The Proceedings of The Academy of the Bow

June A.S. XXXVIII
Being 2003 by the Common Reckoning

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by:
Lord Diethelm Waltorfer

Types of Bows
Lord Diethelm Waltorfer's presentation

The purpose of this class to arm you with enough knowledge to help you find that bow that fits you.

Course Outline

Types of Bows
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Making verses Buying

Bows and Strings
Strings reshape the bow when they are put in place in preparation for shooting. This may seem obvious but you must consider what is happening to the bow.

Tension and compression
The moment you are bending the bow to attach the string, you are placing the back (the side away from you) of the bow in tension and the belly (the side facing you) in compression. The bow is designed to work this way. However, if you should bend the bow the wrong direction you may damage it. Manufactured laminated bows tend to be somewhat tolerant, but self-bows will probably be damaged and it may not be obvious immediately.

Draw weight
Draw weight is built into the bow with a given stiffness and the length of the string. If the length of the string is changed for any reason (and there are some valid reasons) then the draw weight will change. The longer the string for a given bow, the less draw weight the bow produces and vice versa.

String stretch
All strings stretch when strung on the bow. Commercial strings are designed to have as little stretch as possible and therefore have fixed loops at both ends. Self-strings generally have more stretch, especially when first placed on a bow. This stretch affects the draw weight so the string may have to be adjusted several times to establish the proper length. Self-strings usually have enough length (with no bottom loop) to tie a bowman's knot at the bottom knock of the bow, which is used for major adjustment. Twisting or untwisting the string can make minor adjustment.

Bows and the person
There are many ways people use and teach to measure the length of a bow for a given shooter. The proper length depends on what use you want to put it to. Combat bows should be as short as practical when the shooter is in armor. Target bows are about as long as the shooter is tall in most cases. Distance shooting generally requires a bow about 72 inches.

Draw weight should be such that you could shoot all day and not feel tired after shooting about a dozen arrows. You should not feel any pain in the arms, wrists, or fingers after shooting.

You should start with a lighter bow at first then can increase to heavier ones after you have conditioned your muscles

Bow and Arrow
Upon release of an arrow that has been properly placed on the bow, the arrow begins to affect the bow. At first the arrow has very little affect on the bow but as the arrow is closer to the point where it will leave the bow it pulls the string to the side of the bow the arrow is on. This in turn pulls the tips of the bow to that side. The amount of sideway pull affects the flight of the arrow. This is why the tips of the bow are almost never very thin. Heavier arrows will increase this pull.

Bow and the weather
Temperature and moisture have an effect on the bow, string, arrow, and shooter.

Temperature
Modern material laminate bows appear to be made for all conditions. However, temperatures over 100 degrees F. begin to soften the fiberglass bonding material and the limbs of the bow may not spring back evenly. They may twist and throw the string off the bow. The same thing may occur to the string on this type of bow when it is too cold plus the bow may crack. Sometimes the laminations may separate at either extreme.

Wood bows tend to operate well beyond the range of temperatures in which the wood originally grew but if the wood was originally straightened using heat, the bow may revert to its original shape and become useless when overheated.

Moisture
Moisture does not seem to affect modern material much.

Wood bows seem to work best with moisture content of 11 percent, which happens to be the natural condition of wood, dried in Oklahoma. Wood protected with oil after it is dried tends to maintain the 11 percent. The best oil I have found is clear mineral oil. Furniture oils are good also but sometimes they stain the bow and Linseed oil goes rancid after a while and smells bad. Lacquers applied to the wood tend to crack after a while due to the flexing and allow moisture into the wood. Then it is slow to get the moisture out of the wood.

Shooter
Excessive temperature and moisture causes sweat, which carries salts, which can damage wood bows by getting into the wood in a dissolved solution, then crystallize. The solid crystals then break down the wood fibers as the bow is flexed. The bow will then deteriorate and eventually become useless. This is a good reason to have some sort of grip at the handle to protect the bow.

Lending Bows
Lendee's age and abilities
You cannot expect a young person or beginning shooter to draw and shoot a bow that is too large and unwieldy to handle properly. You also have to watch their grip on the bow to see that they maintain a firm grasp.

Draw weight
You cannot expect the person borrowing the bow to draw a bow that is too heavy a draw weight because they may loose an errant arrow placing yourself or others in danger. A bow with too heavy a draw weight will cause the string to tear the skin on the fingers when releasing the string. Too heavy a draw weight can injure the arm, chest, shoulders, and back muscles .

Draw length
An improper length arrow creates the possibility that arrow will drop off the rest and skewer the shooter's hand or it will go completely errant and injure someone else.

Bow construction
Commercial laminated bows are somewhat forgiving in draw length but self-bows are not. Self bows must not be drawn any further than they are designed therefore a good rule to observe is to use the arrows made for that bow or shorter.

Equipment condition
Make sure you do not lend someone a bow that you have any doubt about its condition.

Dangers of bows
Twisting
A bow will twist if something was laid on it for a period of time, was overheated, or it acquired some impurity such as salt. This twist can cause the string to dislodge from the bow when it is drawn or released. When this occurs on the draw, you can do serious damage to your face or eyes. This can also do serious damage to your bow arm or hand and the arrow can injure others around you.

Separating
Laminate bows can separate when the glue fails or the bow has received a forceful blow. The same thing can happen to a wood bow where the rings will separate. Most of the time you will have no idea this has happened unless someone notices the limbs are not bending evenly, the draw is not as strong, or you may hear a clicking when you draw.

Cracking
This can occur when the bow is not properly maintained or is overdrawn.

Lengthwise
This occurs when the edges are chipped or damaged or the moisture content is too low.

Across
This occurs when the back or tension side is damaged in some way. Usually this results in total and sudden failure in a way that can result in very serious injury to yourself and/or those around you.

Too strong
You can injure your bones and joints both on draw and sudden release of the string. Accidental release can misdirect the arrow hitting something you do not wish. Your hand can do some damage to your face.

Not properly maintained
Moisture level and temperature, if not maintained properly, will cause deterioration of the bow in many ways.

Damaged
Any damage to the bow can result in serious injury to you and/or anyone around you in any direction, which is the reason for the limit of shooters on the line. If you feel the other archers are too close, leave the line and point this out to the range marshal.

Making verses Buying
Making your own bow actually takes training. You cannot expect to take a random piece of wood and make a usable bow. In fact you could be making something that could injurer yourself. You have probably heard someone say they can make a bow from any tree limb but the truth be known, they probably have some skill and know what they are looking for in the first place. You cannot pick up a commercial bow and expect it to be the right one for you. This has been the purpose of this class to arm you with enough knowledge to help you find that bow that fits you.

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Archery Form and Consistency

by:

H.L. Elric Dracwin

The most overlooked aspects of archery, by beginners and experienced archers alike, are form and consistency. Consistent use of proper form can dramatically improve an archer's shooting, tightening their grouping and improving their score.

A discussion on archery form must take into account the entire process. This includes stance, grip, draw, aim and release. Inconsistency in any of these will lead to reduced accuracy. The goal of archery is perfection of form. Accuracy and high scoring is a product of that goal.

Stance A proper archery stance begins by straddling the shooting line. This lines up all bows, regardless of the archers' size, making the shooting line safer. The feet should perpendicular to the target and about shoulder width apart for stability and comfort. The feet should never move once shooting has started.

Grip The archer should grip the bow with a comfortable, loose and casual grip. Think of it as shaking hands with a lady. Don't grip tightly! Find a hand position that is comfortable and easy to repeat. A "perfect" grip would be loose and casual enough to allow the bow to drop upon releasing. Olympic archers use a tether to prevent dropping the bow.

Draw A proper draw of the bow will bring the hand back to the side of the face. This positions the string in front of your eye for aiming. The draw should be to the same point every time regardless of the distance being shot. As with the bow hand, find a hand position that is comfortable and easy to repeat.

Aim There are many ways to aim a bow. (SCA archery rules prohibit most sighting devices.) It is important to select one that is easy to use and then to always use that style. Select a method that allows for flexibility in range. Remember that SCA archery will often be at poorly (or not) measured distances. A common style sights the bowstring and arrow point to a position on or near the target.

Release A smooth release is one of the most important aspects of proper archery form. Slight variances in the release result in large changes to the arrow's flight. A good release will not "pluck" the string and should result in the hand either remaining motionless or moving smoothly back along the head directly away from the target.

Although form is very important in archery, consistency makes the difference between a good and a great archer. Any changes will negatively impact the arrow's flight. There are several simple tricks to consistent archery.

Movement All movement during archery will tend to reduce shooting accuracy. Although some movement is required (selecting an arrow, nocking, etc.) most movement seen on the firing line is unnecessary and counter-productive. Always place your self and equipment in a comfortable position that will not require excess movement.

Nocking Bead This is a small metal bead that is crimped onto the bowstring. The arrow is placed below the bead. This will provide a consistent nock point and prevents the arrow from sliding up the string during release.

Anchor Point The hand drawing the string should be anchored on the side of the face. This provides a tactile clue that the bow has been drawn to the same point every time. A good anchor point should be easy to find to prevent delay and over exertion.

Comfort Find the most comfortable archery form that is possible. Your body will fight against the effort if it is not comfortable. That will make consistency twice as difficult. Failure to use a comfortable stance will reduce the pleasure and increase the exertion of your archery experience.

Practice Archery form and consistency comes with practice. Contrary to the popular saying, practice does not make perfect. Only perfect practice make perfect. Practicing a bad style will make it a permanent bad form. Use practice time to review your form and work on corrections. Employ the assistance of another person. If you are both archers, take turns watching each other and pointing out problems.

The equipment that an archer uses makes a big contribution to their ability to maintain proper form and shoot consistently. Improper equipment will ruin the best archer's form and result in reduced consistency.

Draw Weight Bow weight should be matched to the physical abilities of the archer and the type of shooting that will be routinely performed. Hunting will require a heavier draw weight than target archery. Most SCA archery is shot at targets closer than 40 yards and doesn't require more than 40-50 pounds of draw weight. Draw weights below 25-30 pounds will have a very difficult time at 40 yards. Using higher than necessary draw weights may provide "manly" bragging abilities but will result in reduced accuracy and increased exertion. Many archers can't shoot an entire IKAC without a significant loss of accuracy due to their bows' high draw weight.

Bow Weight This is similar to the draw weight in its considerations. Do not select an overly weighty bow. Bow choice should be made based on how comfortable they feel. Remember that you may be shooting for hours at a time.

Matched Arrows Using different arrows is similar to changing bows between shots. I don't know anyone who does that but know too many archers that use mismatched arrows. All arrows should be matched in length, weight, point weight, fletchings and spine (flexibility). It is ideal to use a consistent arrow or arrow component supplier. Being able to add matching arrows to your collection after normal shooting losses extends the life of a set of arrows.

Vambrace Using a vambrace has its benefits and drawbacks. They will reduce wear-and-tear on your arm and keep large sleeves out of the string. They also make it less uncomfortable to have improper form that results in a hit to t the arm. However, failure to use a vambrace when you have occasional arm hits can make you tend to flinch during release.

Quivers Other than being period and very convenient, quivers are a great way to ensure you don't have to move to get arrows while on the firing line. They also help protect arrows and provide a medium for archers to show some A&S skills.

Gloves/Tabs I strongly recommend that all archers use a glove or drawing tab regardless of their bows' draw weight. These prevent tearing up the fingers. Sore fingers lead to drawing short and are a distraction.

