaws of the feather clamps with a single layer of masking tape, making sure you cover the edge. Do this before you start fletching and any glue that would spill onto the clamp will now be on the tape. When done, you can peel the tape off. Sure beats cleaning the glue off after it's set!

Chapter 11

Page 206 – *In the first edition, I presented the classic or textbook directions for making an Endless Loop bowstring, as it's as basic as you can get. In reality, that's not exactly how I make mine. You can save a few steps by doing it this way, and it has been changed in the 2nd Edition.*

Making your first 12-strand string

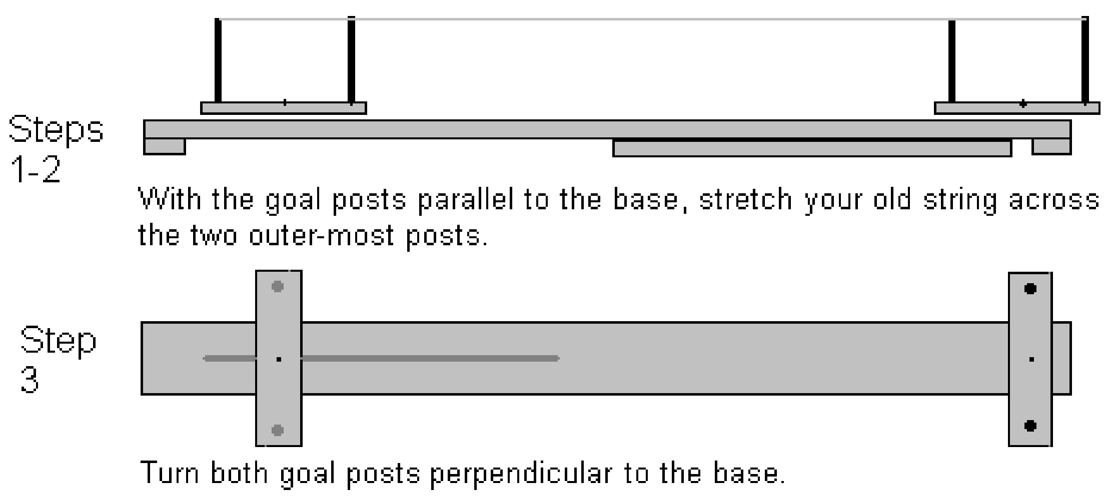
You'll need a spool of string material, a spool of serving material and a serving jig. You'll also need a pair of scissors or knife, either matches or glue (Fletch-tite), and string wax.

You can use an old string you're trying to replace as a template for a new string.

1. Loosen the nuts or wing nuts on the cross arms (goal posts) and turn them parallel to the main board.

2. Put each string loop on the screws atop the outermost vertical dowels and move the cross arm in the channel out so the string is taut. Slightly tighten the wing nuts.

3. Remove the string, and turn the cross arms so they are both perpendicular to the main board. Tighten the wing nuts.



11-17 Endless Loop string building – Steps 1 to 3

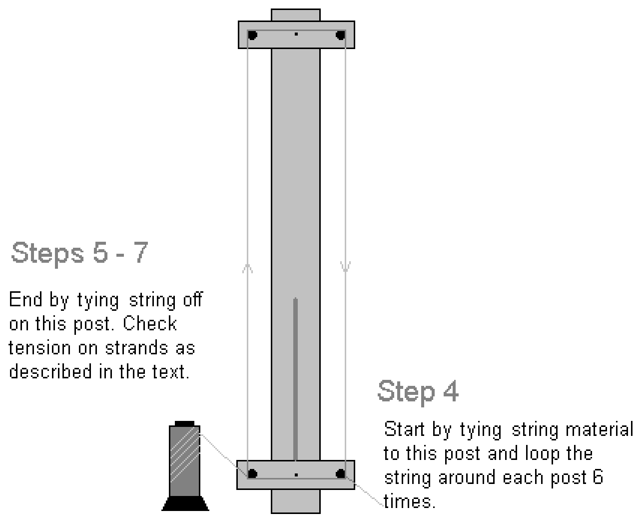
4. Stand at one end of the jig and take a spool of string material and tie it to the screw shank atop the right-hand dowel. Take the spool and bring it around the left-hand dowel screw, and then loop it clockwise around the two dowel screws on the other end.

5. Continue looping the material around each screw until you have six turns around the screw that the thread was initially tied to. The thread should be fairly taut, but not so much as to bend the jig!

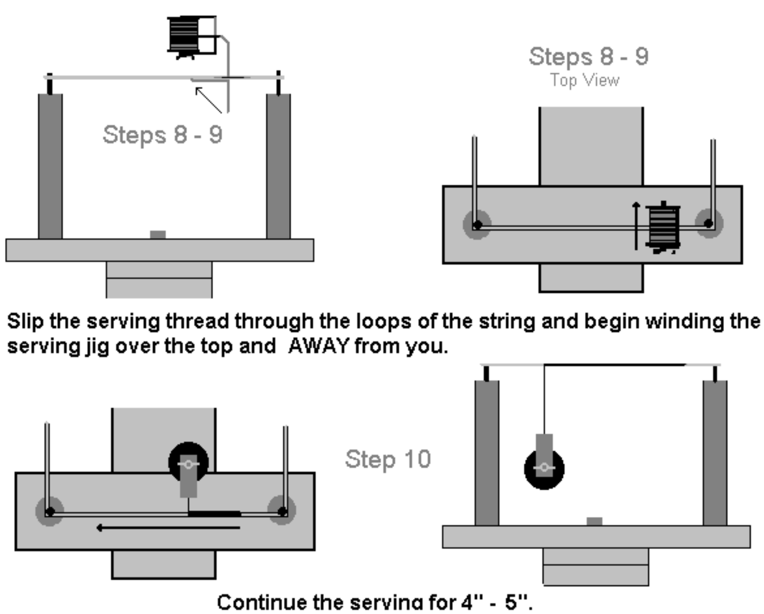
6. When the six loops are done, tie the other end of the thread to the left-hand dowel screw on the same cross arm on which you started.

7. Make sure there's fairly even tension on all the strands by "strumming" the long sections. If you see a loose strand, it can usually be fixed by pulling on each side a few times to even things out.

8. The serving jig should already be assembled with a spool of serving material. If not, assemble it as described in the instructions, which are usually quite intuitive. The tension on the serving jig should be fairly taut, but still allow the serving thread to unwind freely without binding.



11-18 Endless Loop string building – Steps 4 to 7

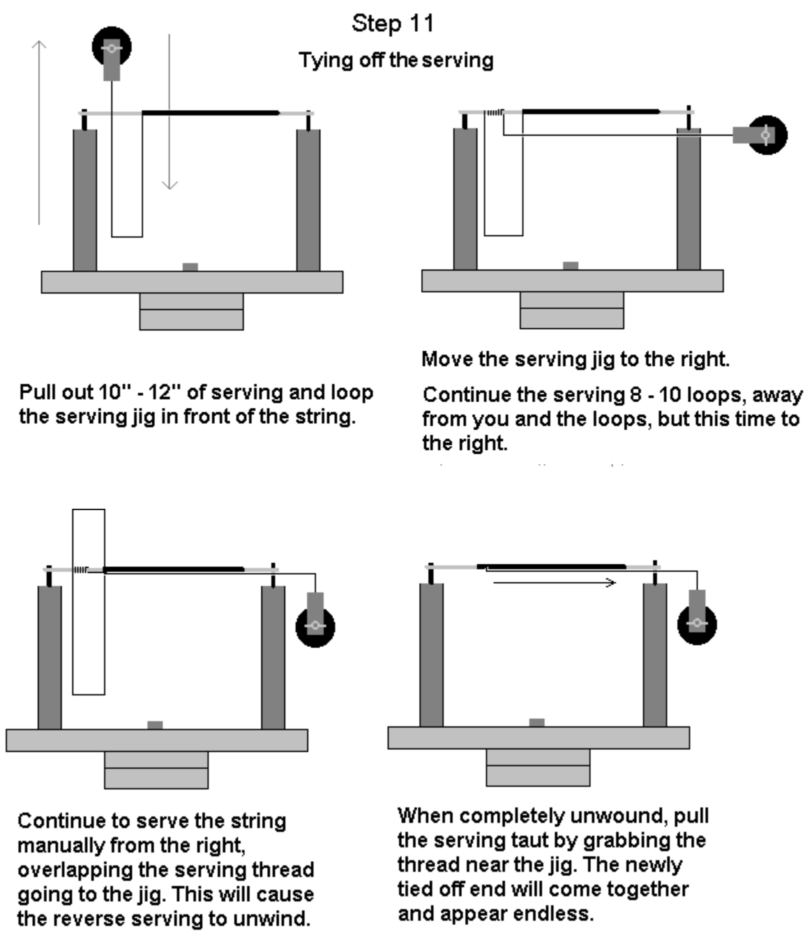


11-19 Endless Loop string building – Steps 8 to 10

9. Starting on the end of the string jig where you began and ended the loops, slide about 2” of serving material between the string strands about 2” away from the right dowel. Loop the serving jig away from you, and start winding it around the strands. Adjust the tension on the serving jig to keep the serving feeding with some resistance. How much resistance will be learned only from experience. As this is your first string, it’s time to start getting some of that experience.

