



**Archery
Victoria**



Recurve Bow Tuning Guidelines

www.archeryvictoria.asn.au

Introduction

To learn how to tune a recurve bow it is necessary to understand the forces at play.

The first part of this booklet discusses the basics of physics and how that relates to arrows and their flight.

The second part discusses arrow selection in more detail and how the laws of physics have a bearing on your arrow selection.

The third part is about the actual setting up of your bow to make the arrows fly correctly. Make no mistake, choosing the wrong arrow makes tuning for flight difficult and for grouping near impossible.



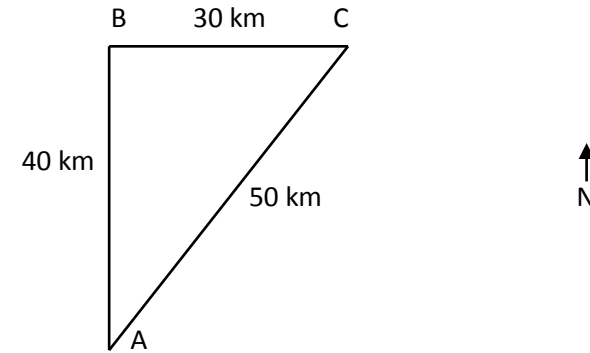
Motion - General

A cyclist in motion can best be described as general motion.

Motion - Displacement

S Speed = distance/change in time

V Velocity = displacement/change in time



A cyclist travels along the road from point A to point B and then to point C. Time elapsed equalled 60 minutes.

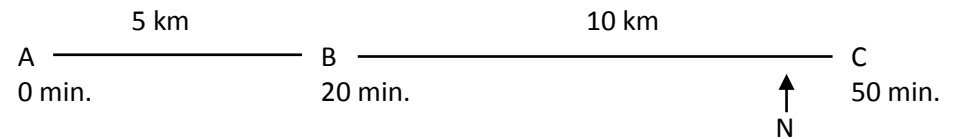
Distance equalled 70 km.

Displacement equalled 50 km.

Time elapsed equalled 60 minutes.

S (speed) = 70 kph

V (velocity) = 50 kph NE



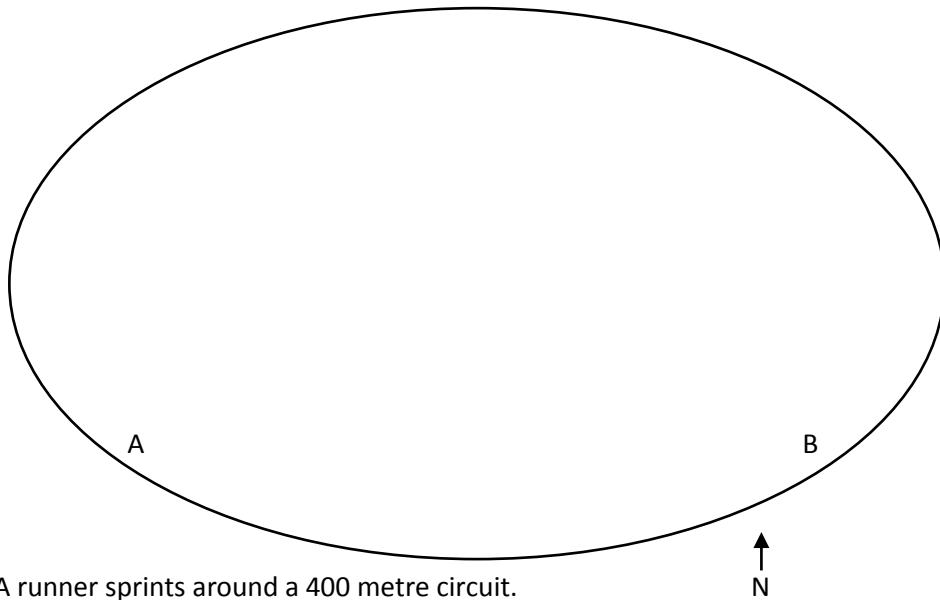
A to B velocity = 5 km/20 min = 15 kph E

B to C velocity = 10 km/30 min = 20 kph E

A to C velocity = 15 km/50 min = 18 kph E

Motion - Vector Quantity

Distance and speed are classified as scalar measurements.
 Displacement and velocity are classified as vector measurements.



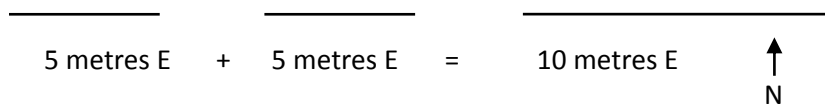
A to B distance = 100 metres A to A distance = 400 metres
 A to B displacement = 100 metres A to A displacement = 0 metres

100 metres scalar measurement
 100 metres EAST vector quantity

Motion - Resultant Vectors

Vectors may be added together to create a resultant vector. This is done by adding the vectors together in a top to toe arrangement and placing a direct line between the start and the finish.