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Building Arrow Shafts
by:
Master Rumil Fletcher

Building Arrow Shafts

While most archers have the equipment to assemble arrows out of pre-made components, few have gone the extra mile to construct those basic components. In pursuit of historical accuracy, stronger arrows, or a desire to build more attractive arrows, some archers would like to cut their own arrow shafts. But most are reluctant to do so because of the apparent difficulty in producing a good, straight, smooth shaft. Cutting your own is not as difficult as you might think. The key is to first construct a jig that gives you the control you need. Without an arrow making jig, cutting shafts can be a frustrating enterprise; one that will usually produce badly shaped, oblong, or oval cross sections instead of round arrows.

We will discuss here two kinds of jigs. The first is for the purist who wishes to build his arrows using period techniques. This method is slow and can be tedious. But it provides you with a sense of accomplishment that can only be achieved from hand-crafted workmanship. This method also allows for more flexibility, as you can cut them to any diameter, or taper them, or even make them thicker in the center of the shaft's length.

The second kind of jig is for those who lack the patience to hand craft individual arrows, or who wish to construct dozens or hundreds of shafts for distribution. It introduces the use of a plunge router to do the cutting instead of a hand plane. This method will produce quality, consistently machined arrow shafts in mere seconds, compared to the many minutes it takes to hand plane a shaft.

I will not presume to tell you which method is right for you. But I can assure you that I have used both to make arrow shafts, and both methods do work. I have also included sections on safely cutting arrow blanks for use in both jigs, and a section on selection of woods.

Rumil Fletcher

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Cutting Arrow Shafts the Period Way

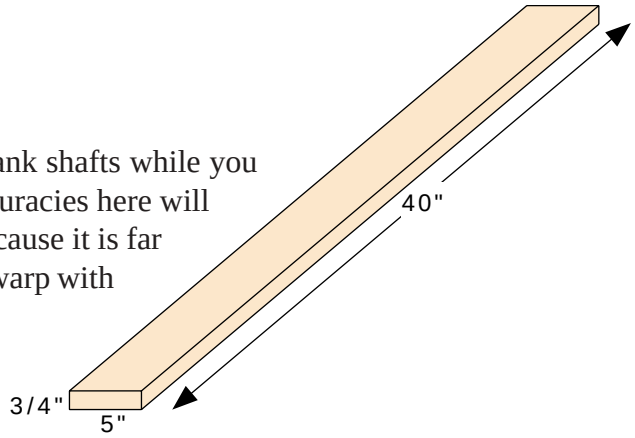
Tools and Materials Required

- A table saw with a sharp blade
- A hand drill
- Drill bits 5/16", 11/32", and 23/64" diameters (For the test template. If you have a hole gauge, you do not need these.)
- A hand plane with 2" wide blade (If you have a planner of another width, you may use it if you adjust the dimensions below to match it.)
- 2 or more clamps
- MDF (Medium Density Fiberboard) 3/4" x 5 1/2" x 40"
- MDF 3" x 5" x 3/4" (To build the test gauge.)

Warning: Construction of this jig involves the use of power tools, which can be dangerous. If you are unfamiliar with the use of power tools, get some competent help to show you how to use them safely.

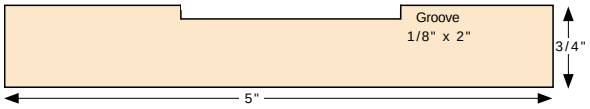
Building the Jig

The hardest part of this process is building a jig to hold the blank shafts while you cut them. Attention must be paid to this, as mistakes and inaccuracies here will translate into deformed shafts later. MDF is used for the jig because it is far more stable than wood. Wood will expand, contract, and even warp with changes in humidity. MDF is far less likely to do so.



1. With your table saw, cut the MDF to size. Make sure the sides are perfectly straight and parallel. This is critical. Next cut off two strips from this board down its length. They should be about 1/4" thick x 3/4" wide x 40" long, leaving you with a board 5" wide. These two strips will be used later as rails for the hand plane.

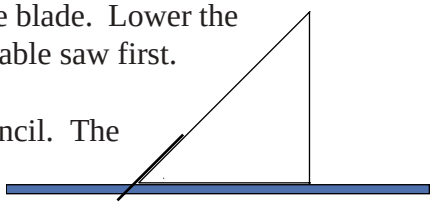
2. Cut a groove down the length of the jig, centered. It should be 1/8" deep x 2" wide. Set the fence on your table saw to cut one side of the groove, then move it 2" over to cut the other side. Remove the material between the two cuts by making successive cuts, moving your fence over 1/16" for each cut.



Cutting the Grooves

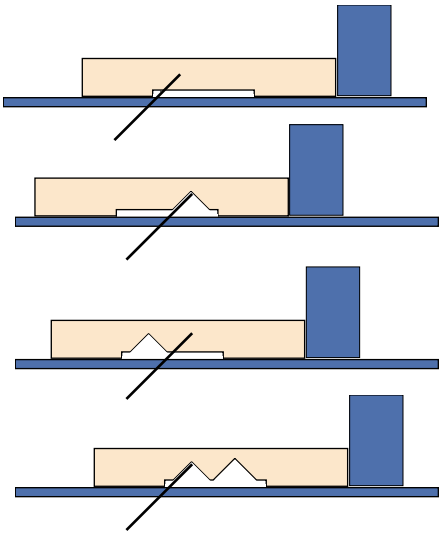
Next, you will cut two "V" grooves inside the shallow groove. This will provide a place for the arrow blanks to rest while you cut them. I strongly suggest using a couple of scrap piece of MDF a couple of feet long to test your cuts on before you cut the real thing. If you are off by a fraction of an inch, it could ruin your jig. Most authorities suggest using a single "V" groove to hold the arrow blanks. This design uses two grooves of different depths for two reasons. 1) With a single groove, a 3/8" blank is too large to fit under the planer in a groove that is also small enough to allow cutting a 5/16" shaft. Trust me on this; I did the math. 2) By using two grooves of different depths, you can rapidly switch the depth of cuts by switching grooves without having to adjust the plane's blade depth.

3. Angle the blade on your table saw to exactly 45 degrees. To do this, raise the saw blade all the way up. Angle it until it is about 45 degrees. Then use a carpenter's "speed square" to measure it for accuracy. Adjust the blade until it just barely touches the square at both the bottom and top of the blade. Lower the blade. When working closely with the saw blade like this, always unplug the table saw first.



4. Mark on the end of the jig where you wish to cut your V grooves with a pencil. The marks should indicate two "V"s. The depth of the "V"s from the top surface of the wood should be 35/64" (0.54") and 31/64" (0.48"). The depths of these cuts are important.

5. Turn the MDF jig upside down on the table saw and position the fence for the first cut. Raise the table saw until it matches the pencil mark. Cut all the way from one end of the jig to the other.

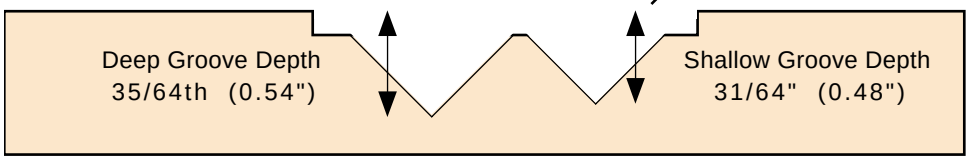


6. Flip the jig lengthwise. Move the fence so the next cut will match the tip of the first. This will result in a "V" cut into the jig that is exactly a 90 degrees angle, and offset 45 degrees from parallel with the jig surface.

7. Turn the jig around to its original position. Position the fence to match a pencil line on the second "V" cut and make the cut.

8. Flip the jig around lengthwise again. Position the fence to match the blade with the last cut, then cut all the way down the length.

9. Flip the jig upright. The cross section should now look like this.



Adding the Rails

10. To keep the blade of the plane from digging in to the sides of the jig, you will need to add a rail to each side. Place your hand plane on the jig where the blade sits in the groove. Move it to one end.

11. Position the two rails to either side of the plane where they touch without rubbing. Tack the rails down at that end.

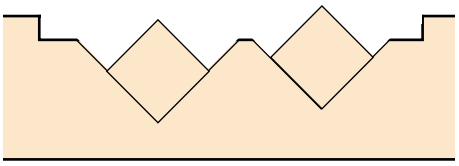
12. Move the plane down to the other end. Position the rails where they barely touch the plane. Tack the rails down here.

13. Reposition the place at intervals of 8 to 12 inches over the jig. Tack the rails down at each point.

Adding the Stops

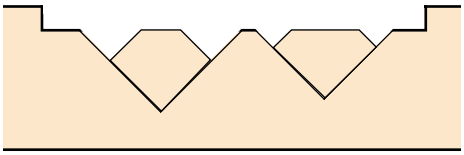
Next you need to make a stop for each groove to prevent the blanks from sliding out as you plane them.

14. Using the table saw, cut two pieces of scrap wood to 2" x 3/8" x 3/8". These shall be the stops to be inserted in one end of each groove.



15. Glue these stops into the "V" grooves at one end of the jig. It should now look like this in cross section. Allow to dry overnight.

16. Set the hand plane into the shallow groove, and plane off the top of the two inserts.

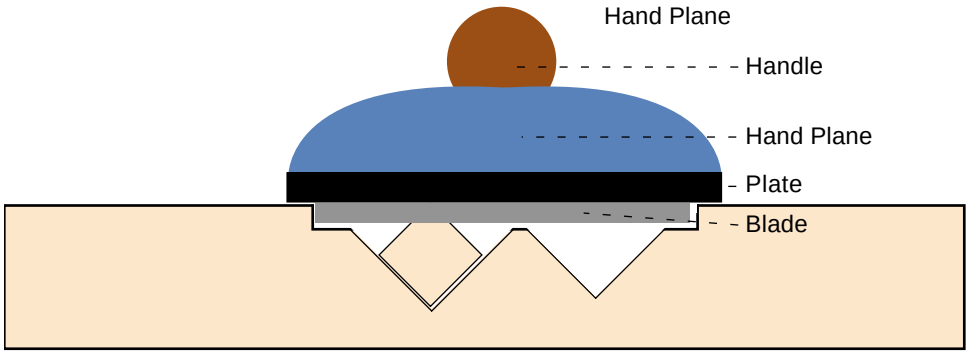


17. To fully secure the stops, hammer a short brad through the top of each stop into the jig base. Use a countersink punch or a thick nail to force the top of the brad below the surface of the wood. Failure to do so could result in the blade of the planer striking the top of the nail.

18. You need one more piece of gear to test the size of your arrow shafts. Take the 3" x 5" x 3/4" MDF or plywood and drill evenly spaced holes in it. The holes should be 5/16", 11/32", and 23/64" in diameter. Label them for size. Alternately, you could simply drill these holes into the jig itself in some unused location. The problem with this is that you have to move the jig to run the shaft through the hole. To test the arrow thickness, simply run the shaft through the hole of the desired size. You will easily be able to see where it needs to be planed off some more.

Planing the Shafts

Before you can start planing the shafts, you must first cut some blanks. See the section in this article on how to safely construct blanks.

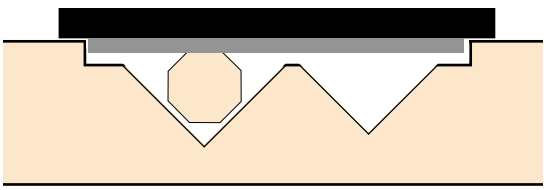


Once you have a number of blanks to work with, it is time to work the blanks into shafts. The first step is to bring the blanks down to close to the finished size. You don't wish to do it all at one time or you will get an oddly shaped shaft. In this function, you will want to tightly clamp the jig down to your workbench. You may also find it useful to use a hand clamp to hold the blank in the groove at the stop end to keep it from coming up and out of the jig. But you will only need to do that if the wood is curved or warped slightly. You would be better off if you rid your shafts of curvature before you plane them, as the planing process will remove any heat or tool marks from straightening your shafts.

