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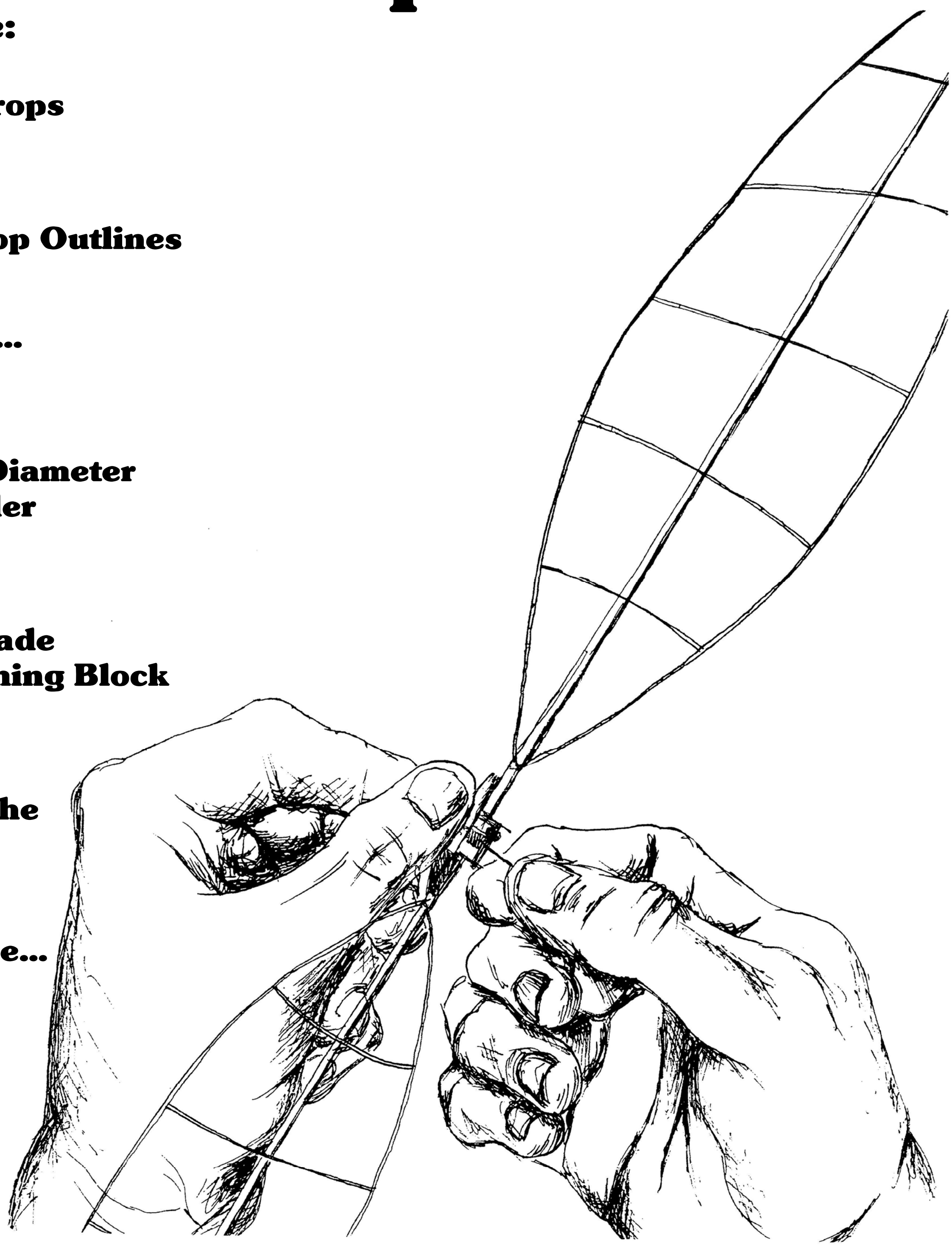
Issue #121

Spring 2007

Props

In This Issue:



From the Editor's Desk

Well, it has been an exciting summer so far, and hopefully when you get this there will still be a month or two left before the weather starts really cooling off. There has been some great indoor flying going on in the US (we haven't received much word from our friends overseas), with Kent, Kibbie, and USIC all having occurred since publishing the last issue of INAV. We'd like some input from our readers regarding the extent of coverage they would like to see for these summer contests. Between results going up on M.Bennet's Yahoo Group, J.Hood's Indoor New's site, and J.Kagan's gargantuan efforts during USIC, most people know the results before we can get them published. We will of course publish any contest reports sent in (such as the great reports in this issue), but the efficiency of republishing (for example) the USIC results is questionable. Rather, what we would like to do for the Fall is publish another winning designs issue, that would highlight the successful designs from the summer contest season. Please email or write us with your thoughts (and winning designs).