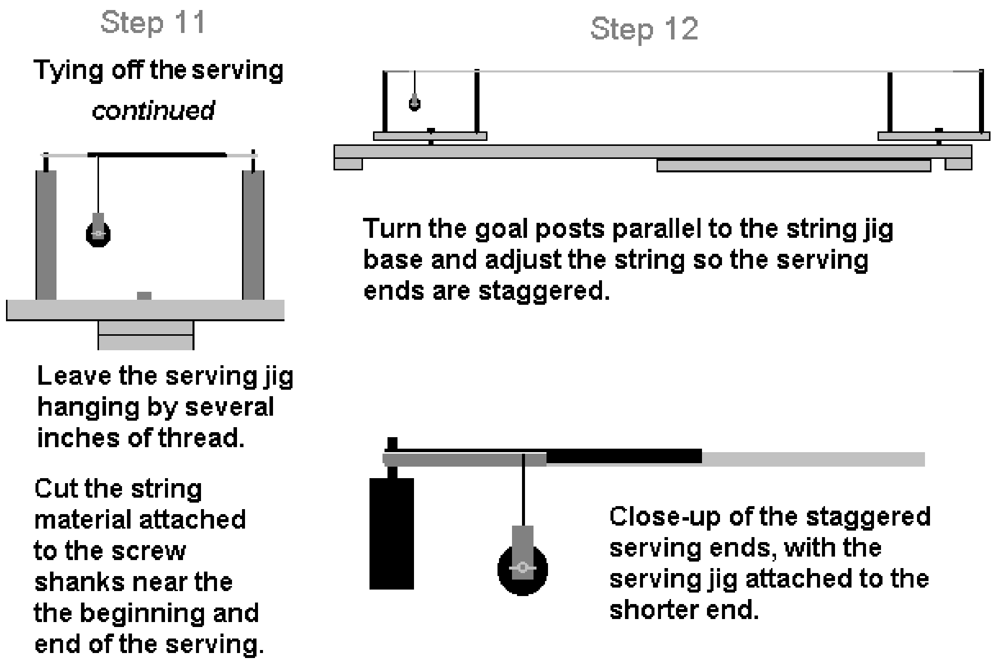
10. Continue the serving for approximately 4” to 5”.

11. Tying off the serving. After the approximate length of serving has been reached, pull out about 10” to 12” of serving thread making a very large loop. Begin serving in the same direction (away from you) but toward the previously served section. When you’ve gotten about ten loops, place the serving jig over the left dowel top and off to the side. Hold the large loop and begin turning it around the string so that it continues the main serving and unwinds the reverse loops. Do this so it overlaps the extended piece of serving thread. When the reverse section is completely unwound, pull the end of the serving (the part attached to the serving jig) taut with your right hand while pushing the far-left end toward the main serving area. Do not cut the serving, but leave the serving jig hanging by several inches. We will continue to the binding serving without interruption. Please refer to the diagrams (11-20 to 11-22); this is actually a lot easier to do than it is to describe.



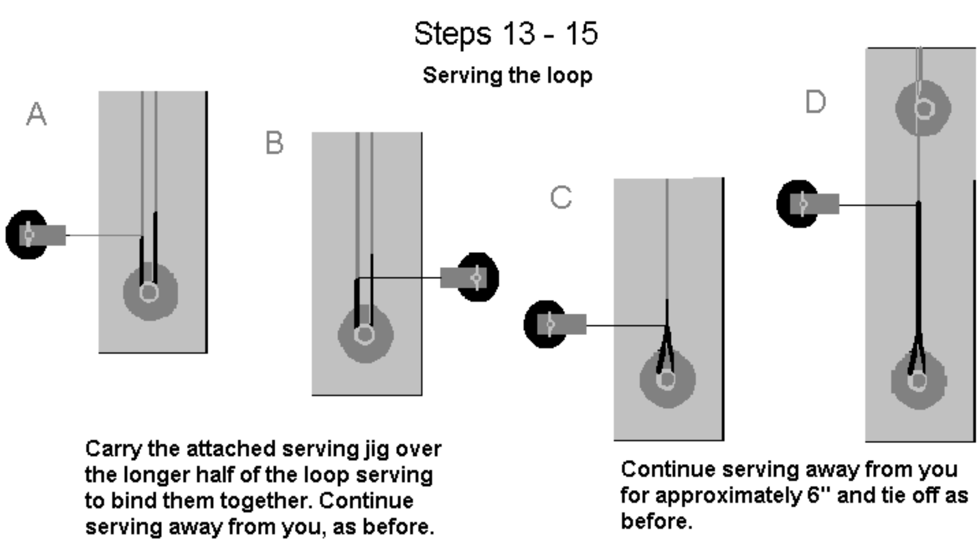
11-20 and 21 Endless Loop string building: Tying off the serving

12. Loosen the wing nuts and rotate the arms back to parallel with the main board. Slide the string around the posts so that the ends of the servings are staggered with the end attached to the serving jig about 1/2” shorter than the free end (diag 11-22).



11-22 Endless Loop string building: continued

13. Repeat the serving process to bind the loop together by rotating the serving jig away from you and continuing 5” to 6” long for a recurve and approximately 3” for a longbow (diag 11-23). This will be the upper string loop and remember that the upper string loop is usually larger than the lower. A good rule of thumb is that the upper loop should be approximately 1-1/2” to 1-3/4” in diameter and the lower about 1” to 1-1/4” for recurves and about 75% of that for longbows. The exact size will depend on the limb width of the bow for which you’re making the string. Tie off each end as before. This time, cut the serving material leaving a pigtail about 3/8” long.



11-23 Endless Loop string building – Steps 13 to 15

14. The exposed ends can be burnt or melted down with a match or lighter. A drop of glue can be used for added insurance. Neither the burn/melt down, nor the gluing, is actually necessary, but can add to the appearance and confidence you have in the finished string. Repeat the process on the opposite side. Since we've already bound one end of the string, we won't be able to adjust the loop serving to stagger the ends as we did on the first loop. Therefore, we'll need to offset the loop serving. If your goalposts are 9" apart, begin the loop serving about 2" from the right goalpost and end it about 3" from the left one. When you turn the goalpost parallel to the base to make the binding serving, the ends will be staggered!

15. Loosen the goal posts and remove the string (no, we didn't forget the center serving). String the bow and check to make sure the brace height is where you want it or slightly higher, as the string will stretch. To hasten the stretching, hold the bow with its back against your thighs, and push down on the mid/upper limb sections (diag 11-24). Letting the bow sit for a while, if possible, may also help.

11-24 Helping a newly made string "stretch".

If the string seems dry, a coat of wax can be applied to the string at this time, following the same procedure described earlier in this chapter. Some Endless Loop string makers like to wax their strings during construction, however most modern string materials are pre-waxed, so there really shouldn't be a need unless they seem unusually dry. Remember, do not wax any of the servings! (If waxed, the loop servings just look very messy and the center serving will get wax on your tab or glove.) We'll see in the next section that Flemish Splice strings actually do require waxing during construction.

16. The center serving is applied with the string on the bow! Find the approximate point on the string where the nocking point is to be placed. Start the center serving about 1-1/2" to 2" above that and continue until you're slightly past the grip of the bow, or as long as you feel is necessary. Tie off as we did for the other servings. (The reason the standard length for center servings is just below the grip is so the serving protects the string material from arm guard strikes.) We didn't put the center serving on while the string was on the jig, because most Endless Loop string jigs cannot stretch the string as a bow can. Since the center serving is usually the longest serving on the bow, if the string were to stretch under the serving, the serving would start to separate (diag 11-25).

Chapter 12

Page 221 – 222 – *Regarding eye dominance…*

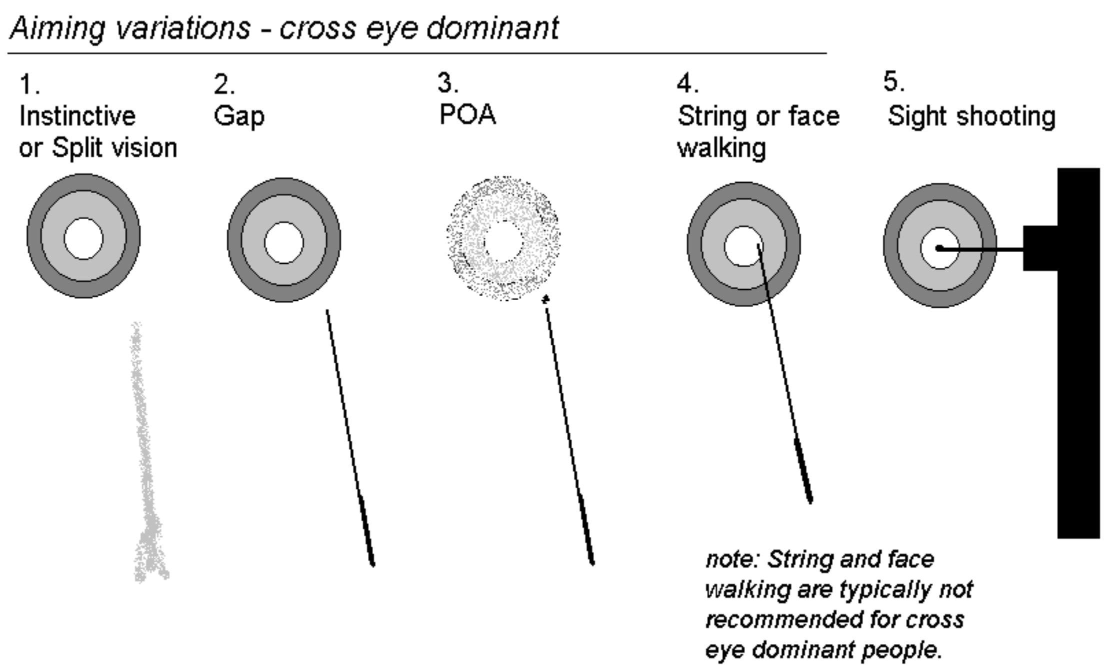
Got it? Good. Now forget it!