Another point of considerable importance is the direction that you plane the wood. You always want to plane it in such a way that the grain, if it is not perfectly aligned with the shaft, is slanting up at the stop end of the shaft. By doing so, the planer will not tend to "dig in" to the wood. The resulting cuts will be smoother and easier to produce. This also means that you will have to switch ends of the shaft when cutting opposite sides of the shaft.

1. Place the blank into the deeper of the two V grooves. Place a clamp at the lower end and middle if you need to. Adjust the blade of your hand plane to take the corner off the blank. Be very sure after each cut to sweep any shaving out of the groove. Such material will slightly raise the shaft off the bottom of the groove, producing a slight "rise" in the shaft, which will cause the blade to take off more material than it should.

2. Run the plane down the length of the blank. Make sure you took enough of the corner off to eventually make the blank into an octagonal shaft. But do not take too much in each slice. In hardwoods in particular, it is easy for the blade to dig in and gouge the wood if your cuts are too deep.



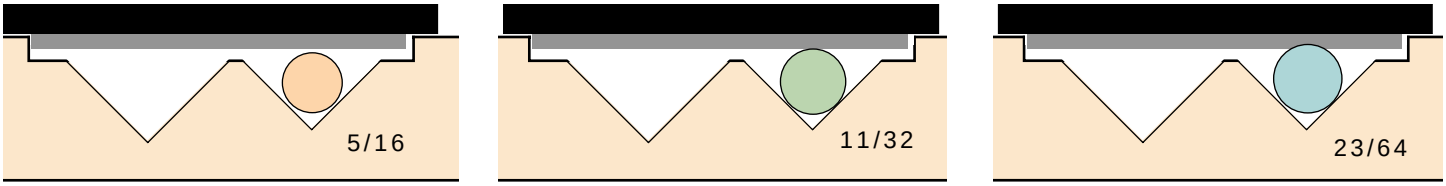
3. Rotate the blank 90 degrees. Run the plane down the shaft again.

4. Rotate it again and plane.

5. Rotate a fourth time and plane. Your blank will now have eight sides, but four of them will be longer than the other four. Move the shaft to the shallower of the two grooves and repeat steps 1 through 4. This will take a little more off.

6. Examine the end of the shaft to see if it needs more material removed. If it does, adjust the blade of the planer

to cut a bit deeper, then move the shaft back to the deeper groove and repeat steps 1 through 5. Repeat this as required until all eight sides are fairly equal in length.



Final Shaping

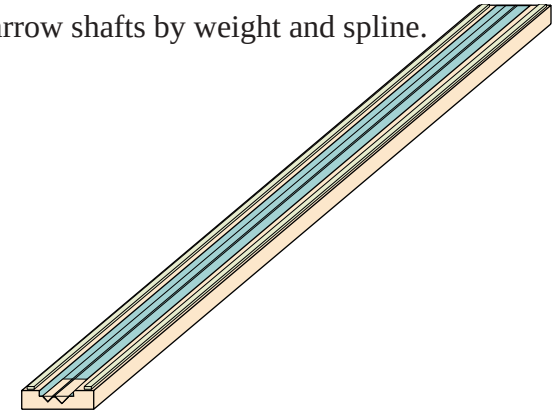
7. To turn the eight sides blanks into a round shaft requires patience. Place the shaft in either of the grooves and adjust the blade until it just barely touches the wood. Take off a tiny portion of the shaft.

8. Rotate the shaft as required, examining the ends after each cut to see where material needs to be removed. Be sure to place that part at top so it can be planed off. You may find is useful to switch back and forth between the two "V" grooves when planing. Doing so seems to make it a bit easier. Above are some scale illustrations to demonstrate how the blades will be set in comparison to the shafts and grooves. In each drawing, the blade is set the same. But note the differences in the shafts compared to the blade.

9. Continue planing the shaft down to size until it can fit through the desired sizing hole in your gauge.

10. Once you have produced a shaft that is more or less round, you can finish it by using sandpaper. Grip the shaft with one hand. Wrap a square of sandpaper around the shaft. Hold onto the excess part of the sandpaper with your other hand, not the part that is actually in contact with the shaft. Sand the entire length vigorously. Remember to rotate the shaft as you work so the sanding will affect all parts of the shaft equally. As with all sanding operations, start with a course grain such as 60 grit, and work successively through lighter grades such as 80, 100, 120, 180, and 320. Finish with steel wool. The more grades of sandpaper you use, the less time it will take to sand overall.

11. If you have a splining jig and scale, you can further match your arrow shafts by weight and spline.



An illustration of the completed jig.

Cutting Arrow Shafts the Industrial Way

Warning: Construction and use of this jig involves the use of power tools, which can be dangerous. If you are unfamiliar with the use of power tools, get some competent help to show you how to use them safely.

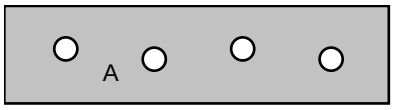
Tools Required to Build the Jig
- A table saw
- A drill press
- A hand drill
- Drill bits of 1/8", 11/32", 23/64" and 1/2" diameter
- Various clamps

Tools Required to Cut Blanks and Operate the Jig
- A table saw
- A hand drill, variable speed preferred
- 3/8" socket and drill adapter.
- A plunge router
- A round nosed router bit.

Jig Materials List	Part Name
(1) steel plate with 4 pre-bored holes.	A
(3) MDF 2" x 6" x 3/4"	B, C, D
(1) MDF 1" x 6" x 3/4"	E
(1) MDF 5" x 8" x 3/4"	F
(3) deck screws 3"	G
(6) deck screws 1 1/2"	H

Building the Jig

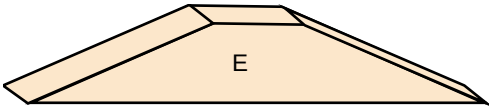
The exit hole for the arrow shaft is critical. It must maintain its size and shape even after repeated uses. With any kind of soft material such as wood, the exit hole will be rapidly worn away with use. A steel plate will be much more durable in this regard. The difficulty, of course, is how to drill a hole in a 1/8" thick steel plate with home workshop tools. The answer is to let the manufacturer do most of the work. You can, at most hardware stores, purchase steel connectors plates with 1/4" holes already drilled in them. They come in various sizes, are inexpensive, and look like the illustration at right. With most of the hole already drilled out, a quality set of metal cutting drill bits will have no trouble cutting out the remainder, as long as the plate is made of regular steel instead of stainless, tempered, or high carbon hardened steel.



I have indicated MDF (Medium Density Fiberboard) should be used for the wood parts. You may substitute 3/4" thick plywood if you like. Plywood is stronger but more expensive than MDF. You must not use a wood board, as it is dimensionally unstable. MDF and plywood will both keep the same shape and size you machined into them, regardless of changes in the humidity. A wood board will change shape slightly, which will adversely impact the precision production of arrows. For this kind of project, I prefer MDF to plywood because it has no grain to influence the position of the drilled holes when using smaller drill bits.

1. Using your table saw, cut out the MDF parts (B through (F).

2. Using your table saw and an angle jig, cut two 20 degree angles into MDF part (E), as shown, to make a triangle.



3. Trim off the top of the triangle. Trim enough to allow room for

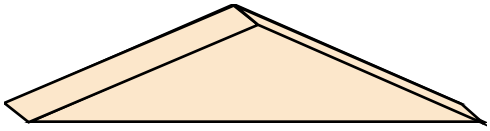
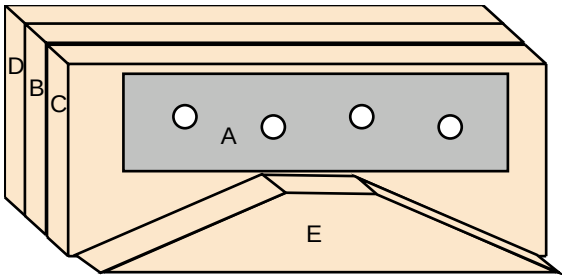
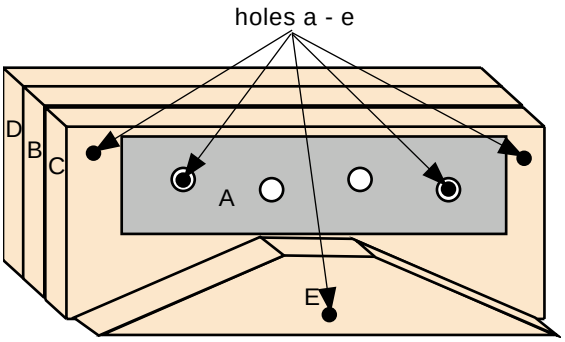


plate (A) to sit above it, with a little extra room as shown. This part will fit beneath the router bit. The slope will encourage the wood shavings to migrate down and out of the jig instead of clogging it up.

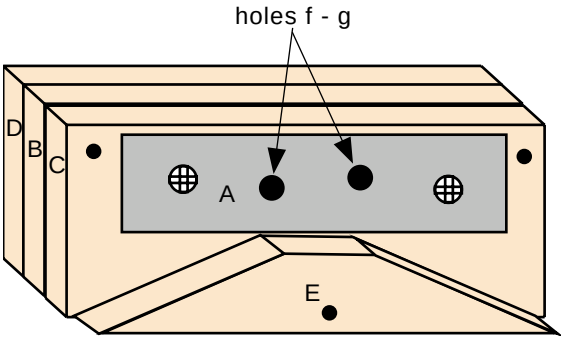


4. Stack parts (D), (B), (C), (E) in that order from back to front.

5. Place steel plate A on the stack as shown and clamp the entire stack together. Be sure to leave room around the clamps for the drill press to drill holes at the indicated locations.



6. Using your drill press and a 1/8 drill bit, drill pilot holes at the points marked (a), (b), (c), (d), and (e). It is important that you use a drill press instead of a hand drill because the MDF part (D) will be moved to the front and its holes must line up perfectly with the others. The outer holes (a), (d), and (e) must go all the way through the stack. Inner holes (b) and (c) need only go through parts (B) and (C), although it won't hurt if they go all the way through part (D).

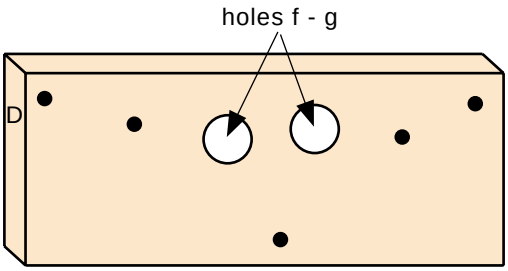


7. Insert 2 of the 1 1/2" deck screws (H) into the inner holes (b) and (c) and tighten fully. This will hold parts (B), (C), and (A) together.

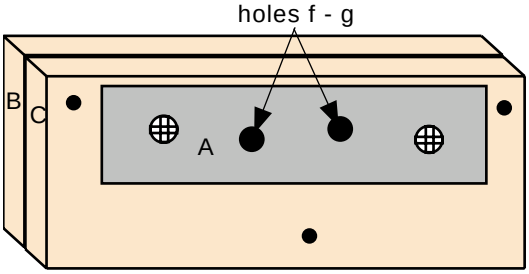
8. Again using the drill press, attach the 1/4" drill bit and drill holes at points (f) and (g) in parts (D), (B), and (C). These holes will be the same size or a little smaller than the holes in the metal plate (A).

