

# PROP CARVING

By Karl Geis

Published in the January 2013 issue of Tailspin, Mike Nassise,  
Editor

I have used different types of knives over the years but have settled on the inexpensive snap off blade knives found at any hardware store. They come in two sizes, 18 mm and 9 mm, and these are the type where the blade slides out. Get both sizes. The small one is handy for tight spots and small props. I have never had a part of segmented blade snap off on balsa. They are razor sharp and the blades flex which is handy when carving under camber into the backs of a prop. The replacement blades are cheap, but by using a stone and razor strop occasionally they last me a long time. When I want the blade to be stiff I do not slide it out all the way. There are many different brands available, the ones I have now are Stanley. A brand called Olfa, however, is fast becoming my favorite. I bought one online at [www.olfaproducts.com](http://www.olfaproducts.com).

A drill press to drill the propeller shaft hole and nose block hole is an absolute must. A bandsaw is indispensable in cutting out prop blocks. Delta makes a good, small 9" bandsaw that has a light on it. It sells at Ace Hardware locally for \$140, but I've seen it in discount catalogs as low as \$110. I have found it quite helpful to score the lines drawn on the prop block because the band saw blade tends to follow these scored lines much better. My bandsaw came very poorly adjusted. Use the manual and make the proper adjustments before using.

I also use a small square, torpedo level (small as you can get), a straight edge and, a course, sandpaper. For getting the same camber in the backs of both blades I use sandpaper wrapped around a CA Kicker (accelerator) bottle that has a diameter of about 1-1/8". Anything from about 1" to 1-1/2" will do.

## Carving:

Start with a small prop, say 8" in diameter, so you don't waste a lot of wood if you mess it up. Always carve the backs of the prop blades first, and only carve to about 3/32" or 1/8" from the diagonal reference line drawn on the end of each block. These reference lines are an absolute must. Be sure you get them the right direction or you will have a reverse pitch prop. Finish the backs of the blades entirely before carving the blade fronts. If you play around with the backs after carving the fronts you will change the pitch of the prop.

Why is correct pitch important? Most vintage rubber endurance and rubber scale models were not designed to handle a lot of torque. The rubber way back then (until the 1960's) did not have a lot of torque compared to the rubber we use today. A low pitch prop does not take much of a bite or produce a lot of rpm's at high speed along with its accompanying torque. This is why I do not like plastic props. Most of them are low pitch props, except for the Gizmo Geezer variety which are repitched Peck props in 8" and 9.5 "diameters. In the old days you could wind the available rubber to its breaking point but it still did not have a lot of torque.

Most vintage duration and scale rubber models need a prop with

at least a 1.25 p/d ratio. Most do their best on a prop with around a 1.37 p/d ratio. The formula for p/d ratio is simple. Multiply the diameter of the prop times  $\pi$  times the depth at the tip. Take the resulting number and divide it by the width of the blade and then divide that result by the diameter. For example, a prop blank 12" long by 1 1/2" wide with a tip depth of .75" would work out as follows:  $12 \times 3.14 \times .75 = 28.26$ .  $28.26$  divided by  $1.5 = 18.84$  which is the pitch of the prop. The pitch  $18.84$  divided by  $12 = 1.57$  which is the prop p/d ratio.

Getting back to the carving procedure, now take the bottle with sandpaper wrapped around it and start sanding away. I hold the bottle at a slight angle away from me and sand forward. Every now and then, check the tip and see if you are close to the reference line. I also use a straight edge, pulling it along the back of the prop blades from tip to hub to check the under camber. Adjusting the angle at which you hold the bottle when sanding will increase or decrease the amount of undercamber. When you are close, start using finer sandpaper until you are right at the line. Do not sand past the diagonal line you marked on the block tips.

Now, turn the blank over and carve off the front of the blades, which is easier to do. Do not carve past the line you have drawn about 1/8" back on the blade leading edges. This will eventually be sanded down to an airfoil shape. Look often at the end of the prop blades. Do not carve the tips too thin, coarse sandpaper is a much safer course to take here.

After you have the blades pretty well finished, take a soft tip pen and draw the final shape you want on one blade. You can use a finished prop for a guide if you like. Use a sharp knife and cut the extra wood away. Now finish sanding the blade, thinning the tip to complete the job. Feel a finished prop as a guide on how much sanding needs to be done. When this blade is completed, place it on a piece of paper or thin cardboard, trace the shape of the blade, transfer the shape to the other blade and repeat the carving and sanding process.

