

# The Black Art of Calculating Pitch for a Carved Prop

by Paul Grabski

We are often told that for most outdoor freeflight models, the best props have a pitch somewhere between 1.2 and 1.3 times the diameter (commonly referred to a Pitch/Diameter Ratio). That sounds nice, but to the average balsa whittler, the question then becomes "how do I get there from here?" How wide and how thick a block do I need to start with?

It's really not rocket science, just a bit of fairly simple arithmetic. We first have to start with the formula for determining the pitch of a propeller, which is:

$$\frac{\pi \times \text{Diameter (D)} \times \text{Thickness (T)}}{\text{Width (W)}} = \text{Pitch (P)}$$

or

$$(3.1416 \times D \times T) \div W = P$$

Using a 10" prop for illustration, suppose we want to carve a helical pitch prop with a 1.2 P/D Ratio, or a 12" pitch. Once we've decided on the prop diameter, we next decide how wide a block of balsa to us for the basic prop block. Many knowledgeable folks recommend a prop width of 1.25" to 1.5" for a 10" prop. Now that we know the Diameter, the Width and the desired Pitch, using a little basic algebra which many of us have long since forgotten, we can determine how thick the prop block needs to be by using the following formula:

$$\text{Thickness} = (\text{Pitch} \times \text{Width}) \div (3.1416 \times \text{Diameter})$$

thus, for a 10" diameter, 1.5" width prop with a 12" pitch, the numbers are:

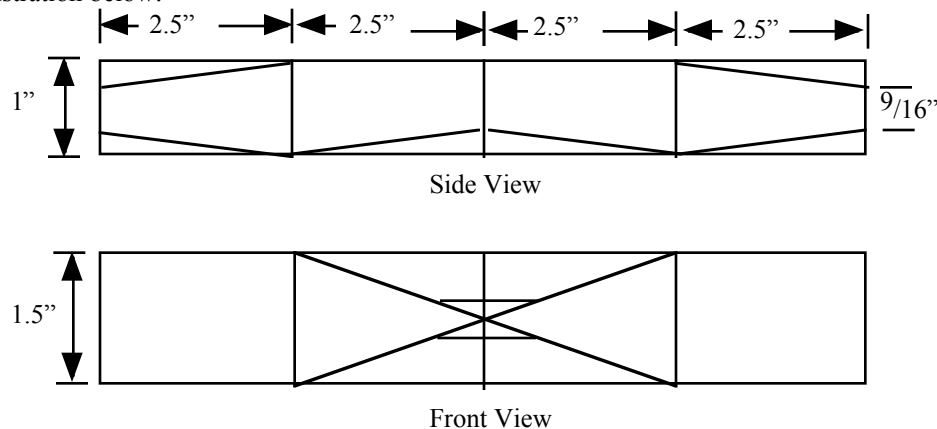
$$T = (12" \times 1.5") \div (3.1416 \times 10") \text{ or}$$
$$18 \div 31.416 \text{ or}$$
$$.573 \text{ inches or about } 9/16"$$

That tells us how thick the prop block needs to be at the tip, or at 10", but doesn't tell how thick the prop block needs to be. We know that the tip is going to be thinner than the midpoint of the blade, so we must really figure how thick the block must be at the midpoint of each blade, or at the 5" diameter point. Therefore:

$$\text{Thickness at the midpoint of each blade} =$$
$$(12" \times 1.5") \div (3.1416 \times 5"), \text{ or}$$
$$18 \div 15.708, \text{ or}$$
$$1.146"$$

Obviously, it is not easy to purchase balsa pieces that are 1.146" thick, so we round the thickness off to 1" which is good enough for us hackers.

What we are saying here is that you should start with a balsa block which is 10" X 1.5" X 1" which will give you a blade thickness of 1" at the midpoint of each blade, and a thickness of 9/16" at the tip before we start to finish carve the prop. These can be seen in the illustration below:



Once we finish these calculations we move into the world of folklore. The width of the block where the prop shaft goes through is normally between 3/8" and 1/2", and the fore and aft thickness of the hub is normally in the range of 5/8 to 3/4 X the max thickness of the prop block.

Keep in mind that this article was not intended to be a complete description of how to carve a prop. For complete prop carving instructions, read the article in the May-June 2002 issue of this exciting newsletter.