9. Unclamp the stack, and remove parts (D) and (E).

10. Insert the 1/2" drill bit into the drill press and, in MDF part (D) only, expand holes (f) and (g) to 1/2" diameter. Do not expand these holes in any parts except part (D). These holes will be the "in" ports for the jig, and will just accept the 3/8" square arrow shaft blanks.



Note: This jig allows the production of two sizes of arrow shafts, 11/32" and 23/64". These correspond in the industry to medium and large arrow shafts. If you wish your jig to instead make small and medium shafts, use a 5/6" drill bit for the small shafts, and a 11/32" drill bit for the medium shafts. Otherwise, follow the directions below.

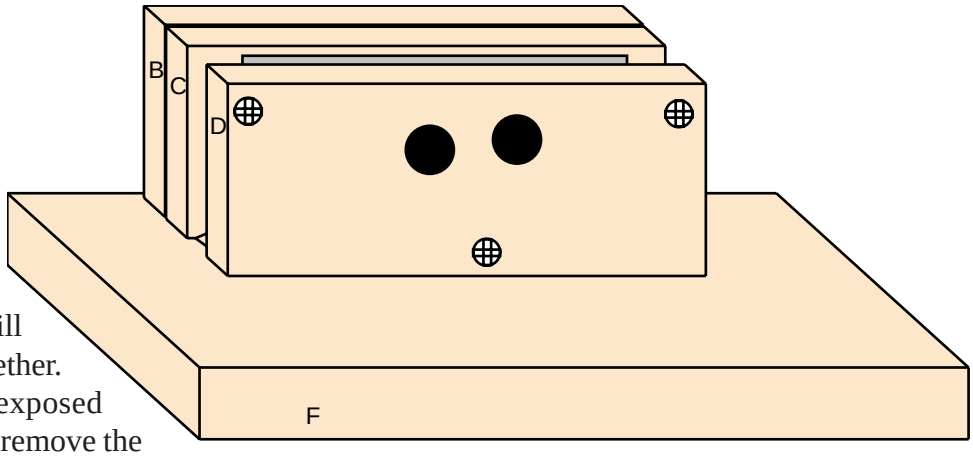


11. In stack (B), (C), (A) which is now screwed together, use the drill press to expand hole (f) from 1/4" to 11/32". This hole is larger than the hole in the steel plate, so the drill will ream out part of the steel as well as the wood. Because of this, it is important to have the assembly firmly clamped down. Failure to do so could result in the whole thing getting slung around in a circle if the bit catches the steel, which could result in personal injury to you.

12. Repeat this procedure in the stack using the 23/64" drill bit to enlarge hole (g). These holes (f) and (g), will be the exit holes for the arrow. They must maintain their size and shape consistently or the whole thing will fail. This is why using a steel plate is so important. If you used MDF or plywood to guide the exit hole, it would rapidly wear out and enlarge, making the entire jig useless.

13. Assemble stack (B), (C), (A), (E), (D) in that order, from back to front.

14. Use a bit of scrap 3/4" thick MDF to insert between parts (C) and (D), above part (A). The purpose of this is to keep the plates (C) and (D) spaced correctly apart while you screw them together.



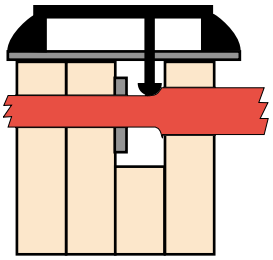
15. Install some 3" deck screws in the holes at (a), (d), and (e). This will permanently hold the entire stack together. At (a) and (d), the screw will be exposed between parts (C) and (D). You may remove the scrap bit of MDF now.

16. Turn the jig upside down and clamp MDF part (F) to the bottom of the stack. Position the back of the stack along one long edge of (F).

17. Drill four 1/8" pilot holes through (F) up into the bottom of the stack where the holes will go into the four corners of the stack in parts (B) and (D). Be careful that you do not place them in such a position that they could run into the screws running front to back through the jig at points (a) and (d).

18. Install four 3" deck screws into the pilot holes, which hold the base (F) to the stack. It should now look like the illustration above.

19. You can now mount the router to the top of the stack with screws. You will have to mark and drill a different set of mounting holes for each size of arrow. I can't give you a specific location for this, because each router is configured a little differently. The important thing is to position the router drill bit directly over the path the shaft will take as it passes through the jig. You will also want to position the router bit closer to (D) than (C) because you don't want to take a chance the router bit might hit the steel plate.



To Use the Jig to Make Arrow Shafts

Once the jig is constructed, you are ready to make some arrow shafts. Here is how it works. You attach your wood blanks to the hand drill. You feed the spinning wood blanks into the large holes on the front of the jig. The router bit is positioned perfectly to cut away any part of the blank that it can reach, while the hand drill spins the blank rapidly, ensuring that all parts of the blank go past the router bit. At right is a side view of the jig, with the router mounted on top. The wood blank is inserted spinning from the right. The router bit cuts away the wood to the proper diameter. The completed wood shaft then exits the jig on the left.

Procedure

1. Cut out some blanks on the table saw. You want each blank to be 3/8" x 3/8" x 36". Set the fence to 3/8". Run your lumber through the saw several times to get a number of blanks. Turn each piece sideways and run them through again. A 1" board from the lumber yard will actually be around 13/16" thick due to shrinkage. If the board

is sufficiently thick, you will be able to get two blanks from each strip of wood. Do not move the fence between cuts or the blanks will not be square. Cut the blanks to 36" in length. Do the same with some cheap wood such as yellow pine from some 2x4s. You will use the pine to test the depth of the router bit, and need some cheap, throw away-wood for this instead of your expensive hardwoods. Cut the pine blanks to half length. You will get twice as much use from them, and they don't need to be a yard long for running tests.

2. Insert a round nosed router bit in the router and attach the router to the top of the jig over the selected hole.

3. Lower the router bit to the correct depth. This step is absolutely critical and must be done with precision. Instructions on how to do this are at bottom.

4. Mount the blank in the 3/8" socket and attach this to the hand drill. You can get a 3/8" socket from any socket set. I have also found it useful to use a square of masking tape to hold the blank in the socket.

5. Start the router and clamp the switch "on."

6. Insert the tip of the free end of your blank into the 1/2" hole in the front of the jig.

7. Start the blank spinning by depressing the trigger of the hand drill.

8. Slowly move the spinning blank into the jig. The router will remove the outer parts of the blank, making it round. You may have some trouble getting it to hit the hole on the other side of the router bit. Just play around with it a bit, moving the drill end about until the free end enters the hole. Once it is started, it should feed easily. Move the blank slowly into the jig until the socket and drill touches the jig. You will have a short stub at the drill end which is still square. The other end will be irregular because it was inconsistently fed while you were getting started. By making the blank 36" long, you can cut two inches from each end and still get a 32" shaft.

9. Once the shaft has passed as far as it will go through the jig, turn the drill and router off. Withdraw the shaft from the jig. You may have difficulty in extracting the last couple of inches of the shaft, it is irregularly shaped from the initial part of the cutting. Since you are going to cut it off anyway, now is a good time to remove the last couple of inches with a small hand saw.

10. Once you have produced a shaft that is more or less round, you can finish it by using sandpaper. Grip the shaft with one hand. Wrap a square of sandpaper around the shaft. Hold onto the excess part of the sandpaper with your other hand, not the part that is actually in contact with the shaft. Sand the entire length vigorously. Remember to rotate the shaft as you work so the sanding will affect all parts of the shaft equally. As with all sanding operations, start with a course grain such as 60 grit, and work successively through lighter grades such as 80, 100, 120, 180, and 320. Finish with steel wool. The more grades of sandpaper you use, the less time it will take to sand overall.

11. If you have a splining jig and scale, you can further match your arrow shafts by weight and spline.

Adjusting the Router Bit Depth

This adjustment is critical. If it is set a hair too high, not enough wood will be cut away and the shaft will be too large to go through the exit hole or will burn from the friction of contact with the sides of the exit hole. If it is set too low, the shaft will not be large enough to feed consistently. The result will be a very rough shaft surface, with spiral cuts going around the shaft its entire length. To get it just right, use the pine blanks as test shafts. Initially set the depth with a known diameter shaft. Then run one of the pine blanks through to see how it goes. Make your adjustment, then try another test shaft. Repeat as often as needed. You may go through several test shafts before you get it just right. Once the depth is perfectly set, you are ready to use your hard wood blanks.

Other Considerations

You must be careful when feeding the blanks through the jig. If there is a little curvature in the shaft, the shaft will be deformed by centrifugal force as it spins, which will further warp the curvature it has, or even break the shaft before you finish cutting it. If this starts to happen, get a friend to put on a heavy glove and loosely hold the free end of the shaft to keep it from flopping about. It is better to go ahead and get rid of any curvature before you turn the shaft. You can also control the flopping of the out end by slowing down your hand drill. The slower it spins, the less it will flop about.

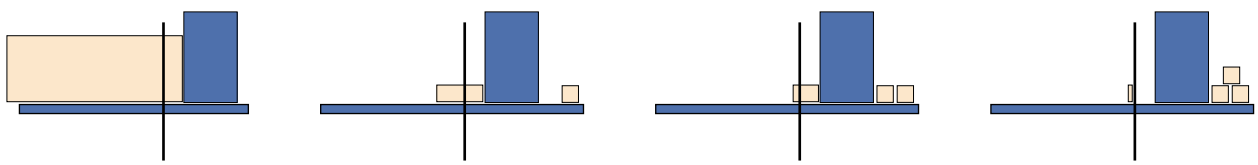
Cutting Blanks

Before you can start planing your arrows, you have to cut some blanks to fit in the jig. You will cut these to 3/8" x 3/8" x 36". You may vary the length as desired to match your draw length. But you should start with shafts that are at least four inches longer than you think you will need to allow for inaccuracies at the ends.

1. Choose a wood. See the section in this article on woods for more information.

2. Set the fence of your table saw to 3/8". Cut some slats of wood from your board.

3. Without moving the saw fence, flip each 3/8" slat onto it's side and cut them to 3/8" wide rods. You will need a feather board to keep the wood nestled firmly against the fence and to keep your fingers away from the sharp blade.



Woods

Some consideration of woods suitable for arrows is in order. So, what wood is the best? The short answer is: there is no short answer. Some people swear that Port Orford Cedar is the best and only choice for arrow shafts. Others claim that Port Orford Cedar is the worst possible wood and that some other wood is best. It ultimately comes down to personal preference. The simple fact is that most woods are usable, with varying degrees of success.

Some woods are definitely not usable. Yellow Pine, such as is found in a 2x4 from the lumber yard, is absolutely not usable. Not only is it one of the weakest woods, but it has hundreds of tiny knot holes throughout it's length. Of the dozens of test shafts I made from pine, not one had a knot-
free length long enough to use. These of course will break the first time any stress is placed on them. Wood from the cedar family tends to do better. It is a little stronger, and has its knot holes grouped together at regular intervals, making the procurement of "clear" wood of suitable length more likely.

You may choose a particular wood for non-archery reasons. For example, you may use greenheart or purpleheart woods if you happen to like those colors. Or perhaps ebony suits you because no one else could afford to build them. (At $90 to $100 per board foot for ebony, I am not kidding.) Maybe you like the grain on a particular wood. You may want to use a wood that would be used by your persona. Or perhaps you just want something stronger than cedar that is cheap and easy to work.

The Japanese used bamboo, the English used oak or ash, some Native Americans found cane useful. People the world over used whatever was available and suited them. So don't be misled into thinking only a few woods are suitable. That said, I have attached a small chart with some characteristics of various woods.

