

John Koptonak's

# 10-Step Guide to Trimming

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This is a topic that gets beaten to death and I'm sure that the method presented here will open up a flood of comments. I will say this method has worked for me quite well for some time and allowed me to save many a model from trimming disaster. It can be used for any type of model, from No-Cal to Jumbo Scale. The important thing to remember is not to skip any steps and to follow them carefully and patiently. Do not go on to the next step until you have met the requirements of that step.

THERE ARE NO SHORTCUTS BUT THIS METHOD DOES WORK!

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There are two concerns with trimming that must be satisfied; **CG and thrust line**. The CG (center of gravity) of the model must be at the right location to provide stable flight and provide maximum aerodynamic efficiency. A CG that's too far forward spells loss of aerodynamic efficiency. A CG that's too far back spells stability problems. The thrust line determines how the model is pulled (or pushed) through the air. Many modelers try to juggle each of these two problems at the same time causing unnecessary trimming confusion. The trimming procedure presented separates the two variables and treats them individually. You first get the most efficient "glider" you can with compromises allowed for free flight stability, then power the "glider" and adjust the thrust line. It's actually nothing new. I hear it's basically the same method utilized by rubber scale modeler, Mike Midkiff. This does have a few differences from other methods I've seen and allows a logical progression towards a trimmed, stable flying model.

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We will assume that your model has been built straight and true. Take the time to check this. I won't go into details on how to do this but make sure you have no warps. This method of trimming also assumes the model has the right amount of dihedral and that all flying surfaces are adequate size, but it does have some leeway to compensate for this since it checks stability. Your model will also need a way to adjust stab incidence.

Here are the steps for trimming. Each will be discussed in the text that follows:

## NO NONSENSE TRIMMING

1. Locate CG
2. Balance model W/O prop or motor to locate CG
3. Glide model
4. Adjust stab for smooth glide
5. Check stability by launching into slight dive and slight climb
6. Readjust CG for stability if necessary
7. Mark location of new CG (if changed in step 6)
8. Install prop/motor and rebalance to established CG
9. Test fly under power
10. Adjust flight pattern with thrust line

There you have it. Ten steps to successful free flight. Perform each step and your model WILL fly. Let's look at each step in detail.

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## 1. Locate CG

If the plan you are using shows a CG location then start there. If the CG location is not known, then "guesstimate" the CG. Thirty percent of wing chord is a good place to start. Step 6 may adjust this later.

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## 2. Balance model - without prop or motor - to locate CG

"What?! Without the prop? You've gotta be kidding!" Nope. Leave the prop off! Have you ever seen people trying to test glide a ship with the prop on? One toss goes into a stall; one toss goes into a dive; next toss looks OK. The problem is that it's difficult to get a free-wheeling prop up to a consistent speed similar to when the model is flying at a consistent glide speed. One toss may not have enough RPM and will provide additional drag and stall the model. Another toss might have too much RPM which means the ship is being launched at too great a speed to give realistic, usable results. The model will be much easier to test glide without the prop. Oh, I hear you theorists out there, the spinning freewheeling prop contributes to drag so will effect the glide. Waa, waa, waa. DON'T WORRY ABOUT IT! Glide the ship at best L/D and when the prop is added it will bring the ship into the best sink rate portion of the polar curve! (that was for all you theorists; the rest of you who just want to get your models to fly can ignore it) So leave the prop off for now so we can establish CG/decalage. Remember? One thing at a time!

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## 3. Glide model

Of course this is the easy part. Now you have a glider so glide it! Launch the model smoothly towards an imaginary spot somewhere out in front of you on the floor (grass). If you're working on a small, light model such as a No-Cal or peanut, this can be done right in your living room (if the wife will allow it...and don't hit the dog). The trick is to launch the model at its glide speed. Do it a number of times to get the hang of it and to get some usable information on the gliding flight characteristics. If the model is turning then you have a warp! A slight amount of turn is OK but hard turns must be tracked back to a warp and eliminated.

