

# Dynamic Spine Calculator



Arrow Inputs								Arrow Outputs				
Arrow Shaft Size	BOP Length (inches)	Point Weight (grains)	Insert Weight	Footing (Y/N)	Nock End Weight (grains)	Fletching Type	Dynamic Spine (pounds)	Total Weight (grains)	Specific Weight (GPP)	F.O.C. (%)	Speed (FPS)	Energy (ft-lbs)
1 2018	2 29.50	3 125	4 19	5 No	6 13	7 4" Feathers	63.6	527	10.2	11.9	177.0	36.6
If "Wood Shaft" or "Other" is selected then enter info here		AMO Static Spine ( 2# @ 26" )		Footing Length (inches)								
0		0.0		0.0								
		Shaft Grains per Inch (GPI)		Footing Weight (grains)								
		0.000		0.0								
		Shaft Diameter (inches)										
Bow Inputs												
Bow Type	Rated Weight (pounds)	Rated Draw (inches)	Your Draw (inches)	Strike Plate Position Red = PAST Center (inches)	String Material Type	Arrow Dynamic Spine Required (pounds)						
8 Recurve	9 50.0	10 28.0	11 28.5	12 - 1/16	13 B50	63.6						
								14 Calibration				
								Personal Form Factor		0		

These two numbers should be nearly equal (within 2#). Fine tuning can then be done by adjusting the bow's brace height.

- If the arrow is slightly weak (lower dynamic spine) for what the bow needs, then lower the brace height.
- If the arrow is slightly stiff (higher dynamic spine) for what the bow needs, then raise the brace height.

## Quick Tips:

- Always start with the "Personal Form Factor" set to "0". After all inputs are confirmed to be accurate, only then use the calibration feature described below.
- Calculations are based on parallel shafts. If using tapered wood or front loaded carbon shafts then the dynamic arrow spine will be slightly weaker and the FOC % will be slightly higher. To estimate this influence, subtract 2# from the arrows dynamic spine number and add 1.5% to the FOC number shown.
- When using inserts longer than the normal RPS (ex: 100 gr brass, HIT inserts, etc.) make sure you compensate correctly using the "Footing" option. See below for detailed instructions.
- A heavy arrow crown/cresting or thick crown wrap will increase the dynamic arrow spine so add the appropriate weight along with the nock weight in box 6.
- If using multiple or extra heavy string silencers on your bow then the required dynamic arrow spine will be slightly reduced. Subtract 2# from the bows required dynamic spine number.
- Most common errors can be attributed to:
  - Using an incorrect draw weight. Many bows can be off as many as 4# from the marked weight.
  - Using an incorrect draw length. Your draw length may vary depending on the specific bow
  - Incorrect strike plate location position (This is the centercut dimension of the riser plus the strike plate thickness).

NOTE: Double check these both by actual measurements whenever possible.
- Fine tuning tips:

Once the arrow dynamic matches the requirement of the bow (approx within 2#) then fine tuning can be accomplished in a couple ways:

  - Brace Height:
    - If the arrow is slightly weak (lower dynamic spine) for what the bow needs, then lower the brace height.
    - If the arrow is slightly stiff (higher dynamic spine) for what the bow needs, then raise the brace height.
  - Strike Plate Position:
    - If the arrow is slightly weak (lower dynamic spine) for what the bow needs, then build out the strike plate slightly. Amount required can be estimated by changing the "Strike Plate Position" number in the Bow Input section to match the weaker spine.

## Instructions for use

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### Enter Arrow Information:

#### 1 Arrow Shaft Size

Select from the drop down menu the arrow size that will be used. The menu contains most popular Easton XX75/78 and X7 series arrows. There are also many popular carbon arrow shafts listed. If you are using a carbon or an aluminum size not shown, then choose "Other" and enter the actual shafts static spine, weight (GPI), and shaft diameter in the three boxes directly below. If you are using a wood shaft select the "Wood Shaft" option and enter the same information in the three boxes below.