Impact Bending - This is the woods resistance to a sudden sideways load.
Stiffness - This corresponds to spine, or a general tendency to stay straight when it is shot. The stronger your bow, the more spine your arrows need.
Density - This will tell you the weight of the arrow. If you shoot a light bow, you don't want a heavy arrow or it will seriously degrade your range.
Workability - While this is not important on shafts made with the Industrial Jig, it is very important on shafts made with the Period Jig. But by itself, it does not present a complete picture. A particular wood may be easily worked with a hand drill, but may be terrible when it comes to using a plane on it. It will depend on how parallel or interlocked the grain is. The only way to find out if a particular wood planes well is to try it.
Bending - This indicates the ability of the wood to withstand bending without breaking.
Crushing Strength - Indicates the lengthwise strength. A shaft with a higher crushing strength is less likely to shatter when shot into a tree or post.

	Impact Bending	Stiffness	Density	Workability	Bending Strength	Crushing
Yellow Pine	1	1	2	2	2	3
Port Orford Cedar	1.5	2	2.5	2.5	2	3
Basswood	2	2	3	2	3	3
Red Oak	3	3	4	4	3	4
Ash	3.5	2	4	2.5	3	3.5
Purpleheart	3	4	5	4.5	4	4
Greenheart	4	5	5	5	5	5
Lignum Vitae	5	5	5	5	5	5

The Academy of the Bow
June A.S. XXXVIII
Being 2003 by the Common Reckoning

Building a Spining Jig and A Simple, Accurate Spline Tester

by:

Lord Ivarr Brokksson

Building a Spining Jig

Before you start, gather the following materials:

1 - 32" 1"x6" board
1 - 10" x 10" section of 1/8" plywood
3 - 12" 1"x6" boards
20 - 3/4" wood screws
9 - 1 1/2" “L” brackets
1 - 1 1/2" bolt
2 - nuts and washers for the bolt
1 - 1 1/2" “S” hook
1 - empty metal can (needs to be thick enough to hold melted lead)
1 - 2lb lead weight or 2 lbs of lead
1 - bag of BB’s or marbles
1 - can of All Purpose glue
1 - 12" section of coat hanger, welding rod, or 24-gauge 1/4" bar stock
1 - copy of the attached dial face
2 - 3/4" brads
1 - torch (oxy-acetylene or propane)
1 - large hammer

Before we start, I want to offer one caveat. This is NOT a precise piece of equipment. The instructions provided will allow you to build a spining jig which will determine spine weight with a margin of +/- 2lbs of error. I would also like to mention that these instructions are adapted (with permission) from instructions provided on the Internet by Johnny Johnson (aka 2jays). The dial face provided is solely the work of Mr. Johnson, who has graciously given his permission to include it for reprint here. The original instructions may be found here. (http://www.bambooarrow.com/tester.html)

To begin, take two of the 12" 1"x6" sections and cut a 1/2" notch in the center of one end. Set these to the side.

On the 32" section of 1"x6", measure 3" from one end and mark this spot. From this line, measure 26" and make another line. These will mark the inside edges of the jig. Finally, measure 13" from the first mark and make a line. Using “L” brackets and screws, mount two of the 12" sections of 1"x6" at these lines. Remember that the inside of these two upright sections should be at the lines you just marked.

Get the plywood and the dial face. Evenly glue the dial face to the plywood and let it sit for an hour or so. After the glue has begun to setup, you can work with the dial face.

Now take the coat hanger or welding rod and pound a flat space into it 3 1/2" from one end; this should be approximately 2" long. Now drill a hole just large enough for your bolt to run through. Measure 2" (the length of the “Line A” on the dial face) from the hole toward the short end of the wire. (or bar stock) Make a 90 degree bend; this will be the hook that allows the jig to work.

Using the bolt, nuts, and washers, attach the dial to the dial face. Be sure to leave enough slack so the dial moves freely.

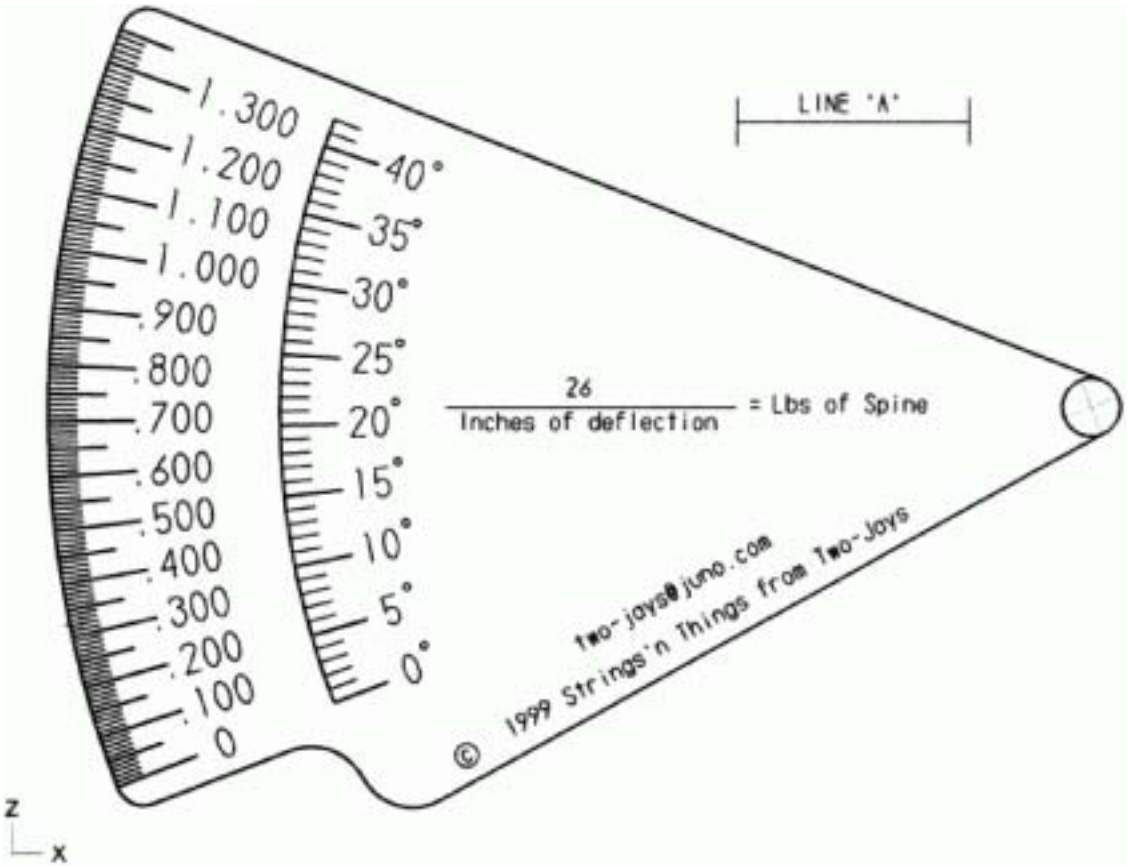
Put one brad into the dial face at the bottom of the dial to stop the pointer.

Mount the final section of 1"x6" approximately 1 1/2" from the line where the arrow will sit. Now mount the dial face to this upright, assuring that the bolt in the bend in the dial is centered between the both ends of the jig and that the bend in the dial connects to the bottom of the arrow without the arrow pressing the dial down.

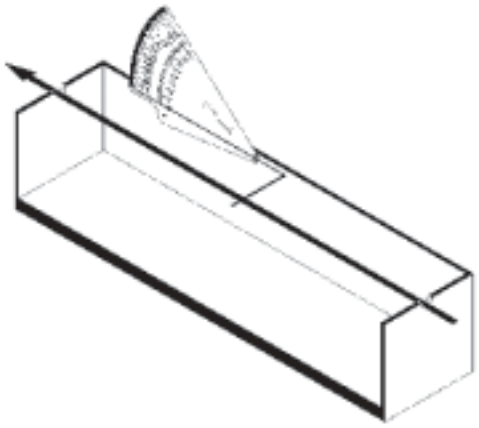
Now we've finished the jig, so we need to put together the weight. If you have a 2lb hanging weight, you're done. Chances are, you don't have this, so we have to make our own. Melt most of the lead into the empty can and let it cool. Once the can is cool enough to handle, you need to weigh the can and the "S" hook together. When you weigh the can, have the BB's or marbles on hand. If the weight is less than 2lbs, add these until the weight is precisely 2lbs. If you have too much lead in the can, you can drill out some of the lead, then start the weighing process again. A precise scale can be found at your local post office or feed store. Be sure to ask permission before using the scales. Once the measurement is good, attach the "S" hook to the can.

Now that we have the weight, let's check the jig for accuracy. Take an arrow shaft with a known spine weight (or spine grade; e.g., 35-40lb) and place it on the jig. It should sit without moving the dial. Now hook the weight over the arrow next to the spot where the dial touches the arrow. Determine the spine of the arrow by dividing 26 by the distance of deflection. (26 / deflection; ex. 26 / .74in deflection = 35.135lbs spine weight) This should be the spine weight of your arrow, +/- 2lbs. If this does not match the known spine weight of your arrow, check the jig to assure that you are using a precise (within 5 thousandths [.005] of a pound), then check that your dial is starting at 0 on the dial face. Finally, check that the dial is only touching the bottom of the arrow and not moving the dial at all.

In closing, I would like to encourage everyone to compare these instructions with those of Johnny Johnson, and determine the best possible building methods for you. Building this jig really is more art than science, and it is shown in that the jig is NOT a precise instrument, but rather gives a close determination without having to spend exorbitant amounts on a professionally built jig. Good luck and good shooting.



A SIMPLE, ACCURATE SPINE TESTER
developed by John C. Johnson (2jays)



Most of us have, at some point, thought "Sure would like to have an accurate spine tester, but that's a weeks groceries for the four of us."
Well, if you can scrounge up a few simple things shown here, chances are you can build yourself a spine tester accurate enough to measure shaft deflection within about .020" deflection. That is 0.00077 lbs of spine. Pretty dern tight tolerances.
I was inspired to develop this spine tester after seeing and building one developed by Rob Goebel (ArcheryRob on the Leather Wall). All I have done is to combine the best parts from a number of sources. There are no new ideas in the world, just new ways of putting them together.

There are only two hard-to-get parts involved. We're going to give you one and teach you how to make the other.

NOTE: if at all possible, do all drilling with a drill-press, as alignment is important to accuracy. Wear Safety goggles and avoid loose clothing when working with machinery. Remember, the best safety device is between your ears. You and you alone are responsible for your safety.

STANDARD DISCLAIMER: I am not responsible for anything you screw up, including but not limited to your body, your marriage, or your budget.

PARTS LIST
(2) pieces 1" x 6" x 26" lumber
(1) 1/8" x 3" machine screw

(3) 1/8" self-locking nuts
(6) 1/8" fender washers
(2) end-caps 1/4" x 5-1/2" x 6-1/4" plywood
(1) shim - 3/4" x 1/2" thick square of hard foam-rubber or something similar. I snipped a piece from my GI surplus sleeping-pad.

THE FIRST HARD-TO-GET PART

After lots of research on the dial-design, I finally figured out how that bad boy was designed and why equal increments on the dial didn't work. Thanks to Bruce Woodard, my Machining Technology instructor, for his encouragement and mentoring.

MAKING THE DIAL

1. Photo-copy the dial illustration. Most commercial photo-copy machines have an enlargement feature. Enlarging/reducing does not normally affect the accuracy of this dial in any appreciable way if you keep the short spoke of your needle equal to 2" (50.8 mm). Use the brightest white paper possible and clean the glass plate of the copy machine to reduce "specks" on your finished copy. I'm currently working on a dial that I can email and you can copy it to a floppy disk, then take to your neighborhood surveyor [or anyone using a CAD-dxf program] to have printed any size you like, but with the current workload it probably won't be ready before Christmas, 2002.
2. Glue it to a stiff backing (sheet aluminum, thin Plexiglas, scrap wall-paneling, etc.).
3. Drill a 5/32" hole at "X marks the spot". If you use Plexiglas, use a new 16d finish nail to drill a pilot hole, then run the drill-bit backwards to avoid breaking the backing.