The resultant vector is the sum total of each vectors quantity.



Motion - Acceleration

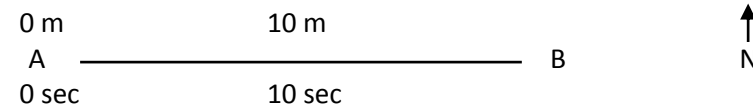
A (acceleration) is a rate of change in velocity, or, the change in velocity over a given time period.

If a car increases its velocity by 1 km/hr each second, its acceleration is described as 1 km/hr/sec.

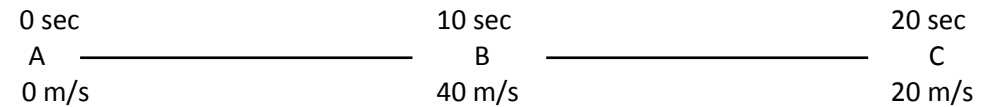
An object accelerating at 1 metre/sec each second is described as 1 metre/sec/sec, or, commonly expressed as 1 m/s² (^ = squared)

If an object is accelerating at a constant rate of 2 m/s² it is increasing its velocity by 2 m/s each second.

- 0 seconds = 0 m/s
- 1 seconds = 2 m/s
- 2 seconds = 4 m/s
- 3 seconds = 6 m/s
- 4 seconds = 8 m/s



B velocity = 10 m/s E (metres per second)
 A to B acceleration = 1 m/s²E (metres per second squared)



A to B acceleration = 4 m/s²E (40 m/s/10 seconds)
 B to C acceleration = -2 m/s²E (-20 m/s/10 seconds)
 A to C acceleration = 1 m/s²E (20 m/s/20 seconds)

Motion - Mass

M Mass = the quantity of matter contained in an object.

I Inertia = the tendency of a mass to maintain a motionless state, or, a state of constant velocity, or, a resistance to action or change.

F Force = A push or a pull that causes or tends to cause motion.

The size or magnitude of the force required to change the state of motion of a body depends on the following;

- The mass of the object to be moved
- The point of application of the force
- The direction the force is applied
- The length of time the force is applied

Newton's laws of motion are:

- The size of the force depends on the mass of the object
- The greater the force the greater the acceleration
- For every action there is an equal and opposite reaction

Motion - Momentum

Momentum = Mass x Velocity $M_o = M \times V$

An objects momentum can be changed by;

- Altering the mass
- Altering the velocity

N Newton = the common unit of expressing force

5 kg travelling at 10 m/s = 50 N

Force = Mass x Acceleration $F = M \times A$

Motion - Moment Of Inertia

Moment of inertia is the objects reluctance to change its angular motion. Moment of inertia depends upon the mass of the object and how far it is from the axis of rotation.

Moment of inertia = Mass x Radius² (radius squared)

A

Length = 2 metres Weight = 2 kg # = axis of rotation

Moment of Inertia = 8 N (2 kg x 2 metres²)

B

Length = 4 metres Weight = 2 kg # = axis of rotation

Moment of Inertia = 32 N (2 kg x 4 metres²)

Motion - Angular Momentum

The Momentum in angular motion depends upon the objects;

- Moment of inertia
- Angular velocity

Moment of inertia is the objects reluctance to change its angular motion.

Angular momentum = moment of inertia x angular velocity

For the examples above we can apply a velocity of rotation of 10 m/s.

Angular Momentum A $8 \text{ N} \times 10 \text{ m/s} = 80 \text{ N}$

Angular Momentum B $32 \text{ N} \times 10 \text{ m/s} = 320 \text{ N}$

Motion - Conservation Of Angular Momentum

When objects are in the air, angular momentum is conserved unless some other external force is acting on the object. To keep the same angular momentum a decrease in the moment of inertia will increase the objects angular velocity.

Arrow Selection - General

It is important to determine to what use or type of shooting that the arrow is going to be used for. This determination should encompass all possible information to make the selection as accurate as possible.

Trying to select one arrow to shoot target, clout, indoor and field is a compromise and does not allow the true score potential to be realised.

Target shooting, especially distances exceeding 60 metres, requires speed and grouping as its main criteria.

Field shooting, especially unmarked distances, has more emphasis on speed.

Hunting has a need for hitting power (kinetic energy), therefore we tend to select a heavier, stronger arrow.

Indoor shooting requires stability but also the need to maximise the score with line cutters so a large diameter, thin walled arrow would be our selection.

Clout shooting is based on grouping but because of the distance the arrow is shot we need to change the dynamics of how the arrows performs. The details of this will follow later.

As you can see, selecting one arrow to do a variety of tasks is a compromise. We will now analyse these variations within each style of shooting to ensure we can make the best selection possible.

When selecting the arrow we should understand what effect the following has on performance.

- Column loading spine, arrow dynamics
- Type of release spine, arrow dynamics
- Weight spine, arrow dynamics, speed, kinetics
- Outside diameter spine, drag
- Point shape spine, drag
- Fletching drag, stability
- Nocks drag, line of force

You will note that drag and spine are significant factors on arrow selection.

