Airplane Flying - A Simple Approach
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This resource is intended to be a launch point to help you get started with flying your airplanes when you are finished building. The methods described in this document do not require that you wind with a torque meter. Once you are comfortable winding and flying, and have optimized your flights with these tips, you can move on to the "Next Level Airplane Flying" resource, which also contains some trim troubleshooting information that is not covered here.

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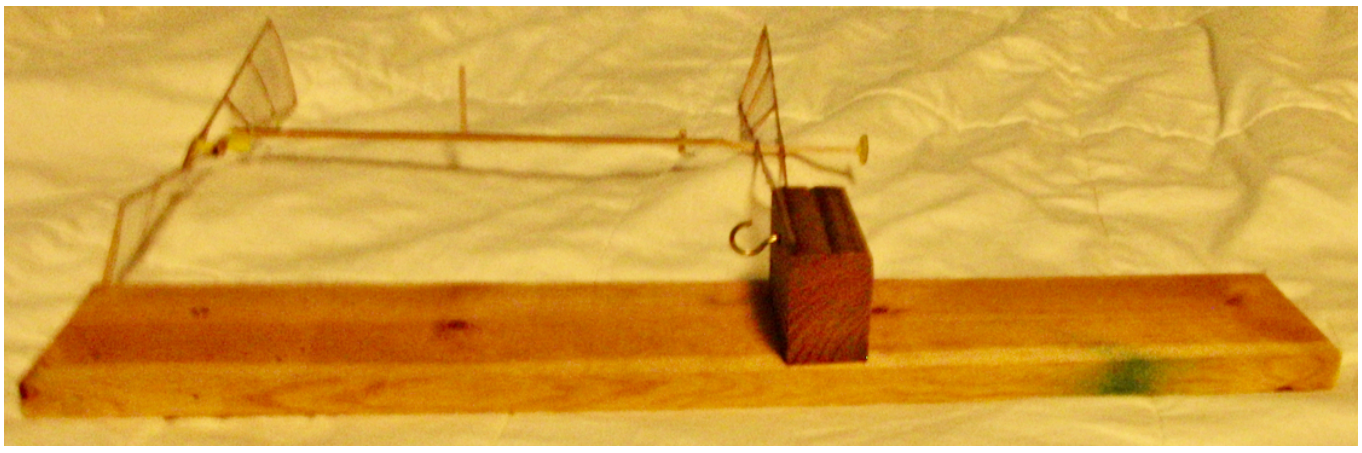
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A. Rubber Motors

1) Typically, SO rules limit airplane motors to 1.5 g or 2.0 g. In order to achieve the longest possible flights, and greatest consistency, it is important to tie your motors as close to this limit as possible. See this resource that shows a simple, easy way to tie motors. If your kit came with rubber in more than one width, choose the larger size for initial trimming purposes.

2) Be sure to lubricate the motor before winding it. This will greatly increase the life of your motors. Use a silicone based lube such as Armor-all, or similar, without petroleum based ingredients, which will degrade the rubber!

3) It is highly recommended that you **wind the rubber off of the plane,** then transfer it to the plane. This is particularly important to avoid damage in case the rubber breaks. A winding "stooge" can be made from a couple of pieces of wood and a metal hook, as shown below. Attach the o-ring at the knot end of the loop to the hook, with the other end on your winder. The o-ring next to the knot should be attached to the rear hook of your plane. This is preferred, as that end of the motor does not rotate, eliminating the chance that the knot will rub against the fuselage as the motor unwinds.

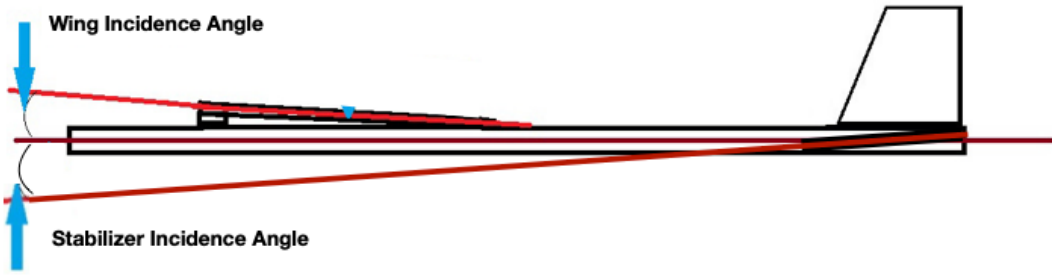


(Shown with a helicopter in the background, but works just as well for airplanes.)

B. Incidence, decalage, center of gravity

This is a short discussion to help you make sense of the adjustments you will make while trimming your plane. While it may be tempting to dive right in and start flying, you'll do yourself a favor and save a lot of time if you read this part. (If you are interested, an expanded version of this material can be found on the AMA website.)

Incidence is a measure of how the wing and stab(ilizer) are angled with respect to the fuselage, as shown here. The wing as shown has a positive incidence, since the leading edge (LE) is higher than the trailing edge (TE). The stab is shown with a negative incidence. Incidence can be specified as an angle, or as a difference measurement. For example, wing incidence of +3 mm would indicate that the LE is 3 mm higher than the TE.



Decalage is wing incidence **minus** stab incidence. For the plane shown below, the wing is at zero incidence, since it is parallel to the fuselage. Zero minus a negative stab angle (or -X mm) would yield a decalage that is a positive angle or a positive measurement in mm.