Finally, sand or cut the extra hub wood away from the back of the prop using a larger bottle with sandpaper wrapped around it. Some articles show the prop blank with this hub area sawed out before the prop is carved. Do not do this because you will not get the proper helix shape in the blade. After doing this you will need to do some shaving and sanding in the area to get it to final shape. Go slow and use care in this final stage. I carve my prop blades very thin as they are more efficient. As you are sanding to a finish check the balance by slipping a piece of wire or a long pin in the shaft hole to see how even it is. Often one of the blades is much harder balsa than the other blade so you cannot sand it to final balance. Having each blade the same thickness is more important here. I get it to final balance when I dope it.

## Finishing:

Give the finished prop several thinned down (50/50) coats of dope, sanding with fine sandpaper in between coats, and finally doping with extra coats on the lighter blade to balance it out. Don't give up if you blotch it, keep trying and learn from your mistakes. If you mess something up, study a well made finished prop and go back over these directions again. Once you get the hang of it go on a binge and carve several props; practice, practice, practice.

Prop shaft holes can be bushed, but metal plates on the front and

back of the prop hub are the way to go. It is hard to bush a prop shaft hole and make it really true. When you drill the prop shaft hole in your balsa blank drill it one size up from the size of the music wire you are going to use for your prop shaft. I use aluminum on small props, but on larger props I use brass. Just do some accurate measuring, cut a piece of metal rectangle, trim one end to make the latch if you are using a free wheeler that is not tensioned, and be sure to make the latch in the right direction for the finished prop. Bend the latch end up and use a round file to make a small notch in it. This is great way to make a non-tensioned free wheeler. It is safer than the swinging latch method and easier to make. The non-tensioned free wheeler automatically locks the prop and works quite reliably. It is commonly called the "latch" free wheeler (*Ed note: See [www.pensacolafreeflight.org](http://www.pensacolafreeflight.org) for info on that*)

I add color to my finished props with Michael's Design Master Floral Spray, and dust it off with Krylon clear. The glass cloth and the Z-Poxy greatly enhance the stiffness and durability of the prop blades but add very little weight. Remember, the worst prop you carve will probably be better than any plastic prop you ever buy. This is an insanely great hobby.

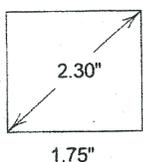
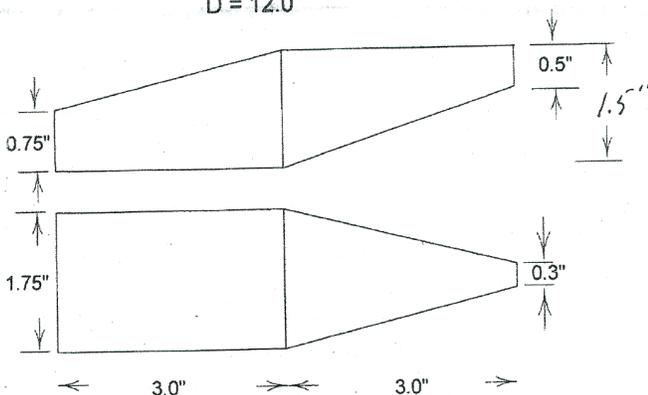
Caution, when you make the front and rear metal hub plates, first glue the back one on. I like to use model cement or epoxy depending on the prop size. Rough up the metal surface to be glued with rough sandpaper for a better gluing surface. Pre glue it, and then glue it again. After the rear plate is on and the glue is dry; make small triangles, 30 degree for small props, 45 degree for larger ones, and glue them on a soft board with the backs of the blades located so that the triangles are in the same position on each blade and completely in contact with them. This is a jig to hold the prop so that it is totally level across the top. Now place the front plate with glue on the hub over the prop shaft hole and while it is drying insert a short piece of wire through it. Use your eye to make sure the wire is exactly perpendicular to the prop and check it with a torpedo level to make sure it's true in both planes. Once you have achieved this, leave the prop in the jig until the glued plate is dry. You want a smooth running prop and you can only get this by first having the prop balanced and the prop shaft in a true, straight position and not off on an angle.

Herb Kothe's Block Layout

I have gone to covering all my props with light fiber glass cloth. To adhere it to my props I use Z-Poxy PT -40 Finishing Resin. This resin has excellent instructions on the box on how to fiberglass things. Before using the fiber glass cloth it must be sized or it is a nightmare to use. Cut off a big hunk of it and hang it from a wire clothes hanger and spray it with rattle can lacquer (I use the cheapest Ace brand) or your wife's hair spray.

Miss Canada Sr. Prop.

D = 12.0"



$$P = \frac{\pi (12.0) (.75)}{1.75} = 16.2$$

$$P/D = \frac{16.2}{12.0} = 1.34$$