Arrow Selection - Spine

Spine can be defined in two parts, static spine and dynamic spine.

Static spine is the deflection caused when a 1.94 lb weight is suspended in the middle of a 29" shaft (supported at two points 28" apart).

Dynamic spine is the deflection caused when an arrow is shot and is affected by different factors such as arrow dynamics, kinetics, line of force and drag.

Parallel shafts have similar static and dynamic spine because a parallel shaft, when shot, will bend through the middle of the shaft.

Barrelled shafts are completely different. When being measured for static spine, a barrelled arrow will bend through the first and last thirds of the shaft. When shot, a barrelled arrow will only bend in the last third of the shaft.

It is this variation that causes the difficulty in trimming these arrows. Trimming a barrelled shaft from the front has little effect on spine. Trimming a barrelled shaft from the rear has a dramatic effect on spine as it is the last third of the shaft that bends during the shot.

The spine deflections for barrelled shafts you see listed in the catalogues are more of a dynamic spine calculation.

Arrow Selection – Type Of Release

In most catalogues you will note that an arrow shot from a recurve bow can also be shot from a compound bow with a peak weight of 5 – 10 lbs. heavier, or, a recurve bow will require up to two sizes stiffer in the spine than a compound bow of matching peak weight.

A compound bow shot with fingers will require a stiffer arrow than a compound bow of the same peak weight shot with a release aid.

I have used the following to describe the different types of release.

RF recurve fingers

CF compound fingers

CR compound release

As shown below the string of CR travels in a virtual straight line, whereas CF and RF have curves in the string line. These curves are called the archers paradox and is the result of the string having to travel around the fingers on release.

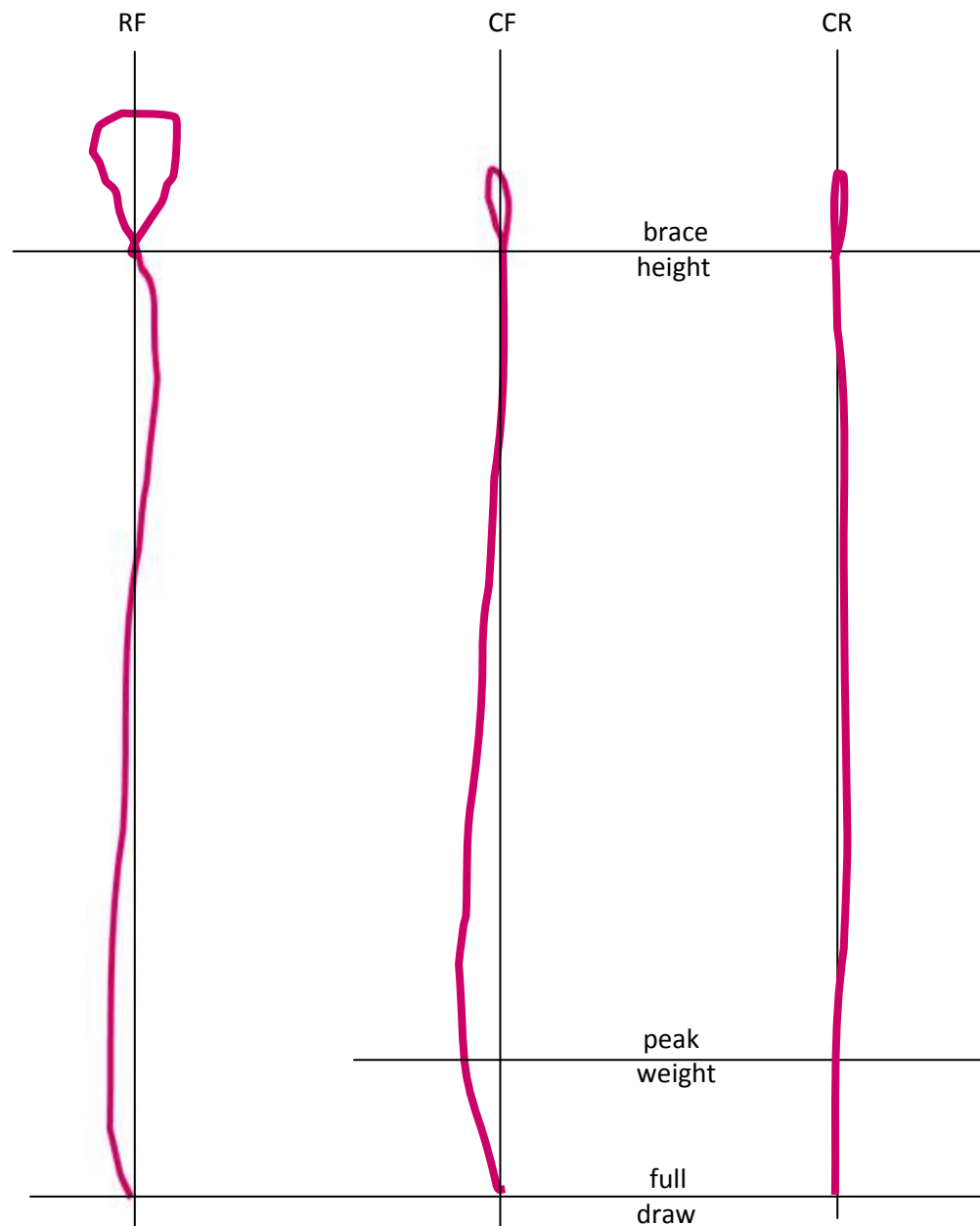
This paradox creates extra forces on the arrow requiring a stiffer spine to overcome them when compared to a release aid.