There are two exceptions that need to be mentioned. When working with new shooters, especially with children, we sometimes see that they actively try to "aim" by looking down the arrow. This is natural, but can cause problems in a cross eye dominant individual. For right-handed shooters, the arrows will impact far left of the target. If your efforts to persuade them to focus on the target and not the arrow fail, they should consider switching hands. A good instructor should be able to pick up on that fairly quickly and suggest the change before too many bad habits develop, and the new shooter loses interest. If a new right-handed shooter is using a bow sight and the sight appears to be set up correctly but the arrows are impacting far left, or the sight must be placed much farther left than usual, it's very likely he is sighting with the wrong eye. To confirm this, tape the left eye closed with a piece of masking or Scotch tape. If that solves the problem, the shooter or instructor will need to consider switching hands.

The second thing that must be considered is "eye vs. hand dominance". Some people are very strongly "eyed" or "handed". Even a severely left eye dominant person may not be able to or comfortable shooting a left-handed bow or vice versa. In that case, it's best to work with the more dominant hand and let the brain handle the offset angles. Again, while being same side dominant is a plus, other factors need to be considered.

An interesting note about children and eye dominance. Until six to ten years of age, some children can change eye dominance, almost at will, especially if visual acuity is similar in both eyes. While that may be possible in certain adults with equal acuity, it's highly unlikely unless the individual is very determined – I've certainly never seen it happen.

Page 223 – *This is diagram 12-3 (lower part) as it should have appeared; target 3 (POA) should have been grayed out.*



Page 228 – *The aiming-off exercise (think you'll like this one):*

An exercise that can certainly be used with any aiming system, but of particular importance in instinctive aiming, is being able to hold or aim off. When aiming at a paper target, we are naturally drawn to the center or bullseye. Once you have the ability to focus on a spot or superimpose one on your target, the next thing to try is to pick a spot "off center" and hit that! On paper targets, you can use a corner or part of a scoring ring. For example, instead of using the bullseye, aim for 12 o'clock in the three ring, or 3 o'clock in the one ring. One thing I like to do is deliberately string a number of arrows from left to right or top to bottom on a given target, putting one arrow in each scoring ring. No, you won't be winning any matches that way, but you will be training yourself to lock onto what you want to hit and not be distracted by other objects that may be nearby. For bowhunters, it may mean the difference between a clean hit and having to look for an arrow that glanced off a branch that was in your field of view and stole your focus.

Page 232 *…and something else to think about:*

String walking and tuning

If you recall, we said that nocking point placement is a function of tiller and tiller is a function of relative limb strength and a number of other factors. One of those factors is the position of the fingers on the string. When shifting finger position, you are effectively changing the tune of the bow. Therefore, the bow will not (cannot) be properly tuned for every distance when string walking. Most string walkers tune their rigs for the average distance and related finger position they will be shooting. Given the advantages of string walking as an aiming tool, the slight tuning imperfections are accepted.

Page 238 *…OK, one more thing!*

The sight as a range finder

Earlier we discussed ranging or range estimations with regard to aiming. While electronic devices are becoming more and more popular, some of us have resisted the urge to purchase one, or in my case, are simply too cheap to buy one! The fact is, by using a sight you have a built-in rangefinder that can be used very effectively for training purposes.

If you have accurate sight markings for 10, 20, 30 and 40 yards, for example, all you have to do is use the sight to confirm your range estimates! Walk into a field that is safe to shoot in, and set up a target (or pick a safe target that may already be there, such as a bale of hale, tree stump, etc.) Guesstimate the distance and use that sight setting. If you feel you've made a good shot and the arrow hits its mark, you've guessed correctly. If the arrow lands high, you were closer than you thought, if lower, farther away. If your arrow hits left or right, you might need to check your shooting form. In addition to pure range estimation, this exercise can show you how light and terrain can affect your ability to judge distance. I'll give a few simple examples shortly.

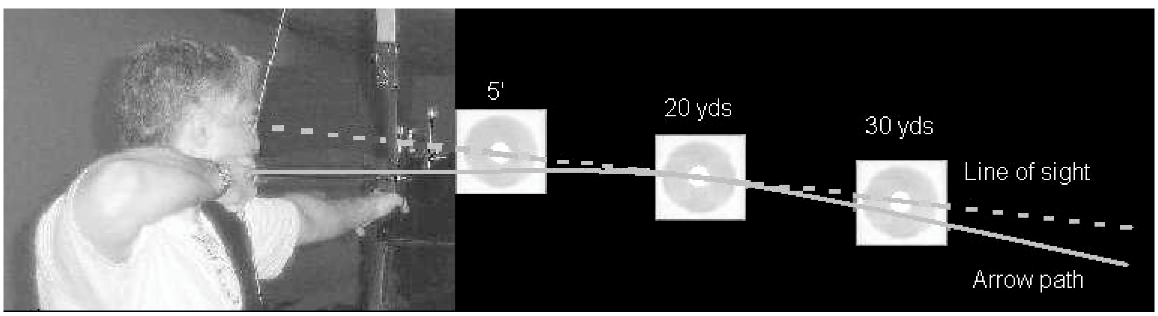
A variation on this, useful for bow hunters, is to find out exactly how far off their range estimation can be and still make an effective shot. Using a life-sized animal target, shoot a group of arrows into the center of the vital area from a given distance using the correct sight pin or marking. For example, use a 20 yard pin at a target exactly 20 yards away. Repeat the exercise, but walk a yard or two closer and see how much higher the arrow lands. Repeat the exercise again, but this time, walk a yard or two farther away. Doing this exercise at several known distances will give you a very good idea of exactly what your "margin of error" is for range estimation.

Page 240 – *Trick question concerning the use of sights and a lesson in sight trajectory*

Let's say you are using a bow sight and have markings for 10, 20, 30, 40 and 50 yards. You need to take a shot at a target between 5 and 10 feet from your shooting position. Which sight mark do you use?

Pretty simple – you would just estimate a mark a little higher than your 10-yard (30') setting and let 'er rip. Easy shot, right? At 5', the odds are you're not going to be that far off, but on a target, you might hit a lot lower than you'd imagine. The actual sight mark you'd need to use will be somewhere between your 20 and 40 setting, on average. Huh???

Let's think about it. If you refer back to diagram 12-21, you'll see that your line of sight and the path of the arrow coincide at the point of impact. If we expand the picture to include both very close and longer range shots, things get interesting (diagram 12-38). Notice that at distances farther than the zero point the arrow path is below the point of impact, due to the effect of gravity, pretty much as expected. Now it becomes apparent that when shooting at close distances, the arrow path is still below the point of impact. The reason is because at closer distances the arrows path or arc hasn't reached the level of your line of sight! At anchor, the tail of the arrow is between 3" and 5" below the eye, depending on the size of your face and the anchor you use. (Naturally, if you were sighted in for 40 yards, for example, the path of the arrow would carry it over the line of sight, and hit high if the point of impact were closer.) In the next section on uphill and downhill shots, we'll see a special case where this must be taken into consideration.



12-38 Arrow path vs. line of sight

What about using a sight and taking a shot straight down? If you're a bow hunter shooting from a tree stand, it's possible that a deer (or bear) may wind up right under your tree. While it might have been better to take the shot before he got there, or possibly wait until he moves a bit farther away (shots through the back of an animal are tricky at best), sometimes things happen!

Referring back to diagram 12-38 and noting that the arc of the arrow is due to gravity, then we see that a straight down shot follows the same laws of Physics as a very close shot. Your sight setting would be somewhere between your normal 20 and 40-yard setting. The only way to know for sure is to try it. The difference won't mean a complete miss, but a few inches either way can mean the difference between a quick kill and a wounded animal.

To complicate matters even more, if the winds are very strong or have severe gusts, then the above weather vane theory may only hold to a degree, or even not at all. Yes, with very strong or gusting winds it is possible that the arrow will be pushed in the direction the wind is blowing. This may be more of a possibility when very small target fletching is used.

Chapter 13

Page 253 – *Just an additional note on breathing*

There's an added benefit to this breathing pattern for those using a clicker. We mentioned earlier that once you've gotten used to it, you should be within a millimeter or two of pulling through when fully anchored. With this type of breathing pattern, the slight expansion of the rib cage (due to the inhalation) may be all you need to effortlessly break the clicker.

Chapter 14

Page 255 – *Thought this chapter needed a little more of an intro:*

Variations in Technique

When we began our journey into the world of archery, we made the rules very specific and allowed little room for variation. That was necessary to develop good shooting form and a strong foundation. While most top archers share the same fundamentals and technique their physical differences and idiosyncrasies will dictate variations in form. Those variations will remain bio-mechanically sound and can be called the archer's individual style. The following is a brief review of some variations and their implications.

