Tip: Measuring control surface deflection in degrees??

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One of the tools I use just about every time I put together a new airplane is my deflection meter. There are a couple different models available but the one I have is fairly simple and looks like this:

It's fairly easy to use. You simply slip the assembly over the surface to be measured with the little pylons over a sheeted section or directly on the rib of the fixed surface. Position it so that the curved "ruler" portion is close but not touching the trailing edge of the control surface and move the pylons fore and aft a bit relative to each other until the control surface is pointing to the 0 at the center and then use the radio to deflect the surface fully and read the deflection in inches. The opposite side measures in millimeters so, if the manufacturer of your airplane uses metric, you are still in good shape.

The challenge for me came when I was finishing up my recent project and the specification for deflection was in degrees! 1" of deflection I can measure, but how much is 22 degrees?! I found a protractor and tried to measure with that but it was difficult at best and involved about 4 hands to do the measurement. I knew there was a mathematical solution involving triangles and trigonometry and fairly quickly located it in one of my old college text books. There were two drawbacks to that solution however. First, it required you to have a table of trigonometric functions available and I had to revive a lot of brain cells to remember how to use them. Second, it seemed to me to be imprecise since it was a solution for finding the size of the "opposite" side of a triangle with a certain degree angle which is not precisely what we are doing here. The path the trailing edge of a control surface on an airplane makes is actually is an arc, not a straight line! That is what the deflection meter is made to measure the length of right? Else it would be a straight ruler and not curved. So back to the books for something more precise and that hopefully doesn't take a reference library to accomplish!
Finally, in one of those dusty tomes on my shelf, I found something promising.

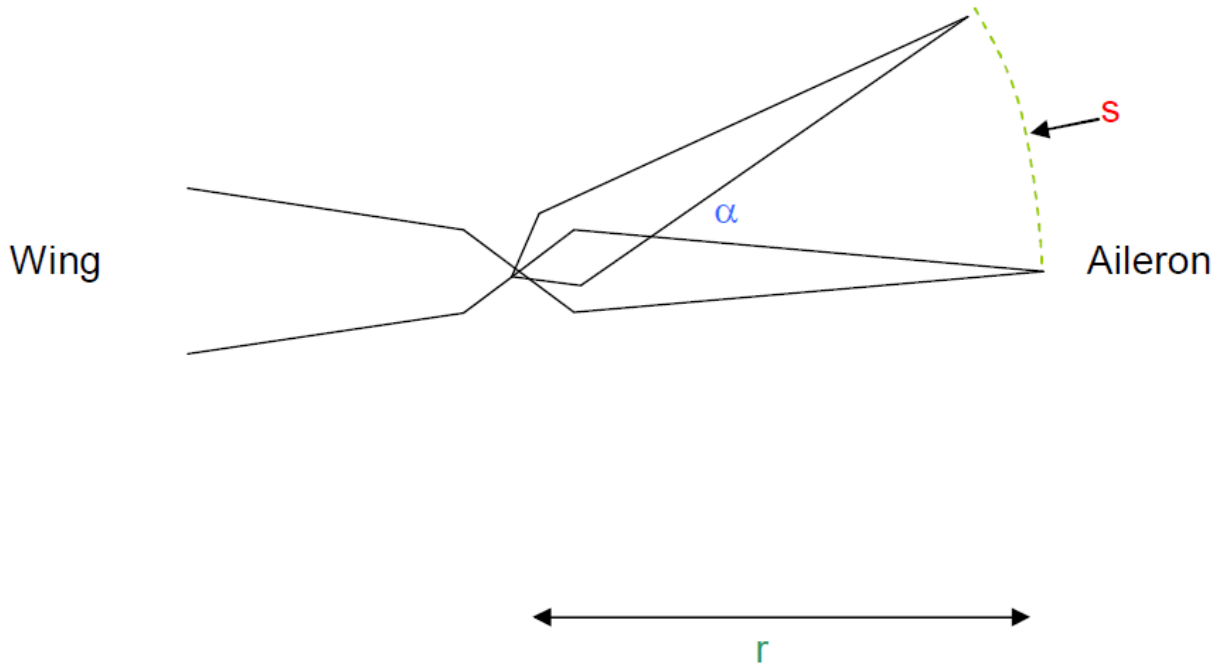
$$S = r\theta$$

It was a formula that would calculate the length of an arc (the value S) by doing some simple multiplication of the radius of the circle (the value r) and the angle measured in radians θ. Now what the heck is a radian?? Luckily, on the following page of the text was an explanation that ended with the information that a radian is equal to 57.3 degrees… After only a few miscues I finally arrived at this:

$$S = r\alpha/57.3$$

Where S equals the deflection of the surface
r equals the length of the surface from hinge line to trailing edge
And α equals the angle of deflection in degrees

Here is a picture to help explain:



So for my 28% Edge with a 5" aileron the manufacturer recommends 16 degrees at low rate and 23 degrees for high.

To calculate for low rates the formula looks like this:
s=5*16/57.3
s=80/57.3
s=1.39"
So for low rates - 16 degrees deflection is approximately 1 and 3/8ths inches (1.375").

To calculate for high rates:
s=5*23/57.3
s=115/47.3

s=2.01”
So for high rates – 23 degrees deflection is approximately 2 inches.
I hope this has helped you to better understand how to set up your control surface throws when the deflection is specified in degrees and you need to measure in inches. Feel free to email me at jack@flyrc.info with any questions or to run your calculations by me if you are unsure. This could easily be made into an Excel spreadsheet and I’d be happy to share that as well if needed.