##### NOTE:

A. The static spine must be per the AMO standard (2# @ 26" centers).

**Most carbon and aluminum arrow manufactures do not report spine in this way.**

They report spine numbers based on an ASTM standard using 1.94# @ 28" centers.

Convert ATSM spine to AMO spine by dividing by 0.825. A static spine converter is included above and is useful if the specific shafts deflection is known.

B. The weight should be entered in grains per inch (GPI) of the bare shaft. If a weight tube that runs the entire length of the shaft is being used then make sure to combine it's GPI with that of the shaft itself. This will affect the dynamic spine of the arrow.

C. Enter the outside diameter of the shaft in inches (ex:0.344)

#### 2 BOP Length

Enter the **B**ack **O**f **P**oint shaft length. This is the length from the back of the point (BOP) to the bottom of the arrow nock groove where the string touches.

#### 3 Point Weight

Enter the point weight that will be used.

#### 4 Insert Weight

Enter the weight of the insert being used on an aluminum or carbon shaft.

*Ex: 5/16" aluminum insert weighs ~16 grains, a 11/32" aluminum insert weighs ~ 30 grains. CE 150 insert weighs 11 grains .*

*Note: There is a list of Easton Insert and Bushing weights include in the Additional Reference Information page.*

Remember to also take into account any weights that are added behind the insert.

##### **Important:**

If using a longer insert than a std RPS insert, like the popular 100 gr brass insert, remember to set the "Footing" option to yes and enter the additional insert length there. For reference, I typically use 1" in the footing length field when using a 100 gr brass insert. The HIT inserts also fall into this category and are very long for their weight. Remember to include the depth set into the shaft also!

#### 5 Footing

If an internal OR external footing is being utilized then select "YES" from the drop down menu. In the boxes below enter the length of the footing in inches and also the total weight of the footing.

- An example of an internal footing would be any insert with a length greater than 0.9" (std. insert length). In that case enter the amount greater than the 0.9" that is already accounted for automatically.
- An example of an external footing would include be an aluminum shaft glued over the outside of a carbon shaft. In the case of an external footing enter the total length and actual weight.

## **6** Nock End Weight

Enter the total weight of the nock and/or nock insert. If an arrow crown wrap is being used then it weight should also be added.

*Ex: A 11/32" Bohning Classic Nock weighs 13.5 grains. A CE Nock weighs 9.8 grains. A wrap typically runs between 6 to 15 grains.*

## **7** Fletching

Select from the drop down menu the type of fletching that will be used. The calculation assumes the std. weight of Trueflight feathers or a total of 32 grains for three generic 4" vanes. If a specific vane is used that differs from this weight, then simply add/subtract the difference from the Nock End Weight.

# Arrow Results:

## Total Weight

The assembled arrow's final weight is automatically calculated and displayed in this box. Aluminum and carbon weights will be very accurate. Wood arrow finishes are not accounted for due the variability of types and application techniques. If desired, this additional weight should be added to the wood shaft's GPI weight. *(A typical wood arrow finish runs about 10~20 grains)*

## Specific Weight

The specific weight is the Grain Per Pound of your arrow setup relative to the bow information and your draw length entered in boxes **9 ~ 11**. Some manufactures recommend a specific GPP for their bows. A good general rule of thumb is 8~9 GPP for a target/3D arrow and around 10+ GPP for a hunting arrow.

## F.O.C. % (Forward of Center)

This is the measure of how far forward from the center of the shaft is the balance point. A minimum amount of approximately 5% is necessary to ensure stable arrow flight. Too much F.O.C. will result in an increase in arrow drag and will limit effective cast.