A brief background on "form"

Once the basic shooting techniques have been learned, there's a split second during your shot sequence that will mean the difference between hitting your target and missing it. That split second is the instant you begin the release. For most of us, the bows we use are stronger, faster and in some cases, smarter than we are! As the string leaves the fingers a series of actions and reactions take place, which are beyond our control. Anything we try to do during that split second will only get in the way of the shot – and cause it to miss its mark.

The only way we can allow those actions and reactions to be consistent and therefore result in consistent arrow flight is by setting up the forces acting on the arrow as it leaves the bow before we release the arrow. That set up has to be the same way every time. That's the meaning and purpose of form. Without that level of consistency, aiming, range and wind estimation become meaningless, as the arrow will always be pushed off course by those errant forces.

Since the bow can and does react faster than we can, our job is not to get in its way.

Over the years archery coaches and instructors have developed a general shooting protocol that allows an archer to make consistently accurate shots by doing as little work as possible. The less work the archer does, the better the chances are that he won't get in the way. That's the essence of form. Clearly different body types will require variations in that basic form, but the salient features, once developed, will be remarkably similar, even when comparing vastly different body types.

Page 256 – *Another neat trick…*

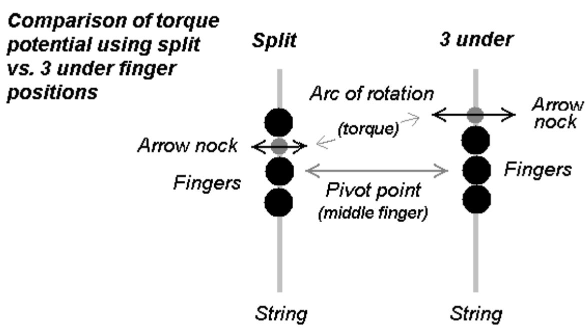
The natural point of aim and shooting in the wind

We previously discussed the effect of wind on arrows. The ability to check and correct the natural point of aim may also be used to counter the effects of a light and steady wind on the shooter as well. For a right-handed shooter, if the wind is causing you, or rather your bow to move to the left, slightly closing the stance, forcing the bow to the right, may bring the bow back to center. Conversely, if the wind is moving your bow to the right, opening the stance may correct the problem. As before, if you are really being buffeted, discretion may be the better form of valor and terminating the session the best idea. Again, only you can make that determination based on your experiences.

Page 260
…and one more:

To find out if you are canting correctly, draw and anchor with the bow perfectly vertical and check or have some one measure your draw length. Repeat with the bow canted. If your draw length hasn't changed, you're doing it right. If it's shortened, you may need to rethink what you are doing.

Page 268 – This might be a little controversial… *(hehehehe)*



14-25a Torque potential for spilt vs. three under.

From a physical standpoint, three under may increase the torque potential the shooter has on the string. Since most people center their drawing force near their middle fingers, that finger becomes the pivot point of string torque. The farther the arrow nock is away from the pivot point, the greater the effects of torquing the string (diag 14-25a). While it's generally a good idea not to torque the string at all, most of us do at one time or another.

Two fingers under or split

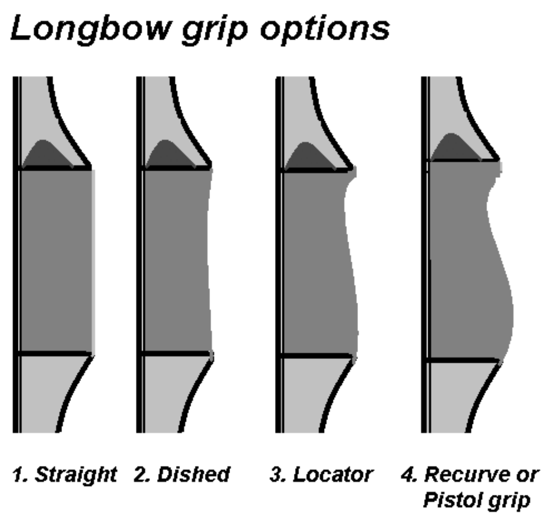
Some people believe that using only two fingers on the string gives them a better release. Unfortunately, that's not usually the case and probably is best avoided for several reasons. The most obvious is that some percentage of strength is lost; not so obvious is that it may increase the possibility of torquing the string. You can try this for yourself. Use a three-finger grip on the string and try to twist your hand clockwise and counterclockwise. Its rotation is somewhat limited. Repeat the exercise with a two-finger grip and notice how much more it can rotate. If we had super-human strength, the three-finger grip could cause a greater torque potential, but since that's not the case (for most of us anyway), it's pretty clear which can do the most harm. As we said earlier, the exact weight distribution on the fingers is not critical, as long as it remains constant from shot to shot.

Page 270 – *More "stuff" on shooting a longbow*

Special Considerations for people shooting a "classic longbow"

We discussed earlier that a recurve has several advantages over a longbow for a new shooter. Most people with an interest in classical archery, however, at one time or another may feel a need or desire to try a longbow. While the principles of shooting either bow are very similar, there are a few variations that need to be considered.

Note that we are talking about the classic "D" shaped or "Hill" style longbow, with a relatively straight grip (diag 14-28), mildly reflexed limbs and a typical length of 66" to 70". Current longbow variants may be quite short, have reflexed/deflexed limbs, pistol grips and sight windows very similar to recurves. Some even have weighted risers for added stability or carbon foam limbs for increased performance. Those types of bows are virtually indistinguishable from modern recurves and may be regarded as such.



14-28 Longbow grip options, from left to right, the straight, dished, locator and full pistol (recurve) grip.

The first thing that you'll notice with a classic longbow is the lightness of the bow in your hand. While a great feature for carrying the bow, the lack of mass and therefore inertia may detract from the stability of the shot, especially at the higher draw weights. The design of the bow can add or replace that stability and make up for the loss of inertia; a lot of archers appreciate a little heft in the hand to help steady the aim and absorb vibration on shock.

The real difference between shooting a recurve and a longbow is the grip. A straight grip longbow riser doesn't fit the hand as well as a contoured pistol grip. The edge or face of the grip will still be resting along your hand's lifeline, but by necessity you'll be using more of a low or slightly heeled grip, sometimes called a "broken wrist" grip. Howard Hill stated that the straight grip should be held as if you were holding a heavy suitcase, meaning the fingers should be comfortably wrapped around the grip but not squeezing or strangling it – still pretty good advice. It will also become apparent that a very relaxed or open bow hand will be impossible. Without the rearward projection of the shelf, an open grip will allow the bow to slip from your hand on release. Volumes have and still are being written about the proper way to "hold" a Hill style, straight or slightly dished grip longbow. Even some of Hill's writings are under constant debate. In my experience with these bows, they bear a remarkable similarity to any other bow as regards hand position.

Rather than rehash what has been written and is readily available elsewhere, I think a conversation I had a few years ago with a new Hill bow shooter sums it up quite well.

A friend of mine came into the range with a new Hill longbow in hand and not the happiest of looks on his face. He said he expected some hand shock, but this was a bit much. (He had been shooting it for about a week.) I looked at the bow and shot it a few times. It appeared to have the correct string and brace height and the arrows were fairly well matched. I didn't notice any more hand shock than expected. Several weeks later, after reading a number of things about how the bow was to be shot "correctly", he proclaimed that by changing his grip, the hand shock disappeared! After watching him shoot for a while, I asked him to revert back to his original method of gripping the bow. He complied and I asked how the hand shock was. All I got back was a blank stare. Apparently the hand shock was still gone, even with the presumed incorrect grip! It didn't take a Sherlock Holmes to figure out what had happened. While there indeed may be better or worse ways to grip a longbow, most people can adapt to the hand shock, given enough time. Sometimes all that's needed are enough arrows down range just to get used to a new bow and its idiosyncrasies. When I shot the bow, I knew there'd be some hand shock; I was used to it and accepted it, so there was no problem.

OK, there is a catch. You really have to shoot the Hill style bows exclusively to get used to them. If you jump back and forth between a Hill and a recurve in the first few weeks, you'll never get used to the hand shock, as you'll have the reduced hand shock of the recurve as a handy comparison.

While anecdotal, it might be worth remembering the next time someone tells you exactly how a certain bow needs to be shot.

Given the longbow's short brace height or fistmele, keeping the grip centered along the bow hand's lifeline and the elbow of the bow arm rotated clockwise becomes of greater importance to keep the lower forearm out of the path of the bow string. A slightly open stance may also help protect the bow arm, but there is room for variation. It's also acceptable to use a slightly higher brace height than expected for a straight-limbed longbow.

Since a low, heeled grip is typical, some people believe that the archer's draw length may be significantly shortened. Even if the wrist is in a fully broken position, as in diagram 14-29, the draw length should not diminish by more than a half inch.

Longbows are tuned using the same principles as any other bow. However, it must be remembered that classic longbows are typically not cut anywhere near center shot. That typically requires an arrow five to ten pounds weaker than would be required for a recurve of equal draw weight. Shooting off a small shelf or rather a ledge may require a slightly higher nocking point.