MAKING THE NEEDLE AND ASSEMBLING THE SCALE TO IT

You need something round and flat for a hub and some stiff wire for spokes. I used a 3/4" thick slice from a hardwood closet rod and two bicycle spokes.

1. Drill a 5/32" hole through the center of the hub for the axle.
2. Drill two holes opposite one another around the rim. Be sure they are the right size to epoxy your spokes into. Install the spokes into these holes. Don't trim them yet. Be sure not to plug up the axle-hole.
3. Bolt the needle-hub through the hole in "Line A". Make a 90º bend outwards in the short spoke 2 inches [50.8 mm] from the center of the axle. Be as accurate as possible. THIS LENGTH IS MOST IMPORTANT MEASUREMENT ***YOU*** WILL MAKE ON THE WHOLE DERN THING!!

3. Remove the hub and put a washer on the machine screw, install the hub to it, another washer, and a self locking nut. Tighten the nut so that the hub spins freely but has a minimum of side-play.
4, Put the axle through the hole in the dial and mark where you want to cut the indicator end of the needle. Cut and shape it to a rounded point.
5. Then install another washer, the dial, another washer and another self locking nut. Here again, tighten the nut so that the dial spins freely but has a minimum of side-play.

THE FRAME

1. Glue and nail the 1" X6" boards together edge to edge.
2. Glue and nail the end-caps on. The 4-3/4" x 26" inside surface is the floor.
3. Locate and mark the center of the top edge of the back wall.
4. Measure and mark the length of line A to the left of this mark.
5. At this point measure down 1/2" and drill a 1/8" hole front to back.
6. Put another fender washer on the axle, install through this hole, add a washer and lock nut. This one is to be tight.
7. Glue the shim on the back wall about where the degree numbers will pass over it. This is so you can zero-adjust the scale and it will stay where you put it.
8. Place an arrow shaft across the two end-caps to locate where you want your grooves. This may vary according to what you used for a hub.
9. Use a 1/2" round rasp to cut the grooves 1/2" deep and sand smooth.
10. Cut the arrow-rest portion of the short spoke to the length you want and balance the needle. I used split-shot fishing weights crimped on the short spoke.
11. Remove the needle assembly, stain and finish the frame to your liking. and re-assemble.

THE "NO-BOX" METHOD

One young man, Andrew Bochnovic, ("DamnYankee" on the Leather Wall), had the idea of mounting two screws in his garage wall 26" apart and placing the pivot bolt at the appropriate place between them . I might suggest using nails or cup-hooks rather than screws so the shaft doesn't get scarred.

Thanks, Andrew, for sharing this.

THE OTHER HARD PART

The second hard part is getting an accurate 2-pound (0,909 kg) weight. After all, if we're going to talk about thousandths of an inch, ± 1/2 ounce is not close enough. Here's how I did it.

MATERIALS

(1) Empty PVC pipe cleaning fluid can Be real sure it's clean and aired out.
(1) 1/8" machine-screw hook
(2) nuts & washers
(6) 4-oz fishing weights
(3) 2-oz fishing weight
(1) 4-oz tube BB shot or lead shot
(2) baggies

1. Remove the brush from the lid and dispose of it.
2. Punch a hole in the lid and install the hook with a nut & washer on each side. Put as much thread as possible through the lid and cut off the excess.

Gather all this stuff up and head on down to your local Feed 'n Seed store. Buy a sack o' feed for Fido and talk nice. If you don't have a Fido, buy it anyway and give it to a neighbor. Notice that they probably have a government-inspected pharmaceutical-type balance for weighing seed, (Man, that stuff is costly, so they want it to be right on the money). Ask if they'll help you get a good weight. You brung the baggies so your lead wouldn't contaminate their scale.

This may be a 2-lb balance but chances are it is only a 1-lb'er, so you can do this in 2 stages:

3. Use 1 baggie for the can and enough lead to get a pound.
4. Use the other baggie for the lid/hook and enough lead to get the other pound.

Shot only weighs a few grains each, so you can trim this real close.

Take it home, put it together, and start making arrows.

GOOD HUNTIN', NEIGHBOR!!

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The Academy of the Bow
June A.S. XXXVIII
Being 2003 by the Common Reckoning

Construction of a Thrust/Throw Javelin

by:

Iaen Mor

Construction of a Thrust/Throw Javelin

Parts:

1- Five-foot piece of 160psi Silo-flex 1" diameter or equivalent.
1- Five foot piece of 160psi Silo-flex 3/4" diameter or equivalent.
2- I" schedule 40 PVC end caps. '
1- 2" or greater thrusting tip.
Strapping tape prefer 3/4"" or better.
Assorted colors duct tape.
PVC Glue, optional.

Equipment:

Dead blow or Rubber head hammer.
Saw capable of cutting PE pipe.
1 1/4 " Forstner bit (drill)
Hand drill or drill press.
Scissors for cutting tape.

Step 1:
Hand start the 3/4" pipe inside of the 1" pipe and then take your hammer and drive it in until the piece has gone all the through the outer pipe. Note, it easier if you pour some rubbing alcohol in first as this lets the piece slide in easier and will evaporate out quickly. It also helps to have another person help hold the outer pipe.

Step 2:
Cut the combined pipe to a length not to exceed 5' in length. It is best to cut this an inch shorter so when you put on the end caps it does not exceed 5'.

Step 3:
Tape on the PVC end caps. Make sure you have enough length of tape so that at least 3" of tape goes down the shaft. A simple X pattern will work for this. You may Glue the top end cap on and then tape it if you wish. The bottom cap is not glued on for inspection purposes. You now will have the shaft of the javelin complete

Step 4:
The easiest way to make a thrusting tip is to go down to your local discount or pool supply store and buy a pool fundoddle. These are available in a variety of colors and generally about 2-3/4" in diameter. Make sure you do not buy the ones with a hole already in the center, it will just push through. You could also build one out of blue smurf foam. A nerf football is also another possible head that you can use. If you use the fundoddle cut it to a 5" length. An average fundoddle will give a enough material for about a dozen heads. Then take your drill and 1-1/4" bit and drill out the center approximately 2-1/2 " deep. Using a nerf football cut one end off so that you have a 1-1/4" flat spot. Then drill it to a depth of approximately half way. Then cut of the other end off so that you have a 1-1/4" flat spot. This is to help against the head penetrating to far into a helm.

Step 5:
Next take the head and push it onto the shaft. Make sure that it seats all the way down. I usually will smack the end of the javelin against something solid. A coffee table works well. Now tape the head down using strapping tape using an X pattern. Make sure this covers the whole head and extends about 3″ down the shaft.

Step 6:
Spiral wrap the strapping tape on the shaft on both ends securing the end caps in place.

Step 7:
Next take your duct tape and smoothly tape the head making sure to cover the head completely and include the part of the shaft with the strapping tape also. Remember that in Ansteorra thrusting tips must be clearly marked in RED. The face and approximately 1″ of the sides must be taped in this color.

Step 8:
You may now mark the rest of the javelin to you preference. Be sure to leave the standards marking the Silo-flex visible. This is for inspection purposes and it will be failed at inspection if they are covered.

Step 9:
Now mark the shaft near the bottom end with your SCA name, Group and Kingdom. I find it best to print out a label with a self-adhesive back and stick it on. Then cover it with clear packing tape to keep the label from wearing off.

Step 10:
Go forth and have fun.

Ansteorran Rule for the Construction of Thrust/ Throw Javelins

Thrust and Throw Javelins (Frama)

SHAFTS
Dual purpose javelins should be constructed of two layers of 160 PSI Sil-O-Flex. The outer layer shall be 1 inch diameter Sil-O-Flex and the inner layer shall be 0.75 inch diameter.

Note: Sil-O-Flex is rated by the inside diameter so 1 inch would actually be more than 1.25 inch outside diameter once wall thickness is accounted for. Sil-O-Flex is defined as Polyethylene water tubing made from PE3408 resin and conforming to ASTM D2239 standards.

The total shaft length may not exceed 5 feet.

There is no taping required along the length of the shaft. In fact the material markings on the shaft must remain visible.

END CAPS
A 1 inch Schedule 40 PVC pipe cap should cover the both ends of the shafts and be fastened securely in place by fiber strapping tape. Fighters should be aware that marshals may ask to remove the cap from the butt end to inspect the javelin and assure proper 2-layer construction.

THRUSTING TIPS
Minimum thrusting tip standards are 2"inch diameter padding with progressive resistant give without contacting the rigid tip underneath. Heads must be securely fastened to the shaft with fiber strapping tape

The thrusting face/tip are to be taped Red.

TOTAL WEIGHT
There is a 2lb maximum weight limit and javelins should be designed to hit thrusting head first.

MARKINGS
The javelin must have in readable English the owners name, kingdom, and group marked on it for identification.

HAND PROTECTION
Any use of these weapons for thrusting or blocking requires that both hands be protected with a full gauntlet or equivalent protection.

Missile troops that only use these as thrown weapons from a distance may wear a single armored combat legal half-gauntlet on the hand used to throw the javelin.

AUTHORIZATION
Any authorized fighter may use thrown javelins. A separate Missile Combat authorization is not required.

To use these javelins for thrusting or blocking the fighter must have the basic Armored Combat authorization

Fighters who have only a Missile Combat authorization and no Armored Combat authorization may use these only as thrown weapons but not for thrusting or blocking.

The Academy of the Bow
June A.S. XXXVIII
Being 2003 by the Common Reckoning

Running an Archery Range and Gilli's Ten Commandments of Range Safety

by:

HL Gilbert Ost Westley

Running an Archery Range

HL Gilbert Ost Westley

The process of running a range can be broken down into three phases: before, during and after. **Do not *assume* that these things will just take care of themselves. You have to make them happen, or they won't.**

Before

1) Find out when is the next time your branch is holding an event.
2) Review the competition rules. Make notes if you need to. Get clarification of the rules if you need it. (Unless it's a particular event that requires a particular type of archery competition, as long as the rules are the same for everyone, it's fair)
3) Find out who the autocrat of the event will be.
4) Coordinate with and advise the autocrat on archery activities. With the autocrat, determine which archery activities, if any (archery is not appropriate at some events), will be held at the event prior to the writing of the event announcement. With the autocrat, determine the suitability of the site selected for the event for safely conducting the archery activities desired. If the site will not support the desired archery activities, either get a site that will safely support what you want to do, do only those archery activities that the site will safely support, or don't do archery at that event.
5) Make sure that what is printed in the event announcement is what you are planning on doing. If it isn't, either **a)** make a correction in the second announcement, **b)** change your plan to fit the announcement if the site will support such a change, or **c)** send out a correction to all the branches.
6) Determine if the local branch has enough archery range equipment; boundary ropes and poles, targets of the appropriate type, pavises, etc., for the size of range required for the amount of participation anticipated at the event. If the local group has enough equipment, fine. However, if not, the additional equipment must be either purchased, built, borrowed, or the plan must be changed (back to the drawing board). If borrowed, make arrangements to return the equipment in at least as good a condition as it was when you borrowed it.
7) Determine the condition of the branch's equipment prior to the event. Arrange for any needed repairs prior to the event.
8) Review the various competition rules. Make notes if you need to.
9) Determine the amount of help you will need to set up, run and disassemble the range. If circumstances prevent you from running the range, make appropriate arrangements for running the range.
10) Determine the time the archery range is to be active. Arrange for transportation for the equipment and setup of the range before that time. Also arrange for transporting the range equipment back to its storage area.
11) Arrange for a time to practice setting up the range. It is best to find out that you need something before the event than when people are standing around waiting to shoot.
12) If the range is not to be open all day, determine when it will be open.
13) At the control point for each range being run, make sure you have the following. These are the minimums. **a)** A copy of the rules for the competitions to be run. **b)** Stop watch in working order (two would be preferable) if required for the competition. **c)** Have a sufficient number of clipboards for score keeping and archer sign up, plus a few extras. **d)** Score sheets for the type of competition being run. Make plenty. It is better to have too many and save them for the next event, than it is to run out. **e)** One ink pen per clipboard plus extras. Paper, stapler, paper clips, etc. should also be there. **f)** Tools such as a wrench, staple gun with staples of the proper size for the gun, or whatever your targets may require to repair any damage incurred during the shoot. **g)** If it's a IKAC range, be sure to have plenty

of new target faces. **h)** Creature comforts such as; shade, water, chairs, table, bug spray, etc. should be considered and provided if possible. **i)** If possible, have some loaner gear available.
14) After the range is setup, but before it opens, review the various competition rules. Make notes if you need to as it is difficult to run a range for a competition if you don't know the rules.
15) Will there be an Archer's Flight. If so, as hosting group, you should provide a table, trash bags and disposables for the pot luck lunch.
16) Have the range rules printed on a sign to be placed at the entrance of the range, or be prepared to give a safety briefing to the archers prior to shooting.