Recommendations are:

- For 3D / Target shooting try to remain in the range of 8% - 12%. This will ensure stability while maintaining a flat trajectory.
- For Field / Hunting try to remain in the range of 10% - 20%. The effect on trajectory at normal hunting distances will be minimal and the chance of arrow deflection if contacting leaves or small branches will be minimized. Increased penetration has been reported with a higher F.O.C. (15% - 25%)

## Speed

The initial arrow speed is predicted and reported in feet-per-second. This prediction is made relative to all the arrow and bow inputs (boxes **1 ~ 13**). The equation has been calibrated to a shooting machine and has a typical error within +/- 2 fps. This number should be considered as a maximum as a "dead" release or tab drag can often cause a slight decrease in speed.

## Energy

The kinetic energy of the arrow, based on its initial velocity, is displayed in ft-lbs.

# Enter Bow Information:

## 8 Bow Type

Select from the dropdown list the bow type that matches closest.

- Use the "Selfbow/Longbow" setting for an all wood bow or a traditional longbow with straight limbs.
- Use the "Deflex/Reflex Longbow" selection for modern longbows with curved limbs and modern materials.
- The "Recurve" category is self explanatory.
- The "Performance Recurve / Horsebow" option should be selected when a high efficiency design such as an A&H ACS or foam core/carbon limb design is utilized. Also a highly recurved short bow or horsebow utilizing modern materials should use this setting.

## 9 Rated Weight

Enter the rated weight of your bow in pounds. *Ex: **45#** @ 28"*

Note: It is always wise to confirm the actual draw weight as the bow makers marking are sometimes off or perhaps the bow has relaxed from age/set.

## 10 Rated Draw

Enter the draw length in inches at which the bow is rated. *Ex: 45# @ **28"***

## 11 Your Draw

Enter your own actual draw length in inches. Don't assume that you draw a standard 28". Have a friend mark an arrow at the front of your bow's riser when at full draw and at your correct anchor. Your draw length is from that mark to the bottom of the arrow nock groove where the string touches.

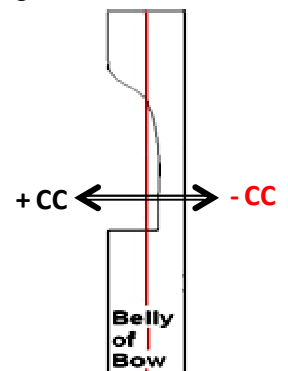
## 12 Strike Plate Location

Select from the drop down menu the location of your strike plate (side surface where the arrow touches). Measure your actual bow's strike plate surface relative to the string when centered on the limbs.

*Ex: Reference the attached sketch to the right.*

*True center position is = 0. Plus +1/8" would be less than center cut (strike plate surface is outside of string centerline), and -1/8" would be cut past center (strike plate surface is inside of the string centerline).*

*Most recurves are center cut or more, most long bows are slightly less than center cut.*



### **13** String Material & Type

Select from the drop down menu the type of string material that is being used. FastFlight strings (low stretch material) also show the number of strands used in the string bundle. These modern materials and low strand counts can make a significant effect on the bow's dynamic spine requirement.

## **Results:**

After each cell (**8** to **13**) has been entered the recommended arrow dynamic spine for your bow will be displayed. This spine is theoretically correct for that bow set-up and only minor tuning (see notes above) should be required to achieve good arrow flight. This assumes a good form and release. (*Ex: A poor release or "plucking" will require a higher dynamically spined arrow to compensate for the exaggerated string deflection forces.*) Each individual shooter is unique and some "experimenting" will be required to dial in the number perfectly. Once you have settled on the optimal dynamic number for an arrow then simply match that number with other new arrow configurations and the same flight performance can be expected.

## **3. Compare Dynamic Spines:**

Compare the dynamic spine required by the bow setup to the one calculated for the specific arrow parameters entered (two black boxes). These numbers should be as close as possible to ensure that fine tuning can be successfully accomplished with brace height and minor shelf adjustments (see notes above). If the two numbers are more than ~2# apart then modify the arrow design inputs in order to reduce the variation. The arrow point weight and shaft length are generally the most feasible and effective to modify.

