

# Plastic Propeller Selection Guidelines for Rubber Powered Novice Scale Flyers

by Sam Brauer

Selecting the correct propeller for your rubber powered model is challenging. All too often, builders that will spend hours agonizing over the tiniest details or trying to shave half a gram will seemingly pull the first random prop that comes to hand and stick that on the front of their model. Yet correct propeller selection matters far more in terms of duration than 1 % of the model's weight.

About 20 years ago, flying buddy Larry Peavey hammered the importance of the propeller home to me. I had been flying a 15" Megow D VIII in the Glastonbury indoor event for WW1 peanuts, even though the event called for biplanes- and a 13" wingspan. Yet even with the monoplane and increased wingspan advantage, I was often the first one down. The airplane would do between 25-30 seconds with a motor wound pretty hard, using a stock 6" Peck silver plastic prop. Larry called me over and told me to take a 7" Peck plastic prop and cut it down to 6", effectively increasing the pitch of the prop. Next flight- using the same motor- the airplane did 40 seconds. I think my best flight was 45 seconds with this setup. So by simply changing the prop, my flight times were a quarter to a third longer. Shortly afterwards, I built a peanut Ansaldo, but Larry's lesson about increasing pitch has stayed with me.

The problem is that propeller selection is complex and really can't be all that simplified. I often find it necessary to try several props for a particular airplane till I hit upon a good combination. The purpose of this article is to demystify the process and make some suggestions about common prop/rubber combinations.

First- all too often I see novices struggling with a propeller that is too large for their trimming skills. And to define too large, let's look at some of the important propeller parameters:

- 1) Diameter
- 2) Pitch
- 3) Blade shape
- 4) Blade area

The old time advice is to go up to 40% of the wingspan for prop diameter. There are a few reasons why I think this advice is a bit off these days. To begin with, larger diameter props are harder to trim. They have larger torque effects and disturb the airflow over more of the airframe. While it may be possible to get an airplane to trim out at low power, adding more power often results in undesired aerobatic behavior and rapid contact with the ground. If your airplane is flailing about when you've added power, try clipping the tips of the prop about 1/4" or so. It won't take much to have a big effect because diameter affects power requirements more than anything else. If you clip much more than a 1/2" or so and you're not getting anywhere, time to rethink your options- although I have been successful in the past with a 9.5" Peck silver prop cut back to about 7".

The second reason that props probably need to be cut down is that rubber energy storage characteristics have changed over the years. I think the older rubber often had a flatter torque curve which meant that you got to cruise mode quickly after launch. Current rubber has a lot of energy storage in the last 25% of turns which means that you get a power burst. If you've got a big prop on the airplane then it's hard to trim for that power burst. The change in energy storage also affects the flight profile. The older flight pattern was a relatively low altitude cruise, the newer rubber allows us to climb quickly- and then

utilize the glide portion of the flight, hopefully with a little assistance from Hung. Hung's assistance can come with a price- too much assistance and you're building a new airplane. But since we aren't using folders, going to a smaller prop can significantly increase the glide, which is often the difference between being an also-ran and a kanone. (I'm getting the also-ran part down well- my kanones have mostly come from flying indoor.)

Where to start ..

Perhaps the most important characteristic of an airplane when choosing a prop is "how clean is it?" Slicker airplanes can work well with smaller props. It's easier to explain why draggier airplanes work better with larger props though .... To begin with, draggy airplanes like biplanes with lots of rigging, well, they're often pretty easy to trim because they have a limited speed range. They have a cruise speed- they climb at cruise speed + 5%, they descend/land at -5%. (If that- might be closer to 2-3%). But adding lots of power doesn't make them fly faster because drag increases quickly with airspeed. (It's NOT linear.) So these airplane can tolerate a larger prop. For airplanes larger than peanuts, try something around 1/3rd the wingspan, for peanuts- well, for outdoors, try the 6" Igra orange prop as a start.

