Trimming Your Sailplane for Optimum Performance

by Brian Agnew

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[*The title of this article is a bit misleading. It should read, "Trimming **and Flying** Your Sailplane for Optimum Performance." Don't let the fact that the planes mentioned are ancient history make you think that this article is any less valid than if it was written yesterday, 7/1/00. It is a highly relevant article, which should be read and heeded by every RC soaring pilot who has moved beyond the basics. Even if you don't compete in contests, a well trimmed ship flown properly will give you a much more rewarding soaring experience -- easier to identify lift, easier to stay up, and longer flights*. --Waid]

Well, for the fifth time in as many months, I have just finished reading an article in ***RCSD*** on how to properly trim a sailplane. All of the articles are based on the "Dive Test" and all were too technical and/or too confusing for the average pilot. I've been flying R/C sailplanes for about 18 years, and what success I have had is strongly related to what I have learned about properly setting up a sailplane. If you decide to finish reading this article, you may learn what took me almost 13 years to figure out.

My father taught me to fly when I was ten. We both loved sailplanes and regularly attended contests. We both became accomplished pilots - doing well, hitting our landings, but we were inconsistent in our flight times. When it came to setting up our sailplanes and reading air, we were the blind leading the blind. For 13 years we balanced our sailplanes per the manufacturer's specifications (usually, the middle of the spar), and flew with the assurance that the manufacturers know what they are talking about or they wouldn't be manufacturers, right?

In the summer of 1988, while preparing for the AMA Nationals, I built an LJMP Meteor and an Airtronics Sagitta 600. Both planes had the Eppler 205 [airfoil] and both were well-suited for thermal duration. At this time, I ran across an article written by Larry Jolly on "How to Fly the Eppler 205." Wow! Here is a world-class pilot telling me exactly how to set up and fly my sailplanes. According to Larry, the magic point on the 205 is 38% of the chord. Talk about eliminating the guess work! I immediately got out my planes and found out that I was flying them near 35%, a 3% difference. No big deal, right? I moved them both back to 38% and headed for the field.

I cannot express the difference this made. It was like I had been hitting tennis balls on the edge of my racquet all my life only to find out that the racquet actually has a "sweet spot." My first impression was that all of a sudden there was an abundance of good air. The sailplanes no longer plowed through the air, but were actually "light on their feet," reacting to the subtlest of movements of the air and controls. My planes were jumping in light lift the way they previously did when I happened into a boomer.

Now that I knew how to fly the Eppler 205, all I had to do was convince Larry to write an article for every other [airfoil] section that I might be flying. Either that or figure out a way to be sure that I know when I have found the "sweet spot" for a particular section. Before I tell you how to go about doing this, let me say as little as I can about the "Dive Test." I know the theory behind the Dive Test, and I know a lot of guys swear by it, but I have to say I believe that, for our application, it is nearly worthless. I do not know of any serious competition pilots that rely on this test to find if their sailplane is neutrally stable. Nevertheless, I watch pilots use it and I read about it to the point of frustration. There is a very simple flaw in the dive test. This flaw is more

apparent in sailplanes with fixed stabs than those that are full flying. The response of your sailplane to the Dive Test is going to be directly affected by your elevator trim setting at the start of the dive. The same sailplane trimmed for best L/D or minimum sink will respond much differently to this test regardless of the C.G. point. So as not to totally offend all of the die hard dive testers out there, let me just conclude by saying that the dive test is far too subjective and inconsistent to be used for our purposes here finding the optimum location for both C.G. and elevator trim. Whew! Try the following, and I think you'll feel the same way.

Assuming that you've purchased your world-beater I 000 and have spent the last several months piecing it together so that its ruler straight and beautifully finished, let's find its "sweet spot." Go ahead and balance it according to the manufacturer's specifications, as this is always a good place to start. However you balance it, make sure you remove nose weight 1/8th oz. at a time.