During
1) Insure that the range is set up and ready to run prior to its scheduled time.
2) Insure that all who enter the range have read and understand the posted range rules or conduct, as many as needed, a safety briefing to the archers prior to shooting. The safety briefing will probably have to be given more than once as new archers arrive at the range.
3) Check each archer's equipment prior to entering the range. Do not allow unserviceable equipment to be used on the range.
4) Conduct the competition according to the rules of that competition. If necessary, refer to a copy of the rules to answer questions or for clarification. Should a question arise not covered by the rules, use your best judgment with safety being the overriding consideration.
5) Monitor the safety of the competition. Pay particular attention to actions of non-archers. Keep the spectators where they are supposed to be.
6) Take such disciplinary actions as are necessary (i.e. verbal warnings, removal from the range, etc.) to maintain the safe operation of the range. Range etiquette requires the spectators and other archers to not disturb the archers on the line.
7) The number of participants will, to a large degree, determine the number of firing orders, and the time for each firing order to shoot. At the smaller events, if the range is to be open all day, firing orders will probably not be necessary.
8) Once an archer has finished shooting for score, make sure that their score sheet is properly filled out. Store the completed score sheet in a safe place till the end of the event.
9) Observe the condition of the archers. Require them to drink water and take breaks if needed. There is no reason for a heat injury to occur on any archery range.

After
1) Identify the range equipment that requires repair and make arrangements for that repair.
2) Disassemble the range and clean up the range area.
3) Transport the range equipment back to its storage area.
4) Make any required repairs.
5) Return any borrowed equipment.
6) Notify your Regional Archery Marshal immediately after the event if any disciplinary actions were necessary or if any accidents occurred.
7) If scores were shot, send them to the appropriate person. If you don't know who these are, check with the Regional or Kingdom Archery Marshal.
8) Report the event to the Kingdom Archery Marshal by using the online reporting.

Lessons Learned
These are a few of the things I've learned doing IKAC and IKCAC tournaments over the years. You can make the same mistakes if you must, but the stove is actually hot and the paint is wet.
1) Practice improves your scores.

2) Using your own equipment improves your score.
3) Do not shoot when you are tired.
4) Don't wear flowing sleeves when shooting. They get caught in the bow string and adversely affect your score.
5) Try to be able to shoot all three days of a three day event.
6) Have someone help with setting up and tearing down the range.
7) Set times that the range will be opened and closed. This will allow you to see something of the event and not be stuck on the range all day.
8) One target is enough to do the competition, but more targets will allow more to shoot in less time, as will each archer having 24 arrows to shoot in the IKCAC.
9) If you can provide loaner gear, do so. The guy who borrows at one event may turn out to be the third place archer in the Kingdom. This actually happened one year.
10) If in doubt, keep safety foremost in your mind, and use your common sense.
11) Make sure all your distances are correct. If they are not, you're either cheating us, or you are cheating the rest of the Known World. So use things that don't stretch like a tape measure or a chain.
12) While practicing for the IKCAC without a helmet or face mask is acceptable, it is highly advisable that, before going for score, you practice with a helmet or face mask on. It is a whole different world in there.

Gilli's Ten Commandments of Range Safety Read Before Entering

1. Individual Equipment will be inspected prior to shooting.
2. While on the range, obey the instructions of the marshal.
3. In the event of an unsafe act, call ***Hold***!
4. Shoot only at designated targets.
5. Drawn arrows or loaded crossbows will only be pointed down range.
6. All bows down before arrow retrieval.
7. No one in front of the firing line while archers are shooting.
8. No running on the range.
9. No unattended children on the range.
10. Failure to follow the above rules may result in you removal from the range.

The Academy of the Bow
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Flemish Twisted Bow Strings & Footed Arrow Shafts

by:

Jacques the Spink

The purpose of this paper is not to provide a discussion of the pros and cons of string making as much as to provide specific instructions in how to make a tapered end Flemish twisted bowstring from standard materials. For a more detailed discussion please go online to Stefan's Florilegium at http://www.florilegium.org/files/ARCHERY-FAQ/string-mak-FAQ.html or to volume 2 of the Traditional Bowyers Bible for a detailed description and discussion using traditional natural materials.

Materials

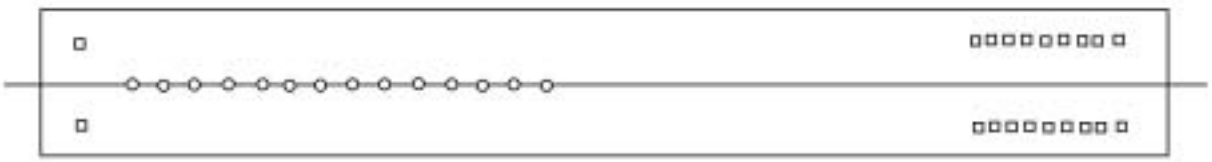
String: In order to make a bowstring it is necessary to have certain basic materials. Fast-flite bowstring is generally not recommended due to its lack of give which can cause some bows to shatter. The preferred and readily available material from most mail order houses is B50 nylon waxed bowstring. It will require 10 to 18 strands for most bowstrings so it is usually worthwhile to buy a couple of quarter lb spools in different colors if you are going to be making very many strings.

Wax: Beeswax works fairly well and you can buy a small cake of regular beeswax that is specifically formulated to work with making bowstrings.

Server and serving: this material is wrapped around the center of the string to reduce wear on the string where the arrow is nocked. A spool of heavy thread in various colors is available from archery suppliers along with a serving tool which facilitates wrapping the string snugly with the serving. Braided serving is somewhat more expensive than the regular serving but is extremely durable. For crossbow string it is the only serving that I use due to the abrasion that occurs from the string rubbing against the stock.

String jig: If you are going to be making a lot of different strings then I recommend that you may want to invest $30-40 in a commercially available jig that is easily adjustable. If you are going to want to make a dozen strings a year for yourself and your friends then you may not want that expense. Following are instructions on how to make a simple jig such as what I use and that can make strings from AMO lengths of 48" up to 72 inches.

Obtain a flat 1x4 board 30 inches long and some small finishing nails plus 1- 16d nail. Mark a centerline down the length of the board. Starting 1-1/4 inch from one end drive 2 nails 1/2 inch deep into the board æ inch on each side of the centerline. Starting at 3 3/4 inches from the end drill 13 1/2 inch deep holes every 1 inch along the centerline. The hole diameter should be just large enough that the 16d nail will fit into it snugly but can be easily removed. Number the holes, starting from the one closest to the end, 48,50,52….74. These will be the string lengths corresponding to the AMO bow lengths.



Measure 27-3/4 inches from the nails that you put into the board and place 2 nails æ inch on each side of the centerline. Place 8 more pairs 1/2 inch apart working back toward the center so that you have a line of nails 1-1/2 inch apart. Starting at the end pair label them 0, 1, 2, ….7, 8. These will count the strands that are going into your string. When done you should have a board looking roughly like the layout shown.

Making the string: with the jig in front of you in the orientation shown, take a spool of B50 and tie it to the nail in the top right of the jig. String it down around the lower right nail, the length of the board to the lower left nail, up around the peg in one of the drilled holes, back to the upper left nail and back down the length of the jig to the next to the last upper right nails. Continue to run the string down to the next to last lower right nail and then repeat as before until the required number of strands have been run. Run a sharp knife down the centerline between the two rows of nails on the right of the jig and remove the bundle of strands being careful to not tangle them. Wax the entire bundle with the beeswax by pulling it between your thumb and the cake of wax. Wax the last foot of the bundle at each end particularly heavily and set the bundle aside.

Repeat the process to create another bundle of strands- preferably with a different color although this is not required.

Take both bundles and match the lengths together. Then place the pair of bundles between your thumb and forefinger of your left hand with 8 inches of bundles extending to the right. The balance of the bundle is off to the left out of the way for now. While holding the bundles in the left, take one bundle between the thumb and forefinger of the right hand and twist the strands together rolling the bundle toward you. Do the same with the other bundle and "braid" it to the other bundle by putting it on top of the other bundle and twisting the two bundles together with the top of the twist going away from you. This combination will lock the strands into place and keep them from untwisting. Continue to twist the strands together and braid the bundles until you have about 3 inches braided. This will make a one inch diameter loop. Braid less for smaller loops.

Next make the loop of the braided section bringing the loose ends to the base of the braid that you have been holding in your left hand. Separate the strands of one bundle and thread the loose end of the bundle through the "eye" that is formed and twist the bundle together as before being careful to keep the direction of twist the same. Continue to twist and braid the bundles together until about 1 inch below the last strand tail.

Hook the loop over a nail and stretch the string out and untangle any tangles. Take the other end in your left hand as before, twist and braid, and form the loop as before. Continue to twist and braid and push the braid into the main bowstring until you have braided about an inch below the last tail. Hook the other end over a nail and pull the string out gently while twisting the whole string in the direction that it was twisting at each end. This will remove any counter twist that would undo your braiding work. Then twist the string until it is about the right length for the bow (approximately 3 inches shorter than the nock ends) and fit it on to the bow. It should have a brace height of about 6-8" depending on the bow and the owner preference. Wax the entire string heavily.

Starting about 2 inches above the nocking point on the string while stretched on the bow, lay the tail of the serving along the string and start wrapping the serving around and over the tail. After about 6 wraps or so pull it tight and continue wrapping letting the serving tool do most of the work. Practice will show you the correct tightness of the serving. It should be snug but not so tight it causes the string to twist. Continue to wrap serving until about an inch short of where you will stop. Lay a loop of string along the string with the tails along the serving and continue to wrap for about another 1/2 to 3/4 inch. Pull out and cut off a length of serving and thread through the loop. Pull the tails and the loop should pull the loose end under the serving.

The string should be done and ready to shoot with the addition of a arrow nocking point.

