Unstrung Measurements

Tools needed: Flexible tape measure, calipers, drawboard

Minimum Box Dimensions

Description: The dimensions of the smallest box that the bow would fit in
Rationale: If you ever wanted to put the bow into a box or buy a case for it, you would need the minimum box dimensions.
Directions:

- Length: Measure from furthest tip to furthest tip
- Height: Put the tips of the bow against a wall and then measure to the furthest point from the wall that it reaches
- Depth: The thickest part of the bow when resting on its side

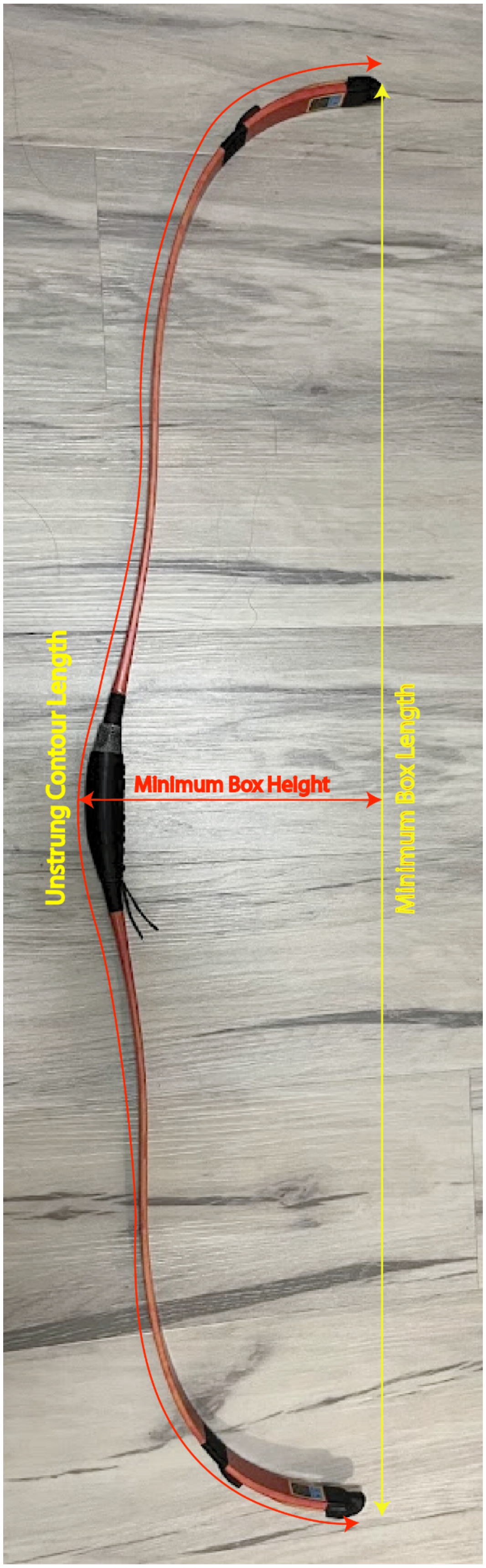
Unstrung Contour Length

Description: The length of the bow along its belly contour
Rationale: Overall length measurement of the bow
Directions:

- Measure from tip to tip of the bow, along the belly, while unstrung

Measuring asymmetry:

Rationale: Primarily for asymmetrical bows, but limb ratios may give some insight into bow performance/characteristics.
Measure the entire contour length of each limb, from siyah tip to respective end of the grip, while unstrung, along the belly


Unstrung Contour Length
Minimum Box Height
Minimum Box Length

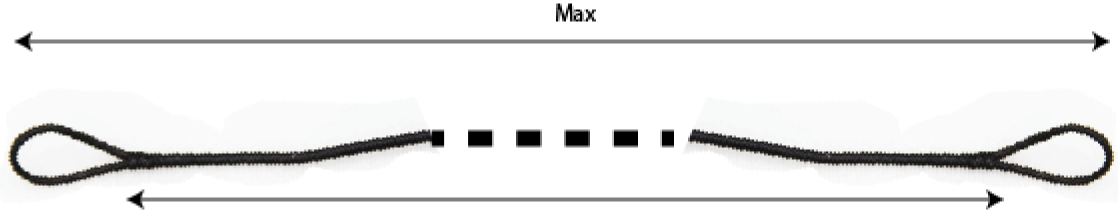
String Length

Description: The minimum and maximum length of the string. The maximum length is measured from the furthest point on the outside of one string loop to the furthest point of the other string loop. The minimum length is measured from the innermost point of one string loop to the innermost point of the other string loop