## **Calibration:**

### **14** Personal Form Factor

The personal form factor is a way to calibrate the DSC to your own shooting style and release. To use it simply enter accurate info about an arrow setup that has been proven to work well for you and then enter your bow's info as usual. I recommend bare shaft testing for point of impact relative to fletched shafts for final confirmation of correct flight. With that done you now simply enter a number (ranging from -15 to +15) until the bow required dynamic matches your good shooting arrows dynamic spine. Now that you have found your Personal Form Factor you simply leave it in place when changing to new arrows or bow. If you are new to trad archery, your form and style will change over the first years. The PFF will provide a way for the DSC to change right along with you....I may even be fun to watch the numbers drop as your form and release improves!

For the vast majority of archers using a default "0" setting will remain accurate and the results will be the exact same as the previous version.

## Additional Reference Information:

### 1. Easton Arrows Info (un-cut shaft length, insert and bushing weights)

Size <sup>8</sup>	Stock Length <sup>3</sup>	UNI System <sup>4</sup>			RPS <sup>6</sup> Insert Alum. Grains
	75 <sup>1</sup> /78 <sup>2</sup>	UNI Bushing <sup>5</sup>	X Nock Bushing <sup>5</sup>	Super UNI Bushing <sup>7</sup>	
	Inches	Grains		Grains	
1816	30	8	4	—	12
1916	31	9	7	—	16
2013	32½	—	—	5	21
2016 (500)	32	—	—	4	20
2018	32½	—	—	4	19
2020	33	—	—	—	18
2114 (510)	32½	11	—	7	25
2115	33	11	—	7	25
2117 (400)	33	—	—	7	25
2212	32½	13	—	9	31
2213 (460)	33½	13	—	9	30
2215	33	—	—	9	30
2216 (380)	33	—	—	9	29
2219	34	—	—	8	26
2312 (420)	33	15	—	11	37
2314 (420)	33½	14	—	10	34
2315 (340)	34	—	—	11	37
2317 (300)	34	—	—	11	37
2412	34	17	—	12	40
2413 (360)	34	17	—	12	40
2512	34½	20	—	15	52
2513 (310)	34½	18	—	14	48

— Indicates not available

1 XX75 Realtree Hardwoods HD Green, Camo Hunter, GameGetter, Legacy.

2 XX78 Super Slam.

3 Length is approximately stock shaft length for each size.

4 UNI—Universal Nock Installation System

5 Parenthesis indicates smaller G Nock Uni Bushing size is available as an optional accessory.

6 RPS = Replaceable point System with 8.32 ATA Standard thread.

7 Super UNI Bushing accepts Super Nock, 3D Super Nock and S Nock

8 GameGetter and Super Slam Digital sizes indicated in parentheses.

## 2. Average GPI for 11/32" Diameter Wood Shafts

<u>Spine Range</u>	<u>Sitka</u>	<u>POC</u>	<u>D. Fir</u>
30-35		10.3	11.1
35-40	10.0	10.6	11.3
40-45	10.2	10.9	11.7
45-50	10.5	11.3	12.0
50-55	10.8	11.7	12.4
55-60	11.1	12.1	12.7
60-65	11.5	12.6	13.2
65-70	11.9	13.0	13.6
70-75	12.3	13.3	14.2
75-80	12.6	13.7	14.8
80-85	12.9	14.0	15.5
85-90	13.3	14.4	15.8
90-95	13.7		16.3
95-100			16.6

### NOTE:

1. For 5/16" diameter shafts multiply number above by 0.826
2. Typical wood shaft finish adds 0.7 ~ 1.0 GPI
3. Sitka Spruce has a wide density range so it is recommended to weigh your actual shafts.

## 3. Broadhead Adapter Weights

<u>Type</u>	<u>5/16 "</u>	<u>11/32"</u>
Aluminum Short:	26 gr	30 gr
Aluminum Long:	30 gr	42 gr
Steel :	N/A	75, 100, 125 gr