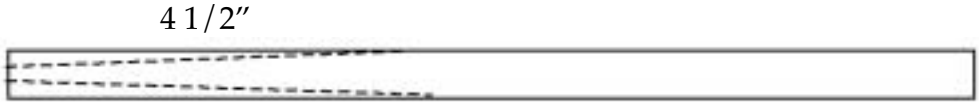
This article is intended mainly as a guide in the making of what is known as the footed shaft. Further and more detailed information is available in Volume Three of the Bowyers Bible on the making of both the 2 and 4 spline footed shaft. In this article we will discuss only the 2 spline as it is fairly simple to make with minimal tools. Source of information is primarily Volume 3 of the Bowyers Bible.

The footed shaft has been in use in various forms among both the American Indian and Europeans for centuries. In 19th century England it was developed into a fine art form. In either case it has quite practical application since it provides a method of repairing broken self arrow shafts as well as the footed portion of hardwood being significantly tougher than the softwood of the self arrow. Very few folks take the time to make such arrows since they are extremely time intensive- requiring time on the order of hours per arrow to make. They are, however one of the most beautiful arrows that it is possible to own.

Tools and materials:
You can use power equivalents of any handtool and vastly speed up the construction of the arrows. For our purposes today though we will discuss the construction of the arrows using strictly hand tools. The following list is required in order to make the basic shaft.

1) patience in generous quantities
2) broken shaft self arrows or a new shaft
3) 7/16 squares of Purpleheart or other straight grained wood 8 inches long
4) Handsaw
5) Block Plane (6-1/2" plane is available from Home Depot for about $10)
6) Titebond 2 glue
7) Coarse and fine Rasps
8) Coarse and fine sandpapers with block
9) 2-C clamps
10) Ruler or tape measure
11) Vice

First take the arrow shaft that you will be using and determine the direction of the grain of the wood. Although not absolutely required to be this way, generally the growth rings of the arrow should be horizontal to the ground (and perpendicular to the string) when the arrow is nocked. Mark a line on the center of the end of the shaft that will be perpendicular to the string when the arrow is nocked. Next mark a line around the shaft
4-1/2" to 5" from the end on what will be the top and bottom of the shaft when the arrow is nocked. Set the block plane to take a very thin shaving from the wood, place the shaft on a flat backing and taper the arrow shaft evenly on both sides from the 5" mark to the end mark being careful to keep the surfaces as flat and parallel as possible. The end of the shaft when finished should be the same thickness as the saw kerf will be in the footing block.

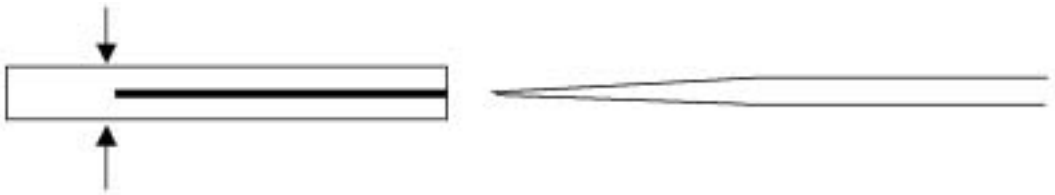


Next take the 7/16 square of Purpleheart or other straight grain footing material and measure 5 inches from one end and make a mark along the center of the square. The grain growth rings should be parallel to the 5 inch slot that you will cut along the marked centerline of the square. If you have access to a bandsaw then by all means

use it. Otherwise some practice will probably be required to clamp the square in a vice or to a table and cut a straight saw kerf down the center of the square.

Once the slot is cut then place a C clamp just below the saw kerf in order to keep the square from splitting when the arrow shaft is forced into the saw kerf.

Next open the saw kerf slightly and fill the kerf with glue. Then place the arrow shaft in the center of the kerf and tap it all the way in until it bottoms out in the bottom of the saw kerf. Take extra time to make sure the block and the arrow shaft are aligned or you will have a great deal of difficulty later in getting the footing true to the arrow shaft and may even have to scrap the effort.



Clamp point

Once the arrow has been position all the way into the block and centered then lightly clamp the end of the slot end of the block being careful not to apply so much pressure as to crush the arrow shaft. Allow to dry overnight before removing the clamps.

Repeat this process as necessary to make the requisite number of shafts.

Now get out your supply of patience and apply liberally. Starting with a coarse rasp shape remove all of the wood that does not look like an arrow from the block. In reality this means patiently rasp or whittle the material away until you have a round shape that is slightly larger than the arrow shaft. Use the fine rasp to take it down a little closer and finally the sandpaper to get the proper diameter of the hardwood shaft. Purpleheart will turn purple with exposure to air.

Once the block is made to match the arrow shaft then, seal the shaft, add a taper for the arrow point and nock , fletch and point the shaft.

Overall you can expect to spend a minimum of two hours or more per shaft. Although the time required is far greater than that for a normal self arrow- the results are well worth it and will mark you as a skilled and serious archer/fletcher.

Notes:

Fiberglass /UHMW
Combat Arrow/Bolt Construction

Eadric Anstapa

Materials Needed

1.25″ diameter UHMW Rod
Closed Cell Foam Padding
0.25″ Good Quality Fiberglass Rod
1″ x 160 PSI Siloflex
Nocks (overnocks)
Hot Glue Sticks
Fiber Strapping Tape
Electrical Tape
Labels
Clear packing tape

A good quality Gel Super Glue may also be needed for nocks and APDs.

Tools Needed

Saws to cut UHMW, Siloflex, and Fiberglass
Drill or preferably a Drill Press.
15/54″ drill bit
Hot glue gun
Belt/Disc Sander
Dead blow hammer
Scissors

Router Table – optional
Rotary Tool -- optional

Materials Preparation

First take all of your raw materials and turn them into the individual components that you will assemble.

Closed Cell Foam
This is the padding for the face of your blunt

- Either cut or punch the closed cell foam into rounds slightly larger than 1.25″ in diameter.

UHMW
The UHMW Rod will become the rigid stop inside the blunt and on the end of the shaft

- Cut the UHMW rod into pieces 1-inch or longer.
- Drill a 15/64″ hole, ½″ deep in the center of one end of each piece of UHMW.

Fiberglass Rod
The Fiberglass Rod will become the shafts for your arrows and bolts.

- For arrow shafts cut the shafts 28.5″ long.
- For bolts cut the shafts the 1″ longer than the length of the track on your crossbow from the lock all the way to the front of your bow.

Siloflex
This will become your APD

- Route a channel down the length of the piece of Siloflex ***
- Cut the Siloflex into pieces 1.25″ long or slightly longer.
- If not using the routed channel design, cut tabs/slots in each piece. ***
- Round all edges of the Siloflex.

Assembly

1. Put UHMW on to shafts. Use a dead blow hammer to the fully seat the UHMW.
2. Take assembly to sander or router table and round all edges of UHMW.
3. If you will be using nocks now glue them to the shaft with good quality glue.
4. For routed-channel design glue and then tape APD to end of shaft. For tabbed design tape APD to shaft. No more than ½″ of shaft or nock may protrude behind the APD
5. Tape entire length of shaft with fiber strapping tape or good quality electrical tape.
6. Glue 1″ thickness of closed cell foam to face of blunt.
7. Tape foam to blunt with fiber strapping tape. Tape should extend at least 1 inch down the shaft and have a strap of tape running around securing entire head assembly to the shaft.
8. For longer life cover all the strapping tape with good quality electrical tape.
9. Place owners label on shaft and cover with clear packing tape.

It really is a lot easier than it seems. Do it in stages and work with friends in an assembly line and it goes quite quickly. If you are new to building arrows and bolts then make one or two and then take them to a CA Marshal to be inspected to make sure you are getting everything right.

Thoughts on Eye Protection

Eadric Anstapa

It is quite common for field marshals to be shot in large melees involving combat archery and if you marshal enough, depending on your style of marshalling, you may eventually be hit with swinging rattan. Hopefully when you are shot or hit it won't be in the face, but if it is you certainly want to be prepared. Wear good protective eyewear.

The inexpensive eyewear that you will find in your hardware department (ANSI Z87 protective eyewear) is intended for use while doing occupational tasks like drilling, cutting, grinding, painting, etc and is intended to protect from small pieces of flying debris. They are not intended to protect from objects with more mass or from swinging sticks and usually offer little or no side-impact protection.

There are separate standards (ANSI F803) in place for eyewear for use in activities like racquetball, squash, lacrosse, field hockey, baseball, etc. These standards are designed to protect against both the impact from the balls and from the swinging racquets and sticks. These are the standards and eyewear that are best suited for SCA marshals.

As a bonus the eye protection used in these sports is usually smaller and more comfortable and designed to stay firmly in place while running and jumping around. Sports eyewear will often fit inside a helm if needed and they generally resist fogging and clouding when you get hot and sweaty better than the generic occupational safety goggles/glasses.

Because essentially all of the sports organizations and most gyms now require eye protection for sports like squash, racquetball, lacrosse, and field hockey just go to your local sporting good store and pick up goggles designed for those sports. In a big sporting goods store you will have your choice of a dozen or more different styles and colors so you can find some that you like and that fit you well. Many are adjustable so you can get a good fit. They even make them that will fit over standard prescription eyewear.

Eye protection that meets the F803 standards typically start about $7 and run upward to around $25 for the more expensive goggles. They are a little bit more expensive that the cheap $2 occupational safety eyewear but most people will think they are well worth the extra expense simply because of the added comfort when marshalling all day long.

The American Standard you are looking for is ASTM F803 "Standard Specification for Eye Protectors For Selected Sports". The equivalent British Standard is 7930-1: 1998. The equivalent Canadian Standard is CSA P400. The equivalent Australia/New Zealand Standard 4066. (Actually probably a superior standard to ASTM F803)

The USRA keeps a list of good eyewear that meets ASTM F803 or better. It can be found at: http://www.usra.org/usra/pub&ref/eyeguard.htm . When you go shopping look for the ***USRA*** logo.

Think a blunt arrow in the eye can't be all that bad? Take a look at the pictures at the bottom of this page. http://www.imask.com.au/squash-facts.htm to see what a squash ball can do to an eye and imagine what a Baldar Blunt tipped Siloflex arrow out of a 1000 Inch-pound crossbow could do to your eye.

Calibrating Bow Scales

Eadric Anstapa

One essential tool for a Combat Archery Marshal is an accurate bow scale. Before any bow or crossbow can be allowed on the combat field it must be inspected to assure that it is within the limits allowed by our missile combat rules.

Ansteorran rules specify that the maximum draw weight for bows shooting thin wood or fiberglass shafted arrows is 30 pounds. Bows that will be shooting large diameter tubular arrows made from Golf Tubes or Sil-O-Flex may draw up to 40 pounds.

The maximum limit for any crossbow in Ansteorra is 600 Inch-pounds. Inch-pounds is a system of expressing the power of crossbows by multiplying the peak draw weight of the crossbow by the length of the string travel (power stroke). Therefore, a crossbow with a 75 pound peak draw weight and an 8 inch power stroke would be rated as 600 Inch pounds (75 x 8 = 600).

The typical hand held bow scale will measure up to 90 pounds and that is generally always adequate for use in Ansteorra. These bow scales are almost always spring scales where the weight is calculated by measuring the compression of a coiled steel spring. While these scales work quite well it is not at all uncommon to find slight inaccuracies. Marshals should check and calibrate their scales periodically.

While the readily available inexpensive tubular spring scales work quite well for our purposes, perhaps their one major drawback is that they are not easily adjustable when they become inaccurate. Since these scales have no true "zero" reading there can be no zero adjustment for them and any adjustment that built-in to them is minimal at best. Lacking a means to adjust the scales, we must simply satisfy ourselves with knowing and compensating for any inaccuracies we know our scales posses. Periodically test your bow scales by hanging a known amount of weight on them to determine how accurate they are. Place a sticker on your bow scale to note the degree of any inaccuracy.

Typical Tubular Spring Scales.