Rationale: You should be able to use these dimensions to recreate the stock string

Directions:

- MinStringLength is the length between the innermost part of the two loops
- MaxStringLength is the length of the entire string, if stretched out, from loop end to loop end


Max
Min

Min/Max Limb Thickness/Width:

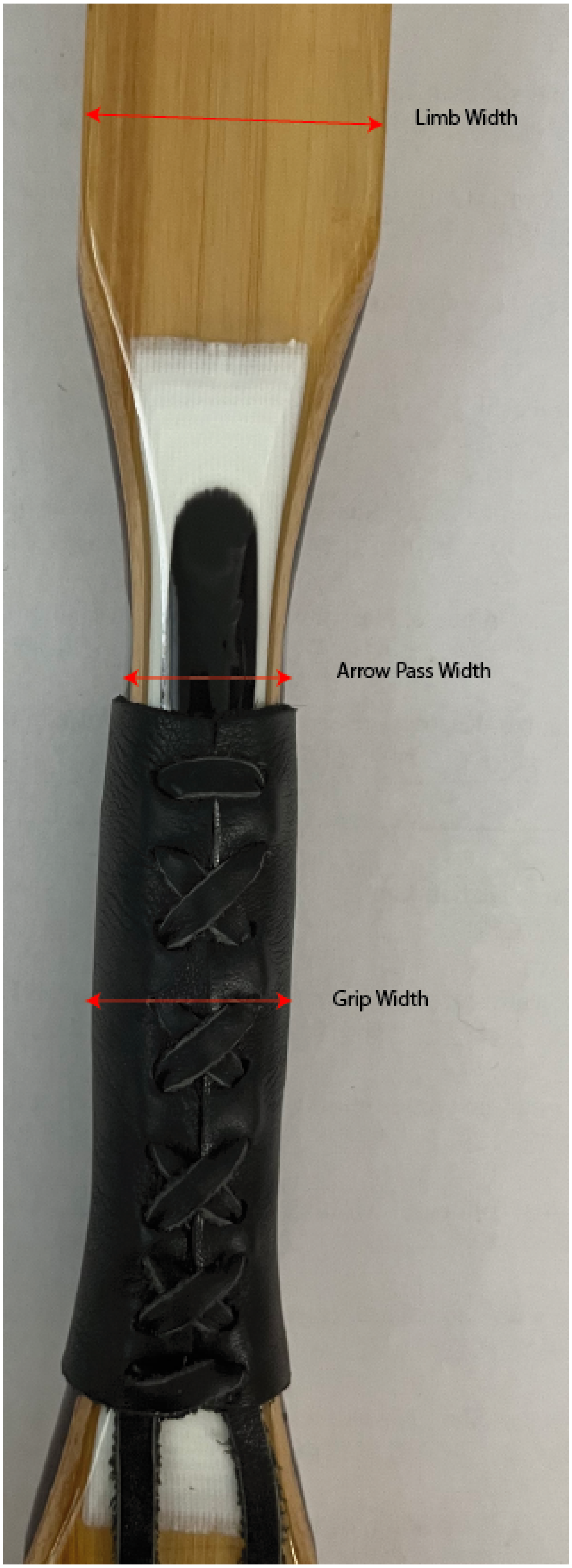
Rationale: Minimum and maximum limb thickness and width will inform you of how the bowyer decided to tiller the bow. Variance between different samples of the same model will inform you of how the bow varies between different poundages.
Description: The minimum and maximum thickness (distance from belly to back) and width (distance from one edge of the belly to the other edge) of the bow in the bending section(s).
Directions: Take a pair of calipers and measure along the bending section of the limbs to find the min/max width and thickness

Arrow Pass Width:

Rationale: Arrow pass width is an important factor in how arrow flight feels due to archer's paradox
Description/directions: The width of the bow at the arrow pass, right above the grip.

Grip Dimensions

Rationale: It would be nice to have an idea of what the grip is like (large, small, long, short, etc) before you buy it.
Description: Grip length, width, and thickness in mm.


Limb Width
Arrow Pass Width
Grip Width


Grip Length
Grip thickness

Effective Siyah Length

Rationale: Actual siyah length is not important, what matters is the effective lever that the siyah forms with the bending section of the bow. See https://www.youtube.com/watch?v=PnA-oDN73a0 for more explanations.
Description: On a recurved bow, there is the section that curves in the direction of the belly (the bending section), and the recurve section that curves away from the belly (the siyahs). Effective siyahs begin at the point where the curvature of the bow changes from bending towards you to bending away from you, the inflection point.
Directions: Measure a straight line from the point where the string sits to the belly side and the back side of the inflection point, and average the two distances.