Slicker airplanes can run into trouble quickly- especially if the cg is off and the airplane decides to tuck. They have a much broader speed range than a draggy biplane. In my fleet, I'm often running a 7" prop on airplanes in the 23- 25" range (this is a prop size a bit less than 1/3rd the wingspan), 8.5" props on airplanes in the 28-30" range. (Don't have many of these.) Peanuts though- since they can take a tumble well- I often use 6" props as a start. For draggier airplanes- add an inch in prop diameter as noted above.

For slick airplanes- I think it's better to start with too small a prop than too large a prop- you'll get a better look at the flight characteristics. I will point out that prop hooks are cheap as are plastic props- don't be afraid to experiment. I often use the diamond hooks to figure out props, going to more sophisticated prop hooks as needed. By using the diamond hooks, it encourages me to try more props since I'll probably cut them off eventually.

Notes on Props..

I'll be the first to admit that these notes are anecdotal- I haven't been scientific in my approach because that's too much like work and this is supposed to be relaxation for me. Nevertheless, much of these observations about props comes from flying indoors rather than outdoors. Indoors has one priceless advantage- flights are much more consistent than outdoors since the variable of lift is eliminated. Often flying indoors, flights are consistent to within a second using the same number of turns.

6" Igra (Czech) orange prop. I have yet to cut one of these down. They seem to do well with motors between 3/32" and 1/8". If you're going over 1/8" rubber- you need a different prop. Seems to be a good start as a Bostonian prop.

6" Black Tern Aero (actually Testers) prop. They are actually a bit larger than the Czech 6" prop and heavier. Note that there's also a 6" MRC prop- rounded tips, doesn't work as well. Unfortunately the Tern Aero props are hard to find- haunt Ebay. The Tern Aero props have a fabulous blade shape- I really like it. They don't have enough pitch for a faster airplane, and I've never been successful cutting them down though. However, I had one on a 24" Easy Built P-39 and with a loop of 1/8" rubber - it won a bunch of kanones. That was a very slick, very lightweight airplane. The comfort zone of this prop is between 1/8" and 5/32" rubber- and at 5/32"- you may want to cut down a Peck silver prop.

7" North Pacific Prop. These props work very well in some smaller airplanes. They have a narrow blade which means that in something large and draggy, well, they slip, but they can work surprisingly well in smaller ships- I have one on a dimey Ike. I've even used one on a peanut bipe, but the blade had to be thinned or the torque was uncontrollable. Not a setup that works outdoors. I think this prop works well with 1/8" to 5/32" rubber. This is the lightest plastic prop going for its size. Again, a hard to find prop.

6.5" wide blade Sig prop. Too much camber in this prop- I'm fooling around with cutting back on the blade area, but nothing has been wildly successful. Don't see anybody else using them either.

7.5" Czech prop (red or yellow). This is the son of the 9.5" Czech prop that's had a lot of success in P-30. Stock, it will work on draggy airplane. If you're putting one on a slicker airplane- I've had good luck trimming the tips at least Yo". That's a Yo" per tip- %" reduction overall.

Peck Silver Props- 7-8". I find these props works well when cut back at least an inch and using a blade shape that approximates the Tern Aero prop or the orange Igra prop. The stock blade shape is not good. They come out lighter than the Czech props. I have little use for the 6" and under Peck props.

The 7" prop- cut back to 6"-can take a fair amount of rubber- between 5/32"" to 3/16"

The 8" prop- cut back to 7"- I tend to run around 3/16" motors on it. If you have an airplane that needs a bit more oomph- I'd lean towards the Czech props instead. The big advantage of this prop is that it's lighter in weight.

These are the props that I know from flying indoors- I don't have as good a "feel" for larger outdoors props, but if you're flying airplanes in the 15-50 gram range, this guide should help. Some thoughts on the Chinese orange props .... These props have very nice blade shape, reminiscent of the APC slow flyer electric props which were quite good. Below 7"- I wouldn't bother, since they are quite heavy. I do have a 7" prop in an 18" Pfalz D-III which I think is doing well, and an 8" in a 24" P-47. In a slicker airframe, I don't know .... might need to be trimmed. Also-no experience with the white Easy built props- they look superficially similar to the Peck props, but they definitely have a different blade shape.