On CF the paradox between full draw and peak weight is reduced because the bow is usually shorter than a recurve so the string cannot be deflected from the centre line as far, then, as the string reaches the peak weight, the paradox is virtually removed.

This is caused by the increased speed that tends to correct the movement in the string. The purpose of this information is to understand what effects the archer's paradox has on the spine of the arrow.

The current archery catalogues have charts that help in the selection process.

Arrow Selection – Type Of Release (continued)



Arrow Selection – Column Loading

Column loading is the term used to describe the characteristics of a cylindrical object when force is applied at one end to create motion. In archery this is of course an arrow being shot and column loading relates to the change in the spine of the arrow when it has to push a different weighted point at the front of the column.

A heavier point will induce a greater resistance on the arrow to forward motion so the shaft will bend more until the heavier point starts to move, or, a heavier point will make the arrow shoot softer.

Changing to a lighter point will allow the arrow to accelerate more easily as there is less resistance at the front of the arrow, or, a lighter point will make the arrow shoot stiffer.

In most arrow catalogues you will find a suggested point weight which relates to the front of centre balance the arrow needs to fly correctly. As a guide, a heavy shaft has more built-in stability so it requires less FOC balance as opposed to a lighter shaft that is more susceptible to floating so it will require a greater FOC balance.

Any variance outside the recommendations will result in a dramatic change in arrow dynamics.

Too light a point (too low a FOC balance) will allow the arrow to float, will drift more in the wind and will tend to become destabilised by the fletches over 60 metres especially if you are using spin-wings.

Too heavy a point (too high a FOC balance) will increase the parabola of the flight of the arrow. This is especially seen at distances over 60 metres where the arrow is starting to lose its forward velocity and a point that is too heavy will make the arrow dive, however, this is an advantage we can exploit for clout which we will discuss later.

Arrow Selection – Weight

A heavier arrow will always have a slower initial velocity than a lighter arrow and even given a strong tailwind, arrows do not accelerate in the air.

In most cases the heavier arrow is stiffer but there are exceptions when given a variety to choose from. What should we look for in making our best selection?

For sheer initial velocity the lightest, correctly spined arrow will be the quickest and again based on its intended use, may well be the best selection.

If its intended use exceeds 60 metres it may well be too light in its mass and become unstable in its last few moments of flight.

There are several factors that affect arrow flight with the major ones being gravity, kinetic energy, drag and wind.

Arrow Selection – Gravity

Gravity has an equal effect on all arrows so it has little bearing on our decision making.

Arrow Selection – Kinetic Energy

Kinetic energy is force (peak bow weight) multiplied by mass (total arrow weight). If peak weight remains the same for each example the heavier the arrow we select the slower it will be but will have more hitting power.

This is important for hunting arrows to be effective.

An example would be a table tennis ball hitting you at 50 kph as opposed to a bowling ball hitting you at 50 kph.

Weight is of paramount importance in calculating kinetic energy and the best selection we can make for target shooting at 90 metres is not necessarily the lightest.

The lighter the arrow the faster the initial velocity, however, the lighter the arrow the greater the rate of deceleration.

The heavier the arrow the slower the initial velocity, however, because of its heavier mass the rate of deceleration will be less.

Arrow weight	Initial velocity	90 metres velocity	Total loss
100 grains	290 fps	140 fps	150 fps
300 grains	250 fps	160 fps	90 fps
500 grains	210 fps	180 fps	30 fps

These figures show that a light arrow is very fast out of the bow but loses its forward momentum very quickly.

This can also be expressed as the elapsed time over 90 metres.

100 grain arrow = 1.5 seconds

300 grain arrow = 1.3 seconds

500 grain arrow = 1.7 seconds

Arrow Selection – Drag

Drag is the effect of air changing direction (deflection) by an object passing through it. Drag can be broken down into two parts;

Positive drag (positive air pressure) is the effect of an object compressing air in front of it which causes the air to change direction as an arrow in flight.

Negative drag (negative air pressure) is where drag is created by the air pulling at the object usually from behind or by vortices created by a vacuum. Negative drag is sometimes described as the effect of a parachute opening.

Dirt and grime have a far greater effect on arrow performance. As an experiment, place a 10 cm strip of thin double sided tape along the side of your arrow starting around 10 cm from the point. There will be no discernible difference in weight but the arrow will miss the target at 70 metres.

