Notes on the RAM Spine Tester

By Jim Murray   11/15/2018

Most of us use the RAM spine tester to locate the line of maximum stiffness of each individual arrow shaft we are building. We do this to try to make all of the arrows in our quiver perform exactly the same as they leave the string and head downrange. The spine tester in the shop works well for this effort as is.

However, if you plan to use the RAM spine tester to measure the actual static spine (stiffness) of a shaft, and compare it to the manufacturers' stated spine for that product, you need to be aware of the following issues that can give you erroneous results if you are not aware of them.

Tester Brass Weight.

The brass weight provided with the spine tester is supposed to weigh 880 grams (1.94 lbs.). I had it weighed at Pack N Ship, and in the fish department at Publix's, and it weighed only 862 grams (1.90 lbs); that's .64 ounces (2.06%) LESS than required for measuring shaft spine correctly.
So, if you want an accurate measurement of spine, you need to add 5/8 of an ounce of lead fishing sinkers to the top of the brass weight. If you don't, your shafts will show up (incorrectly) as 2% **stiffer** than the manufacturer's specs.

Deflection Measurement Gauge.

The dial indicator provided with the spine tester has a total free travel of 1.035 inches. For the typical small diameter carbon shaft used by target archers, .300 inches of this travel is used up just getting down to the shaft surface. This then leaves only about .735 inches of travel available for measuring deflection when the correct weight is hung on the shaft. This set-up is probably adequate for most higher draw-weight bow shafts, but for shafts having a soft spine (ie. greater than .735 inches of deflection) there is not enough free travel left on the dial indicator to make the deflection measurement; the gauge bottoms out before the shaft stops bending.

Here is one way to address this deficiency: Lengthen the indicator stem. There is a quarter inch felt pad taped to the tester. Stick this to the end of the indicator stem where it contacts the shaft and then let it down onto the shaft. Then zero the gauge face. That will get you an extra quarter inch of free travel, which will allow you to measure shafts with up to about one inch of deflection (ie 1000 spine) at the standard 28 inch spec length.

For shafts with spines above 1000, or if you don't put a spacer pad on the stem, this tester will not accurately measure spine using the standard 28 inch test length specified by the industry. A workaround for this is to reduce the test length by moving the support points in to one of the closer mounting holes (provided), measure the actual – smaller - deflection at this shorter span (say 26 inches) and then apply a little mathematics to convert this reduced – span deflection into a calculated deflection at 28 inches. It goes like this:
The formula for measuring the deflection of a hollow cylinder supported between two unanchored points is

$$\text{deflection} = [\text{load} \div (\text{E} \times \text{I})] \text{ x } [\text{length}^3 \div 48]$$

As you can see by this formula, the deflection for a hollow tube supported in this way varies as the CUBE of the distance (length) between the suspension points, because all of the other components of the formula are the same for any given shaft configuration. So you can calculate the expected deflection at 26 inches easily by dividing the cube of 26 (=17,576) by the cube of 28 (21,952) and then multiplying that result by the manufacturers' specified deflection at 28 inches for the specific shaft being tested. In my case, for a Carbon One 660 spine shaft:

Deflection at 26 inches = [(26 x 26 x 26) / (28 x 28 x 28)] x .660 = .528 inches.

Your actual measured deflection using the 26 inch span should be very close to this calculated number **if** the shaft comports to manufacturers spec.

If you want to wade into this deeper, here is the deflection (spine) formula again

$$\text{deflection} = [\text{load} \div (\text{E} \times \text{I})] \text{ x } [\text{length}^3 \div 48]$$

Where, for our purposes:
Deflection is measured in inches
Length is the distance between the two shaft support points in inches
Load = the weight of the brass piece in pounds =1.94
E= the modulus of elasticity of the shaft material
I = the moment of inertia of a hollow shaft free supported between two points

$$I = [\pi \div 64]x(od^4 - id^4)$$

The value for E x I is unique for each shaft configuration produced, and is beyond our ability to determine through testing, BUT we can calculate it by working BACKWARDS from the manufacturer's specifications, substituting in the advertised spine (deflection) for the product we are measuring.

For example: If we have a Carbon One shaft with a stated spine of 660 at 28 inches:

$$\text{deflection} = [\text{load} \div (\text{E} \times \text{I})] \text{ x } [\text{length}^3 \div 48]$$

Putting manufacturers' specification values into the above formula:
.660 = [1.94 / (E x I)] x [(28x28x28) /48]
yields an (E x I) for a 660 Carbon One shaft of 1344.28.

If we then take this value for (E x I) and put it back into the deflection equation and use 26 inches as the length between the supports, we get

Deflection = [1.94/1344.28] x [(26 x 26 x 26) / 48] or .528 inches!

We should therefore see this much deflection using the RAM spine tester for a 660 spine Carbon One shaft supported between two points 26 inches apart (and I did!).