FOC and Why It's Important

By Don Morrison

For starters, FOC means "front of center". The FOC value for an arrow indicates how far forward of the center of the shaft the center of gravity (COG) is located, expressed as a percentage.

In order for an arrow to fly correctly, with the tip in the lead and the fletching following in the rear, the center of gravity (COG) must be located somewhere between the tip and the middle of the arrow shaft. If the COG is located closer to the tip, the arrow will have good stability but will drop quicker because of the heavy nose. However, if the COG is located closer to the center of the shaft, the arrow will have good range, but arrow flight may be unstable. Thus, there are trade-offs between stable arrow flight and arrow distance/speed. The object is to find a happy medium that will allow you to have the best of both worlds.

Also, the FOC relates to two different aspects of shooting arrows, how the arrow behaves on the bow when being shot and how the shot arrow flies through the air. In order to hit what you are aiming at the arrow needs to come off the bow straight and with no rotation. One of the principal factors which effects how the arrow comes off the bow is how much it bends when being shot ("weak/stiff arrow"). For a given stiffness and length of arrow shaft, bending is controlled is by varying the pile weight. The heavier the pile weight then the more the arrow will bend. The shaft stiffness and associated weight depend on the shaft construction e.g. carbon arrow shafts are stiffer for the same weight then aluminum shafts. For the way the arrow behaves on the bow then the FOC is a guide to what the pile weight should be for the arrow to "match" the bow in terms of coming off straight i.e. have the right amount of arrow bending.

The FOC value also effects where the axis of rotation of the arrow is located as it fishtails etc. about. The arrow rotation point is always in front of the COG and as the COG moves forward increasing the FOC the axis of rotation moves forward. The overall speed of response of the arrow to fletching torque (its angular acceleration), i.e. how fast it straightens up, depends not only on the area of the fletching but on the fletching torque and the "rotatability" of the arrow, its moment of inertia. As the FOC increases the effective fletching area increases and the "lever arm" increases. At the same time the "rotatibility" of the shaft decreases (higher moment of inertia). Overall the arrow fletching response increases with FOC.

Having a high FOC for an arrow provides two principal benefits - better arrow groups and reduced wind sensitivity. When you aim at the gold but the arrow ends up in the black something must have changed the direction of the arrow. An arrow mechanically has to leave a bow going in the direction it was pointed and with its axis very closely aligned with the direction it's going. The arrow changes direction after it leaves the bow and the cause is arrow rotational energy (cartwheeling). The arrow flies in a curved path until this energy is dissipated by fletching drag (the stabilization distance). Having a higher FOC results in faster energy dissipation (more fletching action) and because the drag area moving the arrow is smaller the amount the arrow direction is changed is reduced. The result is more forgiving arrow to bad tuning or a poor shot leading to reduced group sizes. In a wind the smaller drag area that moves the arrow results in reduced wind drift.

A FOC value range of 7-18 percent is widely used as the best for a good balance between arrow range and arrow flight stability. If your calculated FOC doesn't fall with this range, don't fret. You can still have good arrow flight with an FOC as high as 18 percent, but your range will not be as good. Try not to go below 7 percent.

How to determine the FOC manually. Take one of your arrows, fully equipped including tip, that you will be using. First you must find the balance point on the arrow's shaft. To do this try to balance the arrow on your finger or a flat edge. Once you have successfully balanced the arrow, place some sort of mark at that spot on the arrow's shaft. Next, measure (inches) from the bottom of the nock grove to the balance point. Then measure (inches) the length of the arrow from the nock grove to the edge of the arrow shaft, not the insert (this is called the arrows cut length.) Divide the arrow length by two, this will give you the physical center of the shaft. Now subtract the physical center number from the balance point value and divide by the arrow length value. Multiple this number by 100 to get a percentage (%).

Example FOC Calculation	
Balance Point Length	17.25"
Arrow Length	28"
Arrow Length / 2	14"
Balance Point Length - (Arrow Length / 2)	17.25 - 14 = 3.25
3.25 divided by Arrow Length	3.25 / 28 = **11.6% FOC**

In this scenario, the tip of the arrow is a bit heavy for the arrow but the FOC is within the 7% - 18% range (use the lower end for aluminum arrows, the middle range for aluminum/carbon composites, and the upper end for carbon and hunting arrows).

If I wanted to lower the FOC for this arrow I could change to a lighter point or I could add weight to the end of the arrow. Lead tape works pretty well, it can be installed near the nock by completely wrapping the arrow's shaft. Lead tape can be found at most sporting good stores. Once you have the FOC calculated, use some trial and error to get the FOC percent you want.

Different types of arrow shaft have, based on experience, different recommended values for the FOC, ideally:

Aluminum shafts:	7-10%
Aluminum/carbon composites:	10-13%
Carbon Shafts:	13-16%