In order to achieve stable flight, your plane must have at least a small amount of positive decalage. This can be achieved with wing/stab settings that are zero/negative, as shown, or could be positive/negative (first diagram above) or positive/zero. The settings that you use may be determined by how your kit is designed, or may be adjustable, usually by moving the wing posts up or down.

Center of Gravity (CG) is a measure of where the plane will balance with the propeller and a motor installed. As Coach Brian shows here, this can be easily determined by balancing the plane upside down on a ruler, pencil, or other similar item.

Your plane will fly if the CG is within a certain range. In general, more rearward CG is more efficient, but less stable. The trimming advice that follows is intended to adjust your plane so that it achieves long flights, but is able to recover adequately from ceiling hits, air turbulence, or other disturbances.



If your wing is mounted on a sliding "saddle", moving the wing forward will move the CG rearward, and vice versa.

C. Trimming your plane

4) CG: start by locating the CG as shown in the photo above, a little in front of the rear wing post. This is most likely farther back than the optimum position, but will increase the chances that your plane will stall when you launch it, **rather than diving into the floor and breaking**!

5) Decalage: If your plane has adjustable wing posts, follow the recommendations in the instructions. Usually this will specify about +6 mm of incidence in the wing.

6) For trimming purposes, you want a partial wind that is sufficient to make the plane climb just a little - approximately 40 cranks on a 15:1 winder (600 actual turns on the rubber) is a reasonable starting point for a 1.5 g loop of 3/32" rubber. The rubber must be lubed, and stretched out to 4-5X its relaxed length. Wind about 50% of the 40 winder cranks at full stretch, then wind the rest as you approach the table (or whatever the other end of the motor is hooked to), finishing up with the rubber the same length that it will be when mounted on the plane. Video of this process can be seen here.

7) Transferring the rubber to the plane. You want only one person handling the plane and rubber when you do this to minimize chance of breaking the plane. Video of this process here.

8) Release technique: Get the plane moving at about flying speed, approximately shoulder high, release the prop first, then the plane. **DO NOT THROW IT!!!** Video of this launch technique.

9) If plane stalls* (flies in this pattern: ), that indicates that the CG is too far rearward. Move the wing back on the fuselage in 3-4 mm increments. Your goal is to find the cg location that eliminates the stall, but just barely so. This is probably very close to the best trim setting for your plane.

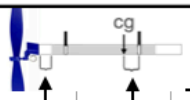
* in the unlikely case that it doesn't stall, try moving the wing farther forward until it does.

10) Once the plane has been trimmed as above, these settings will not change unless the plane is changed in some way. So if it doesn't climb high enough, or some similar problem, don't attempt to solve that by moving the wing, or your flight times will likely suffer.

D. Data Collection

11) Starting right now, it is essential to keep a record of what you did and how it affects the flight of your plane. Your kit may have included a flight log template, but these are sometimes missing certain details that will reduce your flight log bonus as described the rules. NFFS highly recommends that you download the "Basic Airplane Data Log Template" (see below) from the NFFS SO resource page. This includes a detailed explanation of the parameters, how and why you measure them, and proper units. All details important so you get the log bonus for your flights!

12) On the log template, record the width, length, and mass of the motor you used to trim your plane. Measure the wing "setback" and cg location, as indicated on the template. If built from a kit that does not have adjustable incidence, just leave that and the other columns blank. Under comments, write "trim flights to locate optimum cg location".



Flight Data Log

Plane: _____ Team: _____

Date (m/d/yr)	motor W/L/m (in/cm/g)	turns max/launch ÷15	Torque max/launch (in.-oz.)	Wing setback (mm)	cg @ before TE (mm)	Incidence LE/TE (mm)	Maximum height (ft)	duration (min:sec	You don't know what you're doing unless you know what you've done! comments
/ /	/ /	/	/			/			
/ /	/ /	/	/			/			

E. Winding for a full wind flight

Though the very longest flight times can be achieved much more easily and consistently with the use of a torque meter, the instructions below will show you how to do reasonably well without one. ("Winding with a torque meter" is the topic of another resource on the NFFS SO Resource page.)

13) You can use the same loop as you did to trim your plane. We want the plane to climb more than it did during the trimming process, so increase the total turns by about 25%. This would be a 50 winder cranks (750 turns with a 15:1 winder). Wind as shown in the video: 25 cranks at full stretch, 25 more as you move inward.

14) Launch the plane from about 12-18" above the floor. Same technique as shown in the previous video, except you'll grip the fuselage from above rather than below.

15) If the plane climbs a bit, record its estimated maximum height and the flight time in your log, along with the motor and winding details. If it doesn't climb much or not at all, **do not try to fix this by moving the wing!** Instead, just bump up the number of winds for your next flight.

16) Continue this process until you know how to wind so that your plane flies from down near the floor up just below any ceiling obstructions.

17) **It is essential to keep good records in your log!** If you fly in a venue that has a lower or higher ceiling than the one where you practice, you will need to subtract or add turns accordingly.

F. Going to the Next Level

18) Following the procedure above should result in pretty decent times, depending on the design and construction of your airplane. However, there is still room for improvement. For example, wider or narrower rubber may result in longer flights, if you have rubber in more than one width. To pursue this, just tie a loop of the same mass, and follow steps 12-16 to see if your plane flies longer. **Be sure to keep good records in your flight log!**

19) Advanced winding techniques and rubber management methods can also increase your times. To investigate these options, take a look at the "Next Level Airplane Flying" document, found on the NFFS website.