Strung Measurements

Effective Siyah Angle:

Rationale: See rationale for effective siyah length. Note that the angle that the effective siyah forms with the limbs of the bow changes with brace height/string length, hence why this measurement should be done while strung.
Directions: String the bow with the stock string. First, draw a reference line through the inflection point along the bow . This will be roughly where the bow begins to reflex. Next, draw a line from that same point to where the nock is for the effective siyah angle.

18.96 degrees
44.96 degrees

Brace height:

Measure brace height to the belly at the arrow pass with the stock string

Strung length:

Length of the entire bow, when strung, tip to tip

Draw Force Curve

Rationale: This is probably the single most important measurement that we will have, as this curve tells you how the bow performs/what it will feel like in usage. Note that this draw force curve is measured from the belly of the bow rather than the back of the bow. This is due to the fact that bow grips are of variable thicknesses, and so it would be very difficult to have a locator to the back of a bow, but it is very doable to have a locator on the belly of the bow.
Directions: If possible, measure the draw force curve with a winch and a drawboard setup.

Calculated Variables

These are calculated by me after you send in the curve. You don't have to do anything.

Regression Curve

The regression curve is calculated using https://tom-alexander.github.io/regression-js/ as a sixth order polynomial. Originally, we tried to use a lower order polynomial, but that resulted in the derivative behaving oddly (the lbpi started dropping according to the derivative… which is… definitely wrong).
In actual fact, the curve should really be a difference of two exponentials, but it's a little hard to implement that, so that is still yet to be done.

Central Difference Curve

The central difference curve is actually composed of three parts: The first two points are done using fifth order forward and backward differences, and then all the middle points are done using a fifth order central difference calculation. Data around the edges will be fuzzy.

Stored Energy

The stored energy is calculated by taking the integral of the draw force curve using the trapezoidal rule. We calculated the stored energy at 28”, max draw, and the mean of 28” and max draw.

Virtual Mass

Rationale: Bows exhibit hysteresis (The draw force curve when the string is released is lower/distorted compared to the draw force curve when the string is drawn). That hysteresis is part of the bow inefficiencies. While we cannot easily measure the hysteresis easily, what we can do is calculate the bow’s virtual mass, which will let us more accurately calculate energy transfer and efficiency of the bow.
More information can be found here:
https://doi.org/10.1119/1.1990474
https://sites.google.com/site/technicalarchery/technical-discussions-1/virtual-mass---the-key-to-understanding-arrow-speed

Efficiency/Velocity/Energy TransferTests

FPS tests should be conducted with the following arrow weight buckets in mind:

- Minimum GPP
- Minimum GPP + 20-30%
- Minimum GPP + 40-60%

Ideally, these would be done with a Hooter Shooter style rig, ensuring minimal amounts of human interaction.
Arrows shot can be of 3 different draw lengths. It can be the same physical arrow but drawn to different draw lengths, with the weight adjusted to match the GPP for that draw length.

- 28” (Standard draw length in archery)
- Max draw (Bow’s maximum ability)
- (28 + max draw)/2 (Medium energy test)

I.e., if your bow has a max draw of 32” and is 30#@28”, 35#@30”, 40#@32” with a min GPP of 10gpp, then you would test with 300gr (28”), 350gr (30”), 400gr (32”) as the “Minimum GPP” bucket.

Drawbacks with using the same physical test arrow (with adjusted weights)

- Dynamic spine may be greatly affected by the added weight at either end. Increasing weight by equal amounts should negate the changes in dynamic spine but this has not been tested.

Test Arrow

20-40#
Shaft Options:

Easton Carbon Legacy 700

Stock length of 34” to account for majority of archers and same component selection to 340

Estimated arrow weight of 336gr

CrossX Ambition 700/600/500

Stock length of 33” excludes the rare monkey arms without any adjustability

Estimated arrow weight 296.6(700), 319.7(600), 378(500)

40-150#
This is a test arrow that should be used for bows that will work safely with arrows of weight 421gr up to 1381 grain of arrow mass. For most modern material bows, this would likely be the arrow of choice for testing bows between 40# and 120#