This issue is our "Props" issue – which was conceived and largely executed by Jeff Hood. We think there is a bunch of great new info in here, as well as some "classic" INAV articles to round out the coverage. In addition to his efforts on with the newsletter, those of you who attended USIC know that Jeff has put together hardcopy compilations of INAV going back to 1962. Through the wonders of the internet (and Jeff's hard work), these books are available for purchase at Lulu.com. Just do a search for "INAV" and they will all be listed. The price ranges from $24.95 to $34.95, based on the number of pages, and the profits will go to the publishing of INAV. Be patient if you order, as they take a few weeks to print and ship, but they are really nicely done and in my opinion well worth it.

Now, for a few housekeeping issues. We are experimenting with different printers to find the best price/quality we can, so if in the next few issues you notice different paper etc., that is the reason. I've had a few inquiries regarding the lack of envelopes when we mail INAV. This is predominantly a cost issue as we are currently running in the red; as well as a labor issue as I have to individually label and stamp each issue. An envelope, even if we could afford them, is one more step that I just wouldn't have time for. Our subscribership is still below 200, so mailing to the US is pushing 2 dollars an issue, and the rest of the world is over 5. We are doing our best to streamline the publishing and hope to avoid having to raise the price of subscriptions, but we will have a better idea in the next quarter. We will publish a full accounting of funds, expenses and operating costs in an upcoming issue. Any thoughts or suggestions are welcome.

Well, that's about it from the editor's desk. I would personally like to thank all of you who have subscribed or renewed in recent months, and assure you we are on our way to ironing out all the wrinkles in the production and publishing of INAV. We are working hard to get you issues in as timely a manner as possible, and hope that you are finding them enjoyable and useful. As always, we are looking for content so please don't be shy and send us your articles, plans, pictures and thoughts.

Best regards and good flying,

Tony Pavel

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Kevlar F1D Prop Outlines

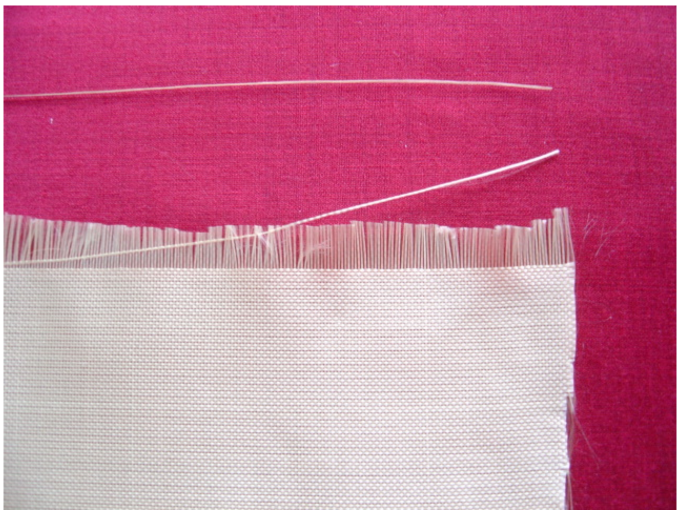
Lutz Schram

The following is a method of making F1D prop blade outlines from Kevlar thread, developed by F1D record holder Lutz Schram.