The effect of drag will be discussed in more detail over the next few sections.

Arrow Selection – Outside Diameter

As a general rule an increase of 1/64" in outside diameter will increase the spine to the equivalent of around .0003" in wall thickness but will only increase weight by around 20 grains (4 fps). As a general rule an increase in wall thickness of .0001" will have little effect on spine but increases the weight of the arrow by around 20 grains (4 fps).

Some examples are: (70 lb compound, 29" arrow)

2312	spine .420	weight 270 grains	240 fps
2215	spine .415	weight 310 grains	232 fps
2117	spine .405	weight 350 grains	224 fps
2020	spine .420	weight 390 grains	216 fps

In the above examples each of the arrows will fly correctly out of the same bow yet as you go down the list from size 2312 to size 2020 each arrow will have a slower initial velocity of around 8 feet per second. Over the range of arrows listed this means the 2020 is some 24 feet per second slower than the 2312.

Differences in outside diameter have little effect on drag as the total surface measurement (for our examples) is minimal. The use of different points should be considered as per the next section.

Arrow Selection – Point Shape

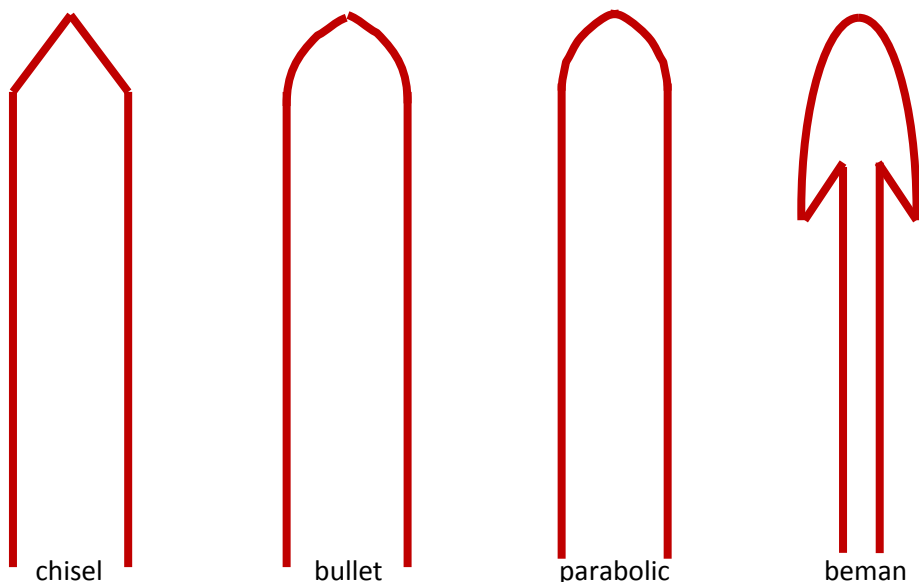
Whilst the outside diameter has little effect on drag the shape of the point can be very important. Drag is basically the deflection of air passing over an object so the smoother and softer the shape the less the effect of drag.

In most cases a series of points are made to match a series of shaft types so you have a few selection opportunities, however, it is important to understand why these points behave differently so the selection process can be more effective.

The parabolic point offers the most efficient shape because it allows air to pass over it from a centre profile but also several degrees off centre. This effect happens in strong crosswinds so whilst a bullet shape is efficient in perfectly calm conditions a slight crosswind will cause the point to present a different profile and drag will increase.

The Beman outpoint present an aerodynamic nightmare. The point is fairly rounded at the tip offering a good profile in crosswinds but the stepped ridge at the back of the point creates a large area of negative air pressure that pulls at the shaft. Whilst negative air pressure occurs on most arrows at the rear the destabilising effect is minimal. On the Beman outpoint it is also happening near the front of the shaft and this effectively destroys stability and accuracy.

Profile of various points.



Arrow Selection – Fletching

To understand how fletching works, and why we have such a large range to choose from, we should again discuss shaft weight and how this changes the moment of inertia, angular momentum and the conservation of angular momentum. A lighter shaft will have less resistance to spinning on its axis than will a heavier shaft, however, once a heavier shaft is spinning it will maintain that rotation for a longer period. Some basic guidelines in selecting fletching;

Light target arrows	- small fletches	
Medium target arrows	- medium fletches	
Light field arrows	-medium distance	- small fletches
Medium field arrows	- medium fletches	
Small game hunting arrows	-field point	- medium fletches
Large game hunting arrows	-broadhead	- large fletches
Indoor arrows	- large fletches	
Clout arrows	- small fletches	

Light weight arrows will lose forward velocity very quickly. After 60 metres, if the fletching is too large, the effect of rotation will overcome the stability of the point.