Most longbowmen shoot with a slight cant. There are several reasons for this. First, without an arrow rest, slightly canting the bow helps keep the arrow on the narrow shelf before the draw has progressed to uncurl the fingers sufficiently to begin pushing the arrow into the riser. As most longbows of this design do not have true sight windows, the cant gets the riser out of the archer's line of sight and thus provides a better view of the target. As with the recurve, the bow arm should be fully extended (but not locked) at the elbow and pointed toward the target prior to commencing the draw.

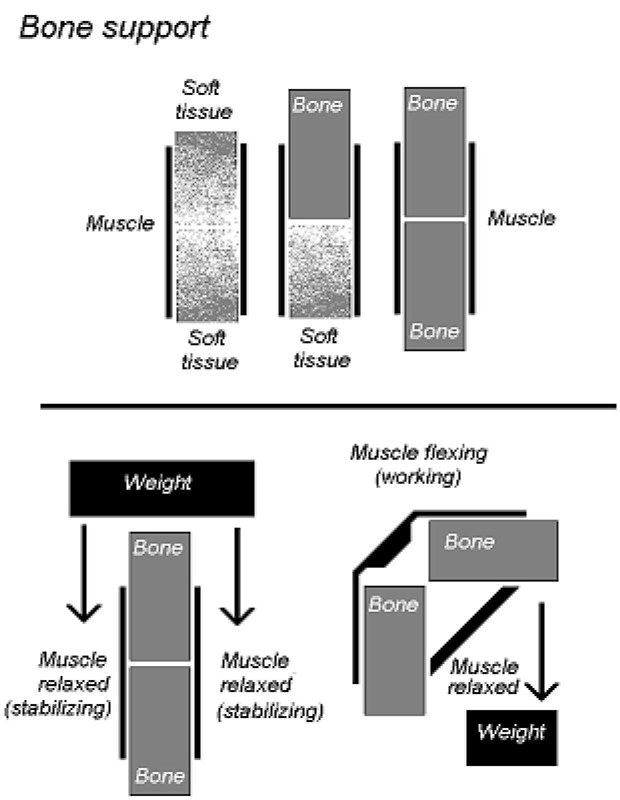
14-29 Canting a longbow; notice the low, but relaxed grip.

The drawing arm and hand should follow the same procedure as previously described for a recurve. Aiming methods can vary as much as with any other type of bow. Comparing competitive longbow archers and FITA / Olympic archers, you might be hard pressed to notice any significant differences in form!

Chapter 15
Page 271

In this chapter, we'll look again at some of the variations in form, those that are acceptable from a "don't get in the way" perspective and those that might not be.

The idea of bone support



While muscles play an obvious role in any physical activity, the object of proper form is to use them as efficiently as possible. In a number of sports, the idea of bone support is defined as having as much weight as possible being held on the long axis of the bones and not the related muscles. Before we look at each part of the archer's shooting system, let's briefly look at this.

In the top left diagram we have examples of soft tissue against soft tissue, soft tissue against bone and finally bone against bone. The left and center examples demonstrate a nebulous interface as the soft tissue component can move or change position easily, even when surrounding muscle is working to keep it in place. In the example on the right, bone is pressing directly against bone, resulting in a much more stable joint and requiring less muscle assistance. In this case, the muscles act as joint stabilizers rather than actively holding the joint in position.

The bottom left diagram gives a more concrete representation of bone support. The left example shows a weight being bone supported, while the right example shows the upper muscle working to support the weight, while the lower muscle is doing very little work.

See if you can spot these mechanisms in some of the following discussions!

Page 280 – one more "obvious" warm-up exercise

Lastly and perhaps the most obvious warm-up is drawing the bow. Some people have advocated partial draws, but we have shown that's probably not a good idea. If you'd like to do something similar, I would suggest you purchase a lightweight stretch band as described in the chapter on back tension, and do a few light "draws" to anchor prior to shooting for real.

Chapter 16

Page 296 – *And you thought target panic was bad…*

Deer panic or buck fever

While this isn't a book about bowhunting, a variant of target panic called *buck fever* needs to be addressed. Regardless of how well an archer can shoot in controlled conditions, and while being able to shoot that way is necessary to become a successful hunter, when a live animal presents itself for a shot, some hunters, especially new hunters, do "panic". The archer/bowhunter has an adrenaline rush. With his heart pounding, breathing rapid, and hands shaking, a controlled shot is all but impossible. Again, preparation is the key to overcoming this eventuality. Most bowhunters are taught to focus on a tiny spot on the animal overlying the vital organs they wish to hit. That picking a spot exercise is required for the aiming process, but may not be as easy as it sounds when the heart is racing, breathing rapid and shallow, and hands or body trembling.

The only solution I've seen be effective in this situation, is to focus on the shot sequence, the mechanics of the shot and make the target secondary until you are anchored and ready to release. By using the previously described shot sequence and doing it by the numbers, your mind should remain focused with appropriate things to do, rather than getting lost in the panic of the moment. The added benefit is that most shots miss not because of poor aiming, but because of form errors. The extra time taken to ensure a clean shot should allow the hunting archer the time he needs to settle in and lock onto his target. As with the target scenario, the more this is practiced, the quicker the process becomes.

The salient feature of this exercise is to keep the mind working on concrete functions and not falling prey to the panic of the moment.

Page 301 – *How to prepare for a "real" match:*

So, how can we prepare for competition? The best way I know is to make the match a non-event. While the exact training regimen has to be tailored to the individual shooter, the following series of exercises may help prepare you for the "big day", in this case an indoor 300 NFAA spot match.

1. Establish a "zero condition" baseline. Shoot the 12 ends of five arrows each at a single spot target set at shoulder height. Shoot at a leisurely pace. Do this for several months until you establish a baseline or "average score" of at least a 240 for barebow or 270 for sight/freestyle shooters. (The two standard practice ends are optional at this point.)

2. Be able to shoot TWO full matches back to back without tiring.

3. Once your average has been established, impose a time limit. 4 minutes for five arrows is standard. If this is no problem go to number 4. (This is more of an issue for Olympic sight/clicker shooters than most barebow or traditional shooters.)

4. Once #3 is accomplished, increase the number of arrows to SIX or SEVEN per end, and do not score the last one or two. (I use different nock colors to differentiate the last arrows.) At this point, disregard the time limit.

5. When your stamina has developed to a point that shooting seven arrows is no longer a problem, re-institute the time limit. If at any time you find yourself fatiguing or consistently running out of time, temporarily extend the time limit and then gradually reduce it again.

6. Same as above, but start with the target at shoulder height and after 6 ends, lower it approximately 2'. Alternate with the target starting in the low position and after six ends going to the high position. (This is the way official matches are shot.)

7. When the above has been accomplished, shoot the match with seven arrows, but discount the two HIGHEST scoring arrows. As cruel as this sounds, it puts you in a framework for what can happen at a bigger match when things aren't as comfy.

8. Another exercise for advanced shooters is to use part of the above with only bare shafts.

9. Finally, if the facilities are available, shooting the match at greater distances will also make the closer distances seem easier.

Page 301 – *this bears repeating*

<u>The "secret" to making a good shot</u>:

By now it should be pretty clear that there really are no secrets to good shooting. It boils down to a solid foundation in shooting technique, good, well-tuned equipment and a confident mental affect. As an archer travels or evolves through his shooting career, those three factors should combine to allow the archer to perform at his best when necessary.

If you were to watch any top-level archer shoot, one thing would become very apparent. Champion archers, like champion golfers, tennis players or any other elite athletes will appear very relaxed during the critical moments of their game and their actions will appear effortless. Their hearts are pounding, sweat is streaming down their faces and there may be physical exhaustion setting in, but that is all secondary – they remain in control of the action being performed. There's almost a serenity that takes over before and during the critical moments of play. It might seem strange to think about relaxing while holding a 50# bow at anchor, focusing on a target 90 meters away. There's a nasty 10 mph crosswind buffeting you while thousands of people are watching and taking pictures and your adrenaline is pumping, but that's exactly what a champion archer needs to do – and does.

Being able to relax also prevents extraneous muscle activity from getting in the way of the shot. That's why earlier we discussed never using muscle tension or locking any joint while shooting. Relaxing lets you and the equipment do exactly what you and it are supposed to do!

Being able to relax comes from the three factors I stated above: confidence, technique and equipment, in that order. Most of us will not be competing in the Olympics or FITA World Matches, but we might compete in regional or league shoots. We may be trying to best an old friend or score a hit on a trophy game animal. ***The pressure we feel is not due to the event, but rather to our anticipation of the event.*** Being able to "relax" during the shot process, which is a learned skill, will allow you to use the techniques you've learned and exploit the equipment you've tuned. Being confident in your technique and equipment will allow you to relax and that will make the shot appear effortless. *That's why I previously outlined an over-training regimen!*

The "secret" is that you don't need to wait for a shot at an Olympic title or a trophy buck to experience relaxing through the adrenaline rush. Once your form begins to solidify, spend some time relaxing at anchor. Hold a second or two longer than usual and feel the process. Find the equilibrium between the string pulling forward, its weight on your fingers, and the draw of your back countering it. As bizarre as that may sound, the sooner you begin incorporating that into your practice sessions, the sooner you'll be able to get in "the zone" as athletes call it, the moment of relaxation before the sear disengages and the arrow flies to its mark. As you practice, find the equilibrium, enjoy the sight picture and relax!