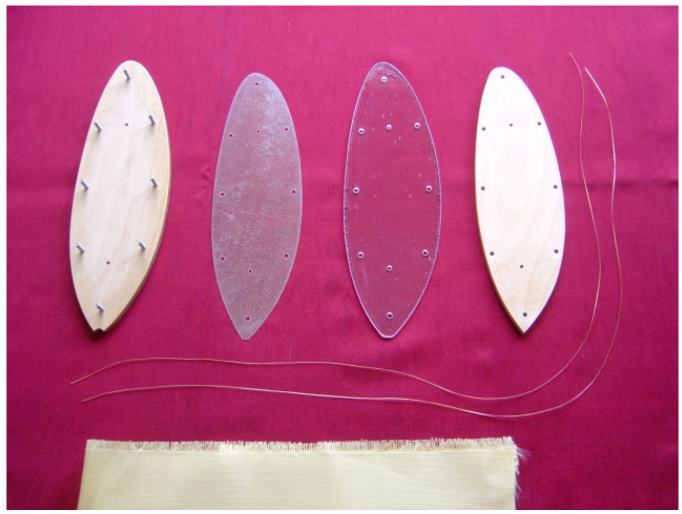
The Kevlar fibers are taken from a piece of Kevlar fabric and saturated with epoxy resin. The epoxy resin used is normally used in construction, and must be very high quality.

The outlines must cure for 24 hours, and then after curing are left on the form for one to two days (at 25-30 degrees C).

Weight of the finished outlines are in the 26-30 mg range.



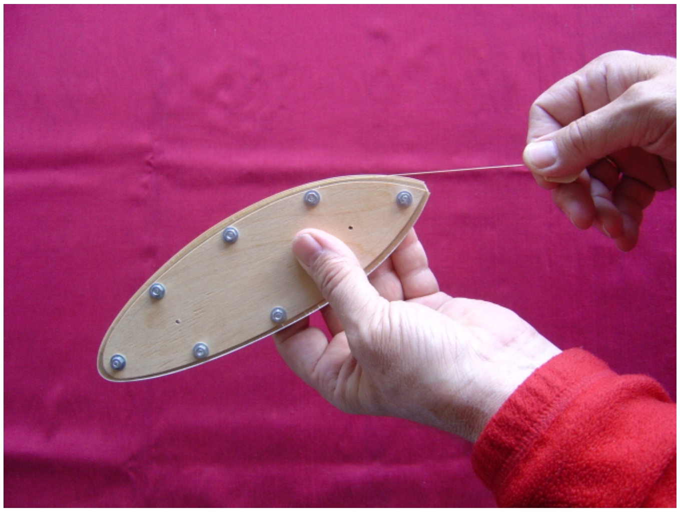
Kevlar fabric which the threads are taken from



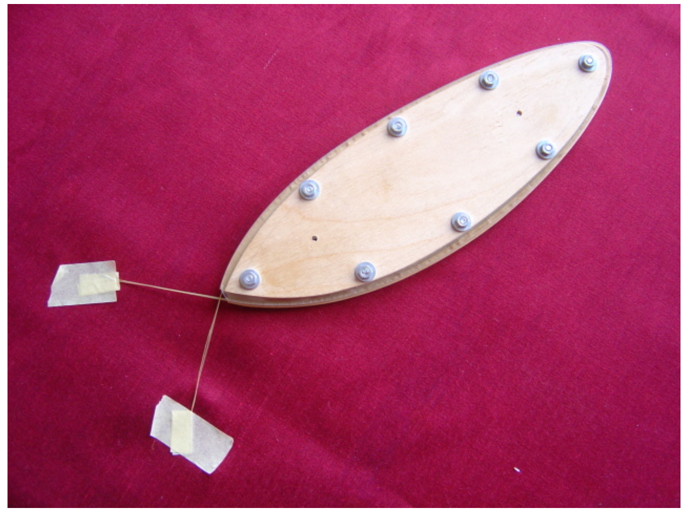
Parts of the prop form, and Kevlar threads