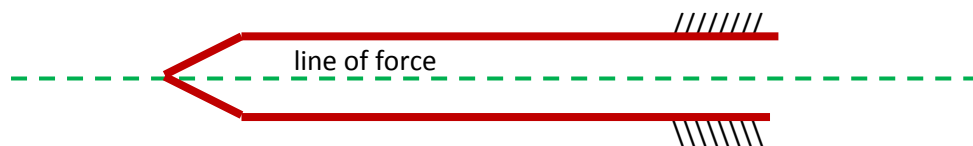
In hunting conditions it is important to get penetration, this is why we select a strong, heavy shaft. A heavy shaft by itself is quite stable but a multi-bladed broadhead creates a 'kinard' wing which will guide the arrow along air currents. To overcome this and create stability we put on large, angled fletching to induce enough rotation to maintain straight arrow flight.

When shooting indoors we should select large diameter, thin walled arrows with a heavy point that offers stability. Because of the short distance, and the fast acceleration of the light shaft, very large, light fletching is recommended.

When shooting clout the consideration of drag, kinetic energy and arrow dynamics are all put to the test. An arrow that is too fast will also be too flat in its trajectory and any height errors made at the moment of release will result in length errors in the scoring zone. An arrow that is too slow will require larger fletching which will allow the arrow to be more effected by the wind, however, it will have a good angle of entry. For shooting good scores in clout I recommend a medium weight shaft (about 40% heavier than your normal target arrow) with a heavier than normal point that will encourage the arrow to drop quickly once its forward velocity starts to slow. To maintain stability over such a long distance, and reduce the effect of the wind, the smallest possible fletching should be used.

Arrow Selection – Nocks

Physics can be applied to archery in many ways. Line of force is of paramount importance but it is often overlooked.



From this view we can see the line of force as it would appear with a straight arrow and a correctly fitted nock.

On release, the force of the bow string is directed through the centre of the nock. If the nock is on crooked, or the arrow is bent, the force will be off-centre and the front of the arrow will not be pushed towards the centre of the target.

The UNI-nock system is a good example of a nock system that virtually guarantees correct alignment. Any of the insert nocks, have good alignment.

Great care has to be taken with nocks that are glued onto a conical swage. You may well indeed put the nock on correctly but the swage itself may be off-centre.

The UNI-nock is also very short and therefore very strong. The Beman outnock, and any long shaped nock, may actually warp and distort at the moment of release no matter how straight the nock may have been put on.

Aerodynamics is also important and any nock selected should have a smooth, rounded finish.

The Beman outnock is large and angular and creates quite strong vortices that effect light weight fletching like spin-wings. In conventional nocks the Pronock is probably the best.

Arrow Selection – Summary

The arrow charts supplied by the manufacturers contain up to 50 years of practical applications from archers all over the world and therefore should be followed as closely as possible. You should note that for any given bow type, bow weight and arrow length combination there may be up to 10 choices that can be made.

Using the information you have now learnt you should be able to select the correct shaft for the correct use.

Arrow Selection – Recommendations

	(70 to 90 metres)		
Target	recurve	X10 A/C/E 11, 12, 13, 14 wall	small fletches medium fletches
	compound	X10 A/C/C 11, 12, 13, 14 wall	small fletches medium fletches
Field	recurve	X10 A/C/E 11, 12, 13, 14 wall	small fletches over 20 metres medium fletches under 20 metres
		X10 A/C/C 11, 12, 13, 14 wall	small fletches over 20 metres medium fletches under 20 metres
	compound	X10 A/C/C 11, 12, 13, 14 wall	small fletches over 20 metres medium fletches under 20 metres
		X10 A/C/C 11, 12, 13, 14 wall	small fletches over 20 metres medium fletches under 20 metres
Hunting	recurve	14, 15, 16, 17 wall	medium to large fletches
	compound	16, 17, 18, 20 wall	medium to large fletches
Indoor	recurve	11, 12, 13, 14 wall	large diameter, heavy points, large fletches
	compound	11, 12, 13, 14 wall	large diameter, heavy points, large fletches
Clout	recurve	A/C/C 12, 13, 14 wall	heavy point, small fletches heavy point, small fletches
		A/C/C 12, 13, 14 wall	heavy point, small fletches heavy point, small fletches
	compound	A/C/C 12, 13, 14 wall	heavy point, small fletches heavy point, small fletches
		A/C/C 12, 13, 14 wall	heavy point, small fletches heavy point, small fletches

Bow Tuning

Objective

To understand the process of tuning a Recurve bow.

Overview

A poorly tuned bow placed into a shooting machine will still shoot groups as it repeats every action exactly. However, we are not shooting machines so we should use our equipment to try and dampen any idiosyncrasies we have with our technique. Having said that, a well tuned bow shot poorly will not shoot groups.

Preamble

Some people put a lot of emphasis on bow tuning as being extremely important. A commonly accepted statement from the 1970's was that bow tuning was 10%, biomechanics 20% and mental attitude 70%.

This session is about working on that 10% of bow tuning and how it interacts with the 20% biomechanics of archery in general.

The first step is to understand the reaction between the body and the bow. This is summarised by that famous statement "for every action there is an equal and opposite reaction".