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## 4. Adjust stab for smooth glide

At this point the glide is adjusted using only the stab. DO NOT CHANGE THE CG BY ADDING OR REMOVING CLAY! The most efficient method for stab adjustment is to re-glue the stab with positive or negative incidence. Cement-type glues work great for this since the joint can be unglued with solvent and re-glued. Adjustable elevators can be used but produce more drag and risk being bumped out of adjustment. Take your time to obtain a smooth but not too "floaty" glide (best L/D not best sink rate theorists)

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## 5. Check stability by launching into a slight dive and slight climb

This is the tricky step that requires some patience. If you are using a CG from a plan location then you might be able to skip this step but it's worth checking. This idea came from flying R/C sailplanes. A neutrally stable sailplane when put in a slight dive will remain in that dive at a constant angle. An unstable sailplane when put in a dive will remain in the dive while increasing the dive angle. A stable sailplane when put into a dive will not stay in the dive but will return to its original attitude. This is all based on center of lift, decalage and CG location. I'm not about to attempt a lesson in aerodynamics (theorists) but I hope the idea comes across for trimming purposes. Ideally, for maximum performance, neutral stability is desired. Of course, for a free flight model, neutral stability may not be the best way to go. Some amount of stability is desired because of the possibility of being upset during free flight (i.e. air, ceiling, wall other models etc.). The closer you can get to neutral stability the more you'll get out of your model, but you'll sacrifice stability to do so. So glide your model and experiment with dives. The model should gently pull out of a dive. If forced into a stall it should easily recover. If it doesn't then it's time to move the CG!

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## 6. Readjust CG location for stability if necessary

For a model that seems to stay in a dive add nose weight and negative stab incidence.(leading edge lower) For a model that acts like a falling leaf or is overly stable(pulls out hard from a dive) remove nose weight and add positive stab incidence(leading edge higher). Continue gliding and adjusting until satisfactory results are obtained. Avoid TOO MUCH stability.

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## 7. Mark location of new CG (if changed in step 6)

Easy enough. This is your permanent CG for your model! From this point on you will not change this!

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## 8. Install prop/motor and rebalance to established CG

You might want to start with a bit of down thrust for most models. Also, a slight amount of side thrust. Which direction? This depends. In fact, of all the steps in this trimming method, this is the one which is the most difficult to call. First, which way do you want to turn? Most indoor flyers turn left for low wingers and right for high wingers. That is only a starting point. Torque can play a big part in this decision. The author has been flying many of his models with what would be considered small props and/or low pitch. This has provided many benefits. Problems with torque are almost nonexistent. Small props turn at a higher RPM and use smaller size rubber. Smaller size rubber means the model is carrying less weight and flying at a lower wing loading. I agree that for maximum performance and duration a large prop is the ticket. But why struggle? Start with a small prop. As an example my 24 inch span Cessna C-34 is flying with a 6 inch Peck plastic prop and a VERY long loop of 3/32 rubber. Performance is great! Unless you're heading for the NATs, start with a prop 1/4 to 1/3 the wingspan of your model. So with a smaller prop use a touch of down thrust and left thrust. Rebalance the model to the CG you have established.

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## 9. Test fly under power

Crank her up and let her go. Start with just a few hundred turns. Rubber size is a separate topic that will not be discussed here. Better to start with a smaller motor than a larger one. Just remember to check CG after changing to motor. Observe the flight. Does it turn? Does it stall or dive? Remember how it looked when you were gliding it? What's the different now? Ideally, the model should simply have an extended glide with a slight turn in the direction you desire. If everything looks good, try more power. Otherwise...

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## 10. Adjust flight pattern with thrust line

Adjust powered flight through the following adjustments:

- stalling - add down thrust
- diving - add up thrust
- excessive right turn\* - try small amounts of left thrust otherwise go back to step 3 and glide to adjust for left turn
- excessive left turn\* - try right thrust otherwise go back to step 3 and glide model for right turn

\*(these may also require modification of model fin area.)

All models will require varying amount of thrust line adjustment. Some none at all; some excessive. What ever you do, AVOID REMOVING OR ADDING CLAY AT THIS STAGE OF TRIMMING! Small amounts may have to be added to compensate for propeller drag but if you're using a smaller prop as suggested, then clay will not solve your problem. Look at the thrust line!

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Phew! So there you have it. Give this a try with your next model. Or, if you have one of those pesky models that just doesn't seem to want to fly, take it back to Step One. THIS DOES WORK and really is a simple method for successful trimming. I don't consider it a cure-all but you'll be pleasantly surprised at the results.

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