Parts are treated with mold release wax

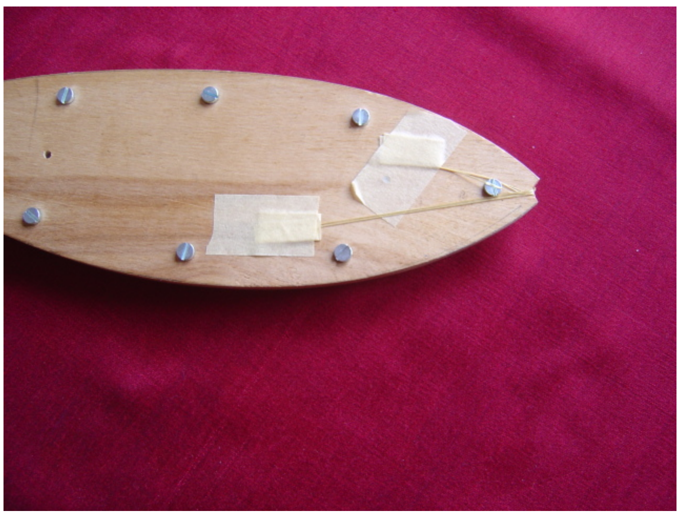
The assembled form



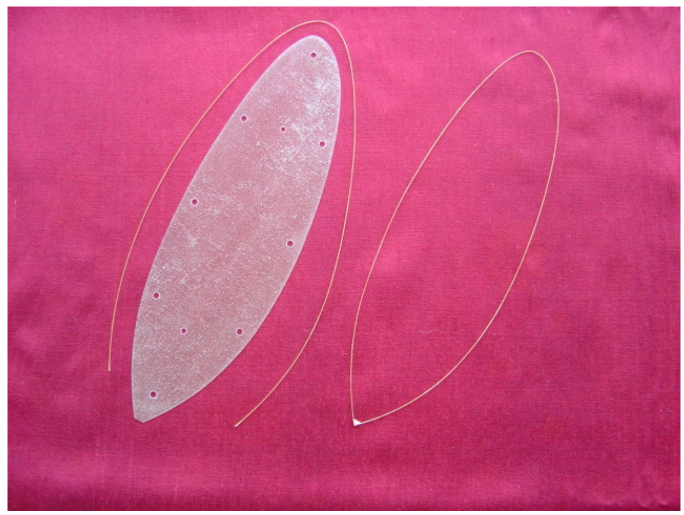
WRAPPING THE KEVLAR ON THE FORM



THREADS ON FORM AND READY FOR SECURING



THREADS SECURED TO REAR OF FORM



CURED OUTLINES REMOVED FROM FORM

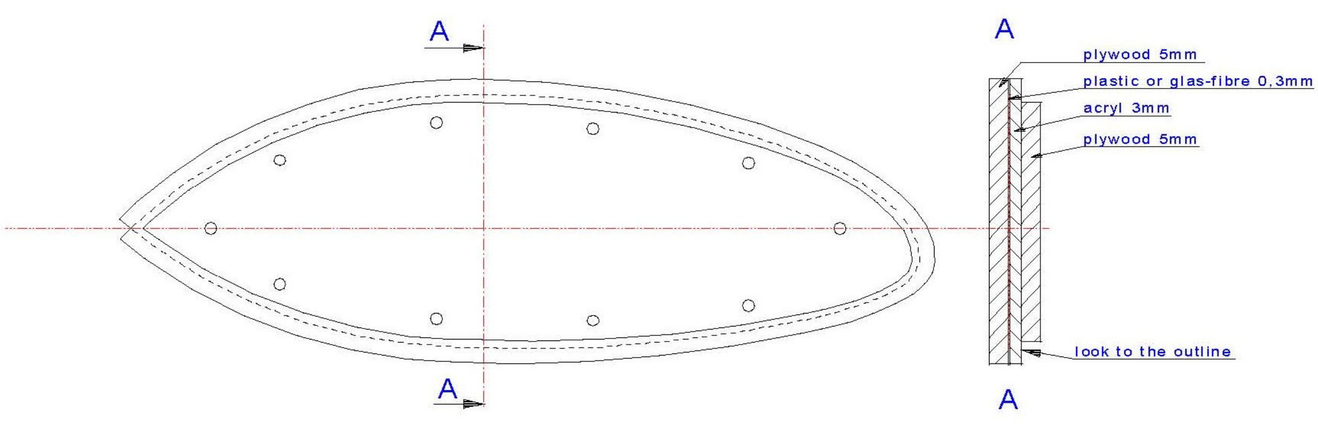


DIAGRAM OF PROP FORM

KEVLAR F1D PROP OUTLINES - ANOTHER TWIST...