It is easy to tune your bow for arrow flight. Two adjustments and it is done. But will these nice flying arrows group? Without going all Zen, it is important you are one with your bow, how it feels, how it sounds.

The Challenge

This booklet is to find a way to make your bow work with you.

The bow will always be more consistent than you will be. The objective is to maximise this consistency to your advantage.

Stabilizers

For freestyle recurve archers the basic v-bar system will suffice. The v-bar is designed to provide weight around the area of your grip but away from the handle. This assists in stability and balance.

V-bar weights that are placed behind the grip only add mass to the bow and neutralises the stability they were designed for.

In my personal opinion, most archers have too much mass on their stabilizers.

A lighter mass bow is easier to control in the wind.

The next is rotation. If a bow doesn't rotate, rotates in the wrong direction or rotates too quickly, then the weights are not in the right place.

The first movement of a bow should be forward at the target, then downwards.

The next is the top stabilizer. These work well to dampen vibration in the top limb. However, a well tuned bow does not require vibration dampening – end of story.

Other than the sight, there should be nothing else mounted on your bow above your bow hand. For good field shooting the more natural the vertical balance of the bow the better.

The Recommended Settings

The most important element to good bow tuning is the arrow selection. You can make virtually any arrow come out of a bow reasonably well but to do this the pressure button may be set too hard or too soft and/or it may be too far off centreshot and at the end of the day your scores will be compromised.

The Pressure Button

For a recurve, after arrow selection, this is the most important component to consider.

We discussed above force, kinetic energy and momentum. An average arrow weighs 30 grams and leaves the average weight bow at around 200 km/h.

In Australia we shoot in a southerly direction. That means for a right handed archer the button is mounted on the western side of the bow.

So referring to the archers paradox we have discussed you will see that the arrow is in contact with the pressure button for only a fraction of a second. Because the arrow is travelling in a N-S direction it will have little impact in the E-W direction.

For a pressure button to work with such small forces acting on it the pressure must be set fairly low. In other words, the pressure button pressure must be set to soft.

This will allow the arrow, when leaving in a normal trajectory, to gently press against the button and the button will move ever so slightly.

When you have a poor release you invariably invoke a larger archer's paradox. If the button is set too hard the arrow will bounce off it and your arrow (for a right handed archer) will impact on the left side of the target.

However, when you have a poor release with a correctly set button pressure the button will absorb the extra movement caused by the increased movement of the archer's paradox and the arrow will continue to fly towards the centre of the target.

Adjusting Arrow Flight

So the pressure button has been set to spongy/soft so the question must be; How do we adjust for the variance in the arrow spine?

The answer is using the bow weight adjustment, string weight and point weight.

When you get to part 1 of bow tuning it is necessary to set the nocking point for vertical adjustment and the other 3 variables for the horizontal adjustment. The quickest method is to adjust the bow weight but if the adjustment is too large then you should consider string weight or point weight.

If the arrow selection is correct there should be minimal horizontal adjustment.

Preparation

- Select the correct arrow.
- Align the limbs to the handle.
- Set the bottom limb with a ½ turn more positive adjustment than the top limb.
- Select a string within the recommended number of strands and that it is twisted to suit RH or LH shooting.
- Set brace height in the high half of recommended.
- Set the pressure button pressure to “spongy”
- Set the centreshot so the arrow is seen just outside centreshot.
- Ensure the arrow rest is attached firmly and that the arrow sits in the centre of the button.
- Make sure the sight is attached firmly and that it is horizontally and vertically square to the bow.
- Make sure your main stabilizer is in line vertically and horizontally to the handle.

The Program

To tune your bow will be done in multiple parts.

Part 1 – Basic Tune

Bare shaft tuning. Shoot 3 fletched and 3 unfletched arrows at 10 metres. Adjust nocking point and bow weight until the unfletched arrows group with the fletched arrows.

If the horizontal adjustment is outside your preferred weight range the change the string weight or the point weight.

Part 2 - Fine Tune

Continue bare shaft tuning at 20 metres for newer archers and at 30 metres for the more experienced archers. The adjustments you will be making here shall be finer than what you did at the shorter distance.

Your bow should now be tuned for good arrow flight.

The Program (continued)

Part 3 – Walk Back Test

This is to set the position of the pressure button not the pressure of the button.

Shoot 6 arrows at 10 metres and set your sight windage so they hit where you are aiming. Now go back to your longest distance, or 70 metres, and shoot 6 arrows. If, for a right handed archer, the arrows go left then your button is too far out. If the arrows go to the right your button is too far in.

If your button position needs adjusting then adjust by a ½ turn and repeat the exercise. Take your time and be pedantic. When you have done this exercise a few times you will see the adjustments getting finer and in some cases you may be only adjusting the button by a 16th of a turn.

At the end of this task you should be able to shoot any distance without adjusting your windage. This is extremely advantageous for field shooting.

Tillering

This is the most misunderstood and underutilized adjustment on the bow.