To sum it up, making your best shot means doing so by doing as little work as possible!

Page 303 – *Details, details…*

Working with kids

That's probably a misnomer as in some ways, a novice in any activity might be considered a "kid". However, it should be remembered that children are a special case. They usually have shorter attention spans than adults do and may not follow instructions correctly the first or second time they are given. Also they may not have the physical coordination to accomplish the tasks at all the first time out. If they don't, concentrate on safety and let them play. As muscle strength, coordination and interest develop, you can gradually begin introducing new concepts.

Children between 11 and 12 years old can usually grasp the concepts and begin shooting properly. Younger than that, it's more of a game or "play-time" to them, and perhaps it should be. Those ages are of course only guidelines, and it is up to the coach to sense when the child is ready to begin practicing in earnest. The excitement that kids exhibit by simply letting an arrow fly is incredible, while the excitement of actually hitting the target (anywhere on the target) has a greater intensity than repeatedly hitting the bullseye has for more seasoned shooters. It would be a terrible mistake to rob them of that experience. After all, that's how most of us got started.

Basic equipment considerations

Even though the title of this book is Shooting the Stickbow, sometimes shooting a stickbow isn't the best approach for a youngster. As with adults, a bow really should appeal to a new shooter on some gut level. Sometimes with kids, that's not the best idea or even possible. For kids who are in a position to start learning to shoot properly, I have a basic rule of thumb: If they are 5' tall or taller and/or have a draw length of at least 24", they can handle a stickbow (recurve) of about 15-20# at their draw length. Less than 5' tall or with a draw length of less than 24", then the odds are they won't get enough "oomph" from a stickbow to really be happy with their results. For those kids, a Mathews Genesis compound bow is in order. While technically and by all appearances it is a compound bow, it has a horizontal draw/force curve and its draw weight can be adjusted from approximately 10 to 20 pounds. That means it will have the same draw weight from brace height to its maximum draw length of approximately 31" and can therefore be used by any family member, including mommy and daddy. The bow can also be used as a tool to introduce archery to both young and old and as a training aid to some more experienced shooters.

As with adults, any arrows that don't leave the bow sideways are fine for starters. For younger children, durability is of greater importance than perfect arrow flight. The blue Easton Genesis "kiddie" arrows (supplied with the Genesis bow kit) are in fact 1820 aluminum shafts and quite durable. As their ability (form) develops, there'll be plenty of time to get properly matched arrows and do basic tuning.

Sights

One of the major differences between kids and most adults is the shorter attention span (with the former). A young archer may execute one shot perfectly and totally lose it on the next. (OK, I know a few adults who exhibit the same tendency.) One way to help funnel their focus is to introduce a sight, such as a matchstick or vane, earlier than usual in their training. If they have previously demonstrated basic form, they can just put "the thing on the thing" and not worry about how to aim the arrow. Having something concrete to do can make everything else fall into place quicker.

An alternative to a physical sight is the POA (Point of Aim) technique previously described in Chapter 12. Placing a mark on the target, target frame or floor and telling the child to place the tip of the arrow on that mark gives them a similar concrete reference point and removes the frustration of, “How do I aim this thing?”

When evaluating a new young shooter, if it becomes apparent either that maintaining focus is difficult or they are beginning to get frustrated because of missing the target, a sight or point of aim is immediately introduced.

Once they can consistently reproduce the shot sequence, it’s a good idea to re-introduce the idea of shooting without the sight. That way, a dependency is not created and they still have a valuable tool in their (or their coach’s) arsenal.

This is the basic method I use when getting “kids” of any age started.

Teaching

1. Make it clear, in the beginning, that there are no options regarding safety. In that regard, it’s a “follow the range rules or go home” scenario. That might sound harsh, but we are dealing with weapons, and safety is always the first, sometimes sole concern. Discuss range rules, especially when it’s permissible to shoot and when it’s not. Make it clear that those rules are not negotiable.

2. Once those guidelines have been established, quickly go over the parts of the bow and arrow and basic nomenclature. Discuss only pertinent details.

3. Next, demonstrate the fundamentals of holding the bow, arrow/string and drawing. But do it at a level they can understand.

4. Start out close. We have 10 yard shooting points off to the side of our regular range. That’s usually close enough for most kids, regardless of age. If the facilities allow, even closer may be better or even necessary.

5. Begin attempting to develop an anchor of some sort. For children, the anchor is usually the most difficult part to learn. Whether it’s the fear of getting the arrow or string close to their faces or just being a new position they are not accustomed to, if you can get them to a reasonable anchor by the end of the first session you’re off to an excellent start.

(Note that some younger kids will insist on drawing back to their ears, or chest, as soon as you look away. If that happens, they’re not ready to get into real “shooting” yet. As long as they are obeying range protocols, let them have fun. When they come to you and want to “shoot better”, then they are ready to start learning.)

6. Once there is a semblance of an anchor, the next step is to start “shooting”. For the first shot, I tell them to “anchor” and not let go of the arrow until I tell them to do so. That’s where a light bow really pays off. I tell them to raise or lower their bow arm so that the arrow doesn’t fly over the target or bounce off the floor. Most people are surprised how low they have to “aim”. After a few attempts most people get the hang of it, and as we said, some do take longer than others.

7. From there, you basically follow the chapters in the book, adding one component or technique at a time, as their desire and proficiency dictates.

8. For older kids with a little experience under their belts, it is also advisable to stick to the fundamentals until they appear to be firmly rooted. It makes no sense to let someone start experimenting before the foundations have been established.

9. Basic equipment tuning can take place as skills develop.

A word about parents…

Parents can be a plus or minus when working with kids. I've worked with parents who are great assets; they listen to what's being taught and reinforce it with their kids. Unfortunately, more often than not, most parents, especially those with some prior shooting experience, are assets without the "t" with regard to teaching. Parents who repeatedly interrupt the instructor or worse, contradict the instructor in front of the kids are sending them mixed messages, if not totally confusing them. It can become a tug of war, and the parent has to be asked (politely) to step back, or the lesson needs to be terminated.

…and safety.

In addition to basic range protocols, if multiple kids are being taught in a group setting, one person must act as a range officer. That person is not teaching or working with a specific child, but "watching the line" at all times. We all know how wonderful our kids are, but they are still "kids". Curiosity and excitement can take over, and things can get out of hand pretty quickly. One misplaced arrow, even one not loosed from a bow can have disastrous results.

Chapter 17
Page 329 – *Better pictures, don't you think?*

Variations on the theme of flipper rest are the single and dual pronged wrap-around rests. They attach to the riser, usually through the cushion plunger hole and are held in place by a bolt for the dual pronged type or the plunger itself for the single arm type. They have either horizontal and vertical pressure arms to keep the arrow in place, or a flipper arm to hold the arrow and center shot / pressure adjustments made with the plunger. These types of rests are fully adjustable and almost required on risers that are designed far past center shot (diag 17-48).

17-47 NAP Center shot flipper rest on a Hoyt Radian riser (left)

17-48 Olympic style rest (Cavalier Free Flyte Elite on a PSE Centra riser. This type of rest is almost a requirement given how far past center the riser was designed (right).

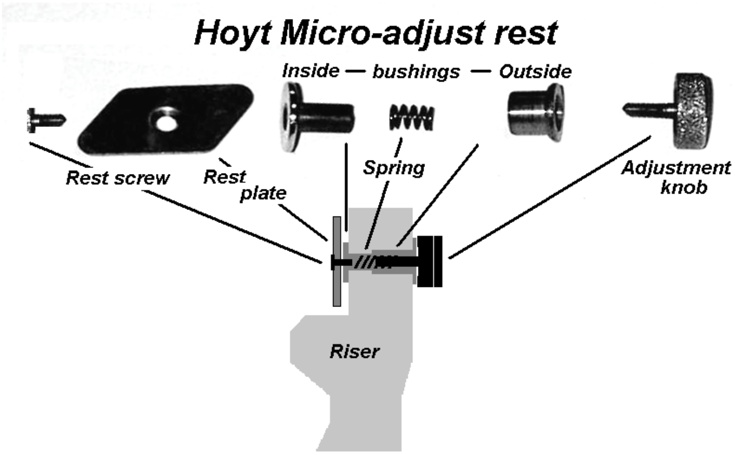
Thought you'd get a kick out of this:

Finally, if you thought that release aids were a new idea, here's a picture of a "Strap-Tab" made by the Wilson Brothers, aka Black Widows Archery, c 1968! (diag 17-51). Previous "releases" were one piece items with a shallow hook that engaged the string. The release was caused by a slight rotation of the device by the ring finger. You did not want to be near someone just learning to use one of those!

Diag 17-51 Wilson Brothers Strap-Tab.

Chapter 18

Page 334 ***Thought you'd like to see what the original Hoyt Micro-adjust rest looked like disassembled:***



Page 338 and 239 – ***Just a few more new items…***

- In 2009, Hoyt re-introduced the Eclipse riser, along with a new entry-level riser, the machined aluminum Excel and the high-end GMX (Gold Medalist Xtreme). The latter is being offered in 23", 25" and the new 27" flavors, providing up to a 72" bow for shooters with longer draw lengths (diag 18-19). Hoyt's new 900 and 990CX limbs, boasting syntactic foam between carbon layers, rounded out the new high-end line up.