- Easton Carbon Legacy 340 stock length - 343gr - 34”
  https://lancasterarchery.com/products/easton-carbon-legacy-arrow-shaft
- Victory VForce .245 insert - 22gr
  https://lancasterarchery.com/products/victory-vforce-aluminum-insert
  - Allows use of Victory .245 weights for micro adjustments to total arrow weight
- TopHat Screw-In Tool Steel Pin Points - 40gr
  https://lancasterarchery.com/products/tophat-screw-in-tool-steel-pin-points
  - Lightest point sold by Lancaster, required to have aerodynamic front
- Gold Tip Traditional Nock Adapter - 19.6gr
  https://lancasterarchery.com/products/gold-tip-traditional-nock-adapter
  - Allows for weights at nock end to negate dynamic spine changes from front weight
  - Requires light sanding for fitment <1gr removed. Final diameter of 6.2 or 6.21mm

- Easton 6.5mm 3D Super Nock - 13gr
    - Included with shaft

Estimated minimum weight of arrow: 437.7gr

Can be further lightened with
- Victory VForce .245 insert - 11gr
    - Not sold on Amazon, only through Victory dealers
- Easton 6.5mm Microlite Super Nock - 8gr
  https://lancasterarchery.com/products/easton-6-5mm-microlite-super-nock
    - Sold seperately or cannibalized from Easton 6.5mm Bowhunter

Estimated lightened weight: 421.7

Victory .245 Back Weight Modules
https://lancasterarchery.com/products/victory-245-back-weight-modules
Ideally a set of each 10, 20, and 50gr weights to allow for maximum adjustability
Will add 120 - 960grs to total weight depending on number of weights used

Draw Board Design

A draw board is a simple device on which draw weight can be measured reliably.
Look for a “luggage scale” or a “fishing scale”
This is an example of a draw board design that is cheap (<$75) and easy to do with a minimal number of tools required:

Tools:
- Electric drill
- ⅜” drill bit
- Saw

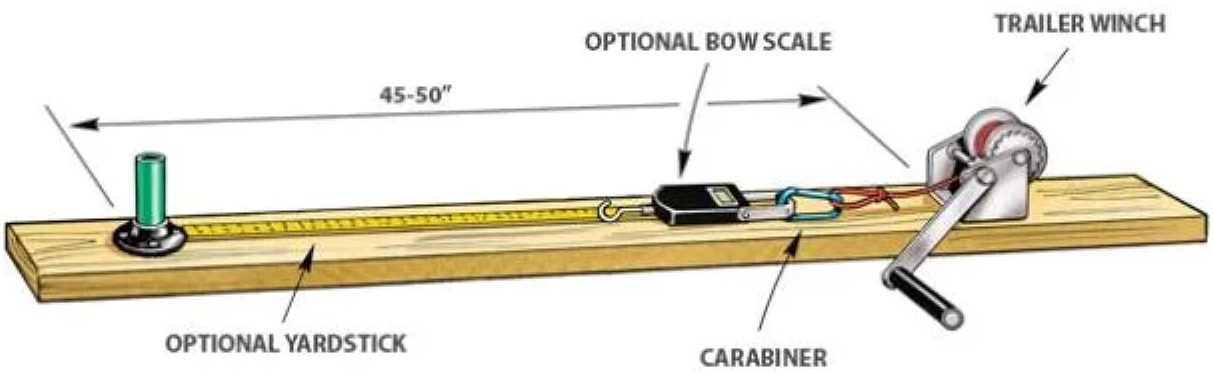
Materials:
- 1x 2x4x8’
- 2x 3” wood screws
- 3x ⅜”x2” bolts
- 3x ⅜” nuts

Winch: https://www.amazon.com/Capacity-Operated-Two-Way-Ratchet-Trailer/dp/B082FK95GZ/
Scale:
https://www.amazon.com/ORIA-Waterproof-Measuring-Batteries-Included/dp/B09MVSTH43/

1. Cut a 60” section off of the 2x4. That section will form the main body of the drawboard.
2. Cut a 2-3” section off of the 2x4. This section will hold the bow.
3. Mark 4” from one end of the 60” 2x4.
4. Line up the 2” section on the 60” section such that there are 2” in front of it (i.e., one edge goes at the 4” mark).

5. Using the electric drill, screw in the 3” wood screws to hold the 2” section in place.
6. Place the winch on the other end of the 60” piece and mark the holes for the bolts.
7. Drill the bolts and install the winch with the nuts and bolts.
8. Mark 1” increments going down the draw board.

Examples:


TRAILER WINCH
OPTIONAL BOW SCALE
45-50"
OPTIONAL YARDSTICK
CARABINER