Charge your sailplane and get to bed early because we're getting up early enough to be out at the field 1/2 hour before dawn. If we're going to test our sailplane, we need the deadest air Mother Nature can provide. By the time you set up your winch and plane. there should be just enough light to launch. it is imperative to get consistent launches, but if you can't zoom consistently, don't, just let the fine fall. Time every flight. Each flight should be as "hands off" as possible and in straight lines to the limits of your vision. Go straight out and straight back 'til touchdown. Record your time. After each flight, change your elevator trim to maximize your time. Once the optimum elevator setting (longest flight) is found, remove 1/8th oz. of nose weight and start over, again. Every flight should be flown as close to minimum sink as possible. This is closer to a stall than you probably realize. It usually takes 3 - 4 flights to find the best elevator trim after removing weight. If the air is dead and you are launching consistently, your flights are going to get longer and longer as you remove weight from the nose and you are going to think, "There is no end to this process," until all of a sudden, your timer peak will start to suffer. This pattern will happen regardless of whether you are flying a Sink Buster 1500 or a Gentle Lady. What happens is simply that as the performance of your sailplane increases, your sailplane's stability decreases. This is the trade-off. You don't get something for nothing as they say. You will notice that as you remove weight from the nose, the performance (dead air times) increases, but at the same time you are having to put in more control input to keep the sailplane flying straight and at minimum sink. Eventually, the airplane requires so much input that the drag from the constantly moving control surfaces brings your Thermal Wonder 1500 down to Earth sooner. Put weight back into the nose until you reach your maximum dead air flight time and call it good. You will never have to wonder about your C.G., again, only your elevator trim.

Incidentally, I did this test on my Meteor and Sagitta 600 and, in fact, found that Larry was right. The optimum C.G. point for the E205 is 38%. How accurate and reliable is this test? Let me put it this way. I did this test several years ago on my Phoenix unlimited ship and on my Mariah 2-meter separately (both use the S4061). By the time I was done, both planes were balanced at not 42%, not 41.%, but at 41.5%. That sold me.

Now, regardless of the airplane or section you are flying, you will be able to set it up for optimum performance What this trial and error approach does not teach you is how to read air. I'll give you another pointer. If you want to learn how to truly be able to read air, stop flying at cloud-base. Buy yourself a good hand-launch sailplane, set it up for optimum performance and let the learning begin.

While I have probably oversimplified all of this, I should add a couple of points. As you move the C.G. back, you should move your tow-hook with it. I tend to put my tow-hook 1/16 inch forward of the C.G. This is conservative, but I'd rather give up a couple of feet on launch than pop-off.

The last point I would like to make is that regardless of how good your sailplane is or how well set up, the only thing that will put you in the winner's circle is your skill. How far back you will be able to move the C.G. when testing your planes depends on your ability to keep the plane stable in its increasingly unstable state. 10 people at different skill levels will come up with different optimum C.G. locations for the same plane. This is the great part about testing your sailplane. This way, it allows you to find the optimum balance point no matter your skill level.

One final note. In competition, I fly at minimum sink the majority of the time. It is only when I know where lift is or when I am in sink that I fly at the best L/D. I always fly assuming I will not find lift and savor every bit of altitude - every point per second.

I am sure a lot of pilots will disagree with my opinion of the "Dive Test," but all I can say is that this system has made all the difference in the world in my contest flying. I wish that I had read an article like this when I was 10 and my father and I were just starting out. I hope it helps those pilots out there looking for the edge to get them into the winner's circle.

Good Luck!

[**A couple of comments about the flight testing process...**

1. Any atmospheric convection is going to play havoc with your flight times. It is critical that the testing be performed in air that is as still as possible -- early morning on a day with thick stratus clouds and no wind would be optimal. Evenings are not a good time, since the ground is still warm, which will cause convection to continue even after dark.

2. A high start would give you more consistent launches than a winch. However, flight times will be shorter and will be influenced more by low altitude convection and ground effects, since the glider will spend less time at high altitude. If you can fly the same launch profile consistently, a winch is the preferred launch device for the flight testing. If your winch launches are erratic you might want to try using a high start.

3. Because of variations in launch height, convection, and your thumb, a single flight at each C.G. location is not going to be sufficient. A minimum of two flights will be needed. Depending on how consistent the duration of these two, you can judge if three or more are going to be required to get a good average reading. This is something you will have to play by ear.

4. Brian mentioned moving the tow hook with the C.G. location to maintain the same relative position. **He should have emphasized this more, as it is critical**. If you do not do this, then your launch heights will probably be reduced as you move the C.G. back, possible making flight times drop even though the glider's efficiency may be improving. The installation of an adjustable tow hook for use during flight testing is going to facilitate the testing considerably. --Waid]