18-19 Hoyt GMX in 27" version. With long limbs this will make a 72" bow aimed at long draw archers.

- For 2010 Hoyt will introduce a variation on the ILF coupling called the HDS (Hoyt Dovetail System) along with a "Formula" RX series of risers and limbs. They will feature a longer dovetail to limb bolt specification, making them incompatible with previous ILF components. While the feel of the shot is slightly different than with some current ILF models, at the time of this printing it has not been in use long enough for adequate evaluation.

Appendices

Appendix A

More math stuff – yeah, these numbers are correct (I think). In any case, here's appendix A in its entirety:

Math, measurements and standards

For those so inclined, here is a review of the formulas discussed in the preceding chapters and a few others that may hold interest for some.

Basic Formulas and Conventions

Draw weight at a given draw length:
Most bows are marked at a draw length of 28".
A 28" draw length means 28" from a point perpendicular to the bowstring to a point 1.75" past the deepest part of the throat of the bow's grip. For all intents and purposes, that means the back of the arrow shelf (see next section on AMO standards).

So, you have a bow that's marked 50#@28", and you draw exactly 28", therefore you should have a bow with a draw weight of 50#, right? Maybe not. First, there's a possibility that the bowyer's scale was slightly off; it happens more often than you'd think. Second, here are the current AMO standards for bow weights:

Bows weighing 19 – 20 – 21 lbs. will be marked 20 lbs.
Bows weighing 22 – 23 lbs. will be marked 20X lbs.
Bows weighing 24 – 25 – 26 lbs. will be marked 25 lbs.
Bows weighing 27 – 28 lbs. will be marked 25X lbs.
Bows weighing 29 – 30 – 31 lbs. will be marked 30 lbs, etc.

Get the idea?

What makes matters worse is that when dealing with vintage bows, some manufacturers had their own methods…

Ben Pearson and several others used a variation on the "x" system to represent pounds above or below the marked draw weight.

Example of the Ben Pearson system:
A Ben Pearson bow marked xx20#@ 28" would have a draw weight of 18#; x20# would be 19#, while 20x# would be 21# and 20xx#, would be 22#. Likewise, xx25# would be 23#. Some manufacturers who used an "x" system on the bow wrote the true draw weight under the arrow rest or strike plate. Might be worth a look.

If you don't have exactly a 28" draw, you would use the formula we discussed earlier:

Marked draw weight @ 28" / 20 = the amount of weight to add or subtract for each inch above or below 28".

Example:
A bow marked 30#@28”, drawn to 29.5” would weigh 32.25#.

30# / 20 = 1.5#
1.5# x 1.5” = 2.25#
30# + 2.25# = 32.25#

If you’re wondering where the “divided by 20” came from, it was assumed that 8” was a fairly standard brace height, therefore, the actual drawing length was 20 inches, and the bow had to go from 0# at the resting brace height to the stated weight in 20 inches. If you wanted to be technically correct, the formula would be:

Marked draw weight @ 28” / (28 – the brace height) = the amount of weight to add or subtract for each inch above or below 28”. Therefore, using the above example,

A bow marked 30#@28”, with a 6” brace height, drawn to 29.5” would weigh 32.04#.

30# / (28” – 6”) = 30# / 22 = 1.36#
1.36# x 1.5” = 2.04#
30# + 2.04# = 32.04#

The above assumes a linear draw-force curve, meaning a bow that gets steadily heavier the farther it’s drawn. Happily, most new and intermediate archers need not be overly concerned about an additional pound or two above or below the stated draw weight. Most pro shop or personal bow scales won’t accurately pick up small differences either, and the small difference in speed can easily be handled by tuning. As we’ve seen, more advanced archers with Olympic type bows can adjust their draw weight by a few pounds to fine-tune their equipment to their needs.

Arrow weight

The best way to determine arrow weight is with an electronic “grain” scale. They are quite inexpensive these days and very accurate. There are also handheld “balance” type scales that, if used properly, can also give accurate results. If those aren’t available, it’s possible to use the manufacturer’s weight for the raw shaft, multiplying the grains per inch value by the shaft length, then adding the weight of the head, inserts and fletching. To that add approximately 20 grains for glues and paints (if any). If you recall, three 5” feathers weigh approximately 10 grains.

FOC

To determine the Front of Center percentage: use (BPL – OAL / 2) / OAL = FOC

Where: BPL = Balance Point Length (measured from nock groove to balance point of complete shaft)
OAL = Overall Arrow Length measured from nock groove to back of head or point (BOP)

Example:

A 28” arrow with a balance point 18” from the nock groove will have a FOC of 25%.

(BPL – OAL / 2) / OAL = FOC
(18” – 28”/2)/28” = FOC
(18” – 14”)/28” = FOC
FOC = 4”/28” = 14% (approximately)

Arrow spine

Only static spine can be measured. AMO uses the deflection caused by a 2# weight placed on the center of an arrow shaft, supported on posts placed 26" apart. Easton measures their static spine using a 1.94# weight placed in the center of a shaft supported on 28" centers. (Go figure.) Dynamic spine can only be determined empirically, as shaft length, head weight, fletching, bow characteristics and shooting style must be factored in.

Converting Easton's shaft deflection in inches to actual draw weight at a 28" draw length:

28 / deflection of shaft in inches = approximate draw weight (at 28").

Example(s)

An 1816 deflects 0.756"
28/0.756" = 37#
A 1916 deflects 0.623"
28/0.623" = 45#

A 2016 deflects 0.531"
28/0.531" = 52.7#

As previously stated, these conversions are only approximations, but can serve as a quick check when choosing arrows.

Kinetic Energy

Kinetic energy is the energy contained in a moving object. It is a way to begin to understand the efficiency of a bow and arrow combination or compare one combination to another.

The basic formula is:

$KE = ½MV^2$
KE = Kinetic Energy
M = Mass of the arrow
V^2 = Velocity of the arrow at a given moment, squared (VxV)

Seems pretty easy, huh? We'll need to do a little work first, and we'll need a calculator.

Here's why: The MASS of the arrow isn't the weight in grains that we're accustomed to seeing.

1. "Mass" (of anything) is a measurement of the amount of matter something contains, while "weight" is the measurement of the pull of gravity on the "mass" of an object. Weight = mass x the acceleration of gravity, or 32.2 feet per second^2.

2. Therefore, to get the "mass" of an arrow for this equation to work, we'll need to divide its weight by the acceleration (force) of gravity, which is approximately 32.2 feet/sec/sec.

3. Since KE is typically given in foot-pounds and not foot-grains, we'll need to convert grains to pounds as well. Since there are 7000 grains in a pound, we'll again have to divide the grain weight by 7000.

So for our equation to make sense, we'll have to divide the grain weight of the arrow by 32.2, and then again by 7000. Since the equation states that we are using ½M, the entire value is halved, and so we, once again, divide the number by 2.

To make life easier, if we simply multiply 7000 x 32.2 x 2, we get 450800, and can use that as a conversion or “fudge” factor.

Example:
A 400 grain arrow (“fudge” factor x M) launched at a speed (V) of 180 feet per second
KE = ½MV^2
KE = ½(400gr) / 7000 / 32.2) x (180 fps)^2 =
KE = (200 / 32.2 / 7000) x 32,400 = 28.75 foot-pounds

Or

KE = Arrow weight in grains x speed in fps squared / 450800
KE = 400 x 180^2 / 450800 = 28.75 foot-pounds

If we increase the arrow weight to 500 grains, the speed will drop by a given amount, let’s assume 20 fps.

KE = ½MV^2
KE = ½(500gr) / 7000 / 32.2 x (160 fps)^2
KE = 28.39 foot-pounds

Or

KE = 500 x 160^2 / 450800 = 28.39 foot-pounds

In this case, using a heavier arrow did not significantly change the KE of the system.

If you have access to a chronograph, you can use different arrows and determine the KE values for your bow for each arrow. Remember the KE you calculate is only valid for the instant the arrow is traveling at the speed used in the calculation. As the arrow decelerates, it loses KE. That’s why KE is a valid way of comparing one bow/arrow’s performance against another.

Momentum

Momentum is a property of a MASS in MOTION. In archery it is a way of determining the force an arrow will have on impact with a target, or how long it will take an object (the target) to stop the arrow’s motion. In Physics, the letter P represents momentum.

The basic formula is:

P = MV

P = Momentum of an object
M = The mass of the object
V = The velocity of the object at a given time

Example:
We’ll use the same arrow (400 grain) as we did in the first KE example above, but this time, we’ll assume it hit a target at 180 fps.

P = MV
P = (400 / 7000 / 32.2)(180)
P = 0.319 ft-lb/second

Note that with momentum, mass and velocity have equal importance (value) in the equation.

Using the arrow from the second KE example (500 grains and traveling at 160 fps) we get:

P = MV
P = (500 / 7000 / 32.2)(160)
P = 0.355 ft-lb/second

Here we see that while KE didn't show a significant change with arrow weight, momentum showed a change of over 10%. Also note that momentum is a "vector" quantity, meaning not only does it have a force, but a direction. That vector should be in the same direction as the arrow is traveling.
What does this mean? Quite honestly, not much; some bowhunters are overly concerned with the KE and P numbers to maximize the depth of penetration of their hunting arrows, but by these simple equations, we can see that the difference is minor.