There is a point where the arrow leaves the bow to create good arrow flight and this is called the nocking point. Adjusting the tillering may move the nocking point on your brace height gauge but in reality it is still in the same position in relation to the balance of your limbs.

The centre of the bow is where your hand sits so the arrow is located above centre. Finding the centre of your string you will see that the nocking point is also above the centre. When you shoot a freestyle bow you will, in most cases, be using the Mediterranean grip which means you will be pulling back the string off-centre.

Most bow manufacturers already make the lower limb stronger/stiffer for this reason. Tillering is just fine tuning that difference.

The Program (continued)

Part 4 – Tillering Adjustment

So tillering is balancing the difference between your bow hand pressure (the centre of the bow) and your string finger pressure (above the centre of the bow).

To adjust your tillering stand around 5 metres from a target butt and at full draw aim at a point on the target and close your eyes for 5 seconds. When you open your eyes you should still be aiming at the same point.

If you are above the point then the top limb is too strong and you should reduce the weight by a ¼ turn and retest. If you are below the point the bottom limb is too strong and you should reduce the weight by a ¼ turn and retest.

Good tillering provides a balance between the limbs, your bow hand and your string hand. It will quieten down the bow noise as the limbs will now be working in harmony. Your aiming will be a lot easier because you will not be subconsciously fighting the vertical movement of the bow.

You may now mark the nocking point on your brace height gauge.

The Program (continued)

Part 5 – Brace Height Tuning

At a reasonable long distance that you are comfortable at you shoot 6 arrows and measure the circumference of the group. Notate this measurement against the brace height.

Now raise the brace height by a ¼” and retest. Do this 4 times until you have raised your brace height by at least an inch and then repeat the process by lowering your brace height around 8 times in ¼” increments until you are an inch below your starting brace height.

Then repeat the process by raising your brace height in ¼” increments until you end up at the original brace height.

You should have acquired some very interesting measurements and should be ready to make a decision about which brace height setting gave you the best group. If things have gone well this brace height should also have given you the quietest shooting setting as well.

Understanding Brace Height

With a finger release on a Recurve you get the archers paradox. This is where the string loops around the fingers on release and continues this movement until after the arrow has left the string. Because of this movement the string causes a loop at the end of its travel before returning to its brace height.

It is this loop that is changed by adjusting the brace height. This allows the arrow to leave the string at different points of the loop. By adjusting the point at which the arrow leaves the loop will affect the size of your groups.

The correct brace height will produce good groups, little vibration and little noise. An incorrect brace height will create a noisy, harsh bow that doesn't allow the arrows to group well.

The Program (continued)

Part 6 - Notations

Now that you have tuned your bow you should make a notation of all the measurements on your bow. They are;

- Number of turns from full on the top limb
- Number of turns from full on the bottom limb
- Brace height
- Nocking point
- Tiller measurement
- Bow weight
- Length of serving
- Number of strands in the string

Part 7 - Vibration

Using a rubber based glue you should now glue all your parts on the bow. This should include;

- The limb pocket adjustment
- The limb weight adjustment screw
- The limb locating ball bearing
- Sight bar attachment plus all the screws on the sight.
- Arrow rest mounting (where required)
- Pressure button
- Grip locating screws
- All stabilizers and weights

Reference Notes

In this booklet we have discussed several technical points relating to your equipment. I have listed a few points for your reference.

Arrow Spine

If you use Easton arrows you will find the Easton chart will give you a good guide to the correct arrow.

If you use other types of arrows you should refer to their charts to ensure you have the correct spine.

It is important when selecting an arrow that your bow weight is known and is accurate.

Arrow Weight

This is based on how fast you want your arrows to be and much much you want to pay for them.

With Easton you will find the chart will give you up to 10 selections on the spine you have chosen.

All of these arrows should come out of your bow well but some are lighter, some are heavier and some can be quite expensive.

Front Of Centre (FOC)

As a general rule of thumb, the lighter the arrow the heavier the point needs to be to stop it floating. An alloy arrow can use a point of around 50 grains whereas an A/C/E arrow can use around a 100 grain point.

Watch out for “dip”. This is where a heavy pointed arrow may start to dip in flight once past 60 metres on a 40lb bow.

An A/C/E arrow with a 120 grain point and shot from a 50lb bow may dip when close to 90 metres.

Reference Notes

String Weight

A lighter string is more prone to the archers’ paradox. A heavier string tends to negate some of the paradox.

A lighter string is faster, tends to soften the arrow, can have more vibration and be noisier.

A heavier string is slower, tends to stiffen the arrow, can dampen vibration and reduce limb wobble.

Nocking Point And Nocks

A nock that is too tight will grab at the string on release and will therefore leave the string in a less than ideal fashion. Too loose and it may dry fire.

The arrow should clip gently onto the string. A flick of the string with your finger and the arrow should come off.

Finger Tabs

All finger tabs should be identical in design and construction and be equal in wear and tear.

If one tab is soft and another firm then the results between the two will be noticeably different.