Bow Efficiency

This is a function of the force required to bend the limbs to a given draw length relative to the kinetic energy of the arrow at launch. Or, put another way, how much of the energy the archer puts into bending the bow is actually ending up in the arrow. As we stated in the chapter on building a virtual bow, the weight of the limbs, their internal friction, as well as the weight of the string and anything on it, also dissipate energy. Energy is also utilized in flexing the arrow during paradox. How much energy doesn't make it to the arrow depends on the bow design and materials used.

Total Energy In has to equal Total Energy Out. Therefore, if we know the total energy in (Et), and know how much energy the arrow has leaving the bow (KE), then KE / Et = Bow efficiency.

If we use again the first KE example above, let's say we have a 50# bow that can launch a 400 grain arrow at a speed of 180 feet per second. The KE is 28.74 fps.

KE / Draw weight at anchor = Efficiency
28.74 / 50# = 57.84%

Using the second KE example, with a 500 grain arrow launched at 160 feet per second, gives us a KE of 28.39.

KE / Draw weight at anchor = Efficiency
28.39 / 50# = 56.78%
A slight loss of efficiency

Hypothetically, if we had a 50# bow launching a 300 grain arrow at 200 feet per second, that would give us a KE of 26.62 [½(300) / 7000 / 32.2 x 200^2 = 26.62]

Efficiency 26.62 / 50# = 53.24%
A greater loss of efficiency
Momentum = 0.2662

What would happen if we increased the weight of the arrow to 600 grains, and it launched at 140 feet per second?

KE = ½(600) / 7000 / 32.2 x 140^2 = 26.1
Efficiency = 26.1 / 50# = 52.20%
Momentum = 0.3727

It should be apparent, that with our hypothetical bow, changing arrow weights will have little effect on KE and so, efficiency, but considerable effect on momentum.
As an example of a fairly efficient bow, these are the figures for one of my Olympic bows:

Bow – Hoyt Gold Medalist, Carbon Plus limbs 48# @ 29", using a 366 grain arrow.
KE = $\frac{1}{2}(366gr) / 7000 / 32.2 \times (215fps)^{2} = 37.53$
P = (366 / 7000 / 32.2)(215) = 0.3491
Efficiency = 37.53 / 48# = 78.19%

Technical note: The energy of a given bow is defined by the area under its force/draw curve (for example, the curves shown for a generic recurve and compound in Chapter 8). While that would give the most accurate representation, drawing the curve and calculating the area below it can be quite time consuming and for practical purposes yields remarkably similar results to the KE/Et value.

Appendix B

A few additions, nothing Earth-shattering:

Bowstring and arrow references

Bowstrings

Recommended strands per draw weight:

Draw weight	B-50	D97	Fast Flight	S4	450/450+ /8125
#20 – 25	10	12	14	8	10
#25 – 35	10	12	16	8	12
#35 – 45	12	14	18	10	14
#45 – 55	14	16	20	10	16
#55 – 65	14	16	22	10	18
#65 – 80+	16	16-18	22	12	18

Given the high breaking strength of the newer materials such as D97, Fast Flight, S4, and 450/8125, matching the number of strands to draw weight is not as important as with B-50. Some string makers use 14 strands of 450/450+/8125 or 18 strands of Fast Flight for all draw weights. The center serving diameters are typically adjusted by the diameter of the serving thread used, or by adding extra strands of material under the center serving.

Some experience (and personal preference) is also necessary when making or buying strings. For example, I never go below 12 strands of Dacron on any weight bow. This has nothing to do with material strength, but with having good arrow nock fit with minimal effort.

People have been recently experimenting with very thin strings, using 4 to 6 strands of the newer high strength materials. While in some cases remarkable speed increases were noted, on the order of 12 – 15 fps, for practical purposes its value is questionable for both nock fit and durability reasons.

Page 354 – *And more details …*

Bear Archery introduced their "Magnum" series of aluminum arrows in the late 60's and converted to "Metric Magnums" in the middle 70's. Both were believed to be Easton X7 alloy shafts made to Bear's specs. The designation in both cases represented the shaft's outside diameter.

Bear Magnum arrows

	27"	28"	29"	30"	31"	32"
.308 (inch)	50/60#	40/50#	40/50#	40/45#	30/40#	
.312	60/70#	50/60#	50/60#	45/50#	40/50#	40/50#
.316	70/80#	60/70#	60/70#	50/60#	50/60#	50/60#
.320		70/80#	70/80#	60/70#	60/70#	60/70#

Bear Metric Magnum arrows

	28"	29"	30"	31"	32"
8.4 (mm)	40/55#	40/50#	40/45#	40/45#	
8.5	55/65#	50/60#	45/55#	45/50#	40/45#
8.6	65/80#	60/70#	55/65#	50/60#	45/55#
8.7		70/80#	65/80#	60/80#	55/65

Page 263 – *A few additions were made to the pages on fiberglass arrows:*

Fiberglass Shafts

This data is for historical reference, as fiberglass shafts are no longer being produced commercially in significant quantities.

Microflight Fiberglass Shafts

	Arrow length								
Bow Weight @ draw length	23"	24"	25"	26"	27"	28"	29"	30"	31"
20-25#	0	0	0	1	2	3	4	5	6
25-30#	0	0	1	2	3	4	5	6	7
30-35#	0	1	2	3	4	5	6	7	8
35-40#	1	2	3	4	5	6	7	8	9
40-45#	1	2	3	4	6	7	8	9	10
45-50#	2	3	4	5	6	7	8	9	10
50-55#		4	5	6	7	8	9	10	11
55-60#		5	6	7	8	9	10	11	11
60-65#			7	8	9	10	11	11	12
65-70#			8	9	10	10	11	12	12
70-75#				10	10	11	12	12	12

Bear Kodiak and Kodiak Supreme Fiberglass shafts

	Arrow length					
Bow Weight @ draw length	27"	28"	29"	30"	31"	32"
35-40#				407	407	407
40-45#	407	407	408	408	409	409
45-50#	408	408	409	409	410	410
50-55#	408	409	409	410	410	411
55-60#	410	410	410	411	411	411
60-65#	410	410	411	411		
65-70#	411	411	411			

Bear also offered Kodiak fiberglass arrows in 403 and 405 sizes for target bows in the 20 – 40# weight range. (Prior to the introduction of the Kodiak arrows, Bear marketed Microflight arrows which used the standard Microflight specifications shown above.)

Gordon Plastics Fiberglass shafts
The numbers in the cells intersecting the shaft and arrow lengths are the recommended draw weights.

Arrow length

Shaft Size	24”	25”	26”	27”	28”	29”	30”	31”	32”
A-20	40#	33#	28#	23#					
B-25	50#	43#	37#	32#	27#				
C-30			42#	39#	32#	27#			
D-35			50#	43#	37#	33#	30#	26#	
E-40			55#	48#	42#	37#	33#	31#	27#
F-45			60#	55#	47#	43#	38#	34#	31#
G-50			67#	60#	53#	48#	43#	39#	35#
H-55			73#	64#	57#	52#	47#	43#	38#
I-60				73#	62#	55#	50#	46#	42#
J-65				83#	67#	61#	55#	51#	46#

Robin Hood Archery “X” Fiberglass shafts

For those of us old enough to remember Robin Hood Archery from Montclair, New Jersey, here’s a chart for their fiberglass arrows. X1 – X4 shafts were yellow and X5 – X7 were black.

I’m including these more for sentimental reasons than anything else, as I used the X7 shafts for almost all of my exhibition work in the late 1970’s and 80’s. The heavy black shafts were fairly easy for the audience to see and they apparently held up quite well, as I still have several dozen left to this day!

Arrow length

Bow Weight @ draw length	24”	25”	26”	27”	28”	29”	30”	31”	32”
20-25#	X1	X1	X1	X2	X3	X4	X4	X5	X5
25-30#	X1	X1	X2	X2	X3	X4	X4	X5	X5
30-35#	X2	X2	X3	X3	X4	X4	X5	X5	X6
35-40#	X2	X3	X3	X3	X4	X4	X5	X6	X6
40-45#	X3	X3	X4	X4	X5	X5	X6	X6	X6
45-50#		X3	X4	X4	X5	X5	X6	X6	X7
50-55#			X4	X5	X5	X6	X6	X7	X7
55-60#			X4	X5	X6	X6	X6	X7	X7
60-65#			X5	X5	X6	X6	X7	X7	X7

Wooden arrow spine charts are given in the AMO/ATA section of appendix A.

Aluminum Spine / Weight Table

The following is an example of data compiled from the current EASTON Arrow Selector software. Data is for a 29” raw arrow shaft (used with a 28” draw length), unless otherwise noted.

For arrows other than the listed 29” lengths, add or subtract the number in the grain/inch column for every inch above or below 29” to determine raw shaft weight. For total arrow weight, add the pile weight, and approximately 20-25 grains for feathers, nocks, glue and paint (if any).

As previously noted, arrow deflection can be used to approximate spine for a given draw weight:

0.325”= 90#	0.375”=75#	0.400”=65#	0.500”=55#
0.600”=50#	0.750”=35-40#	0.850”=30#	

(Chart has not changed)

Well, that should be it – thanks again!!!