Jeff Hood

A few months ago, after having a bit of success with my first F1D, I decided to build a few more and take the construction more seriously. The first F1D prop that I built was based on the great article in a past INAV by Steve Brown. Standard enough design, with a .025 square balsa outline for the prop. I made the outline flat as per the instructions, and then mounted on a pitch block, wet the outline, and held in place with thread, and baked dry. After attaching the ribs, and covering the prop, I was not really surprised to see a bit of spring-back of the helical form after a few days. However, after a while, a few of the props that I made lost a significant amount of the shape, and I wondered what I could do differently. Always looking for things to tinker with (instead of flying more, like I probably should be doing…) I got the idea to try to make an outline out of fibers, and mold it around a form made with a method used for Pennyplane props. So I made a few test forms, using my blade outline and cutting them out of a sheet of 1/16 balsa, forming them on a pitch block, and letting them dry. After taking them off the block, I coated the edges with wax, and started experimenting with carbon fiber tow as the material for the outlines, held together by thinned Ambroid. Oops… big mistake there… didn't work at all, at least for me. Thinking that the idea was sound, but needing some tweaks, I sent a few emails inquiring if anyone had heard of a similar method. Nick Aikman got back to me right away, telling me about Schram's experiments and success with Kevlar, and his methodology. I knew at that point that I was at least on the right track, and having thought that epoxy would be too heavy (but knowing that it must work) I started some more trials.

First, I wanted to get a source of light Kevlar that wouldn't be difficult to get ready, i.e. not needing to unravel anything, or separate fibers from a tow. I looked around, and found Kevlar fly tying thread (got mine from Bass Pro Shop online…) and found it to be perfect. The thread is made up of a perfect number of strands for an outline, and a whole spool is just a few dollars. The first outline I made I used two threads, thinking it would be needed, but it came out way to heavy. Then I did one with just a single thread from the spool, in which the fibers are just loose enough to allow saturation with the epoxy, and it came out perfect, and just the right weight (shooting for 20 mg per outline, just with the formed Kevlar).

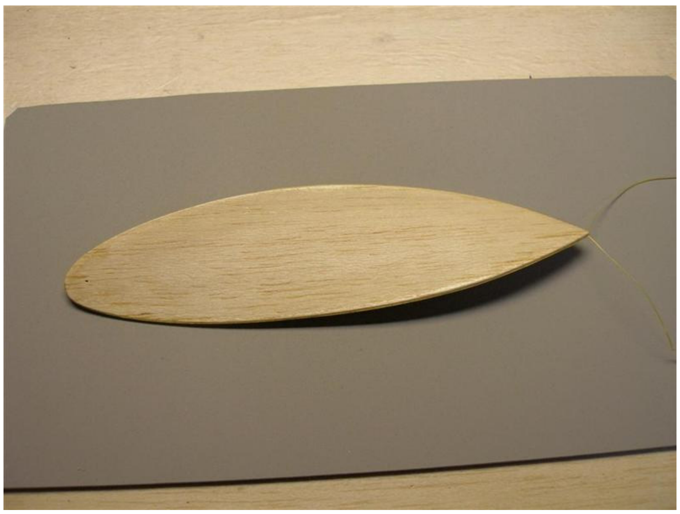
Here are a few notes on the methods that I have been using, with pretty good success to this point.

- I make my forms out of 1/16 sheet, mostly so they retain the shape well, and the thickness is about right to get the thread easily around the helical outline, and not having it fall off too easily. I will probably be making more permanent formers using laminated 1/32 sheets, but that is probably overkill.
- I finally settled on using melted wax (paraffin from the local craft store) brushed on to coat the edges of the forms as the release agent. I have used paste wax, chapstick, and some other things, but the light wax coating seems to last longer between applications. Just make sure you have *something* on there, or you aren't going to get them off (ask me how I know that…)
- You don't seem to need too many fibers in the thread to make a sturdy outline. It seems like most of the strength is in the epoxy, and I will probably be trying to separate some of the fibers in my thread out to try for even lighter outlines.
- I use a standard 12 hour modeling epoxy, since that is what I had around. I'm sure that the type makes a difference, but the hobby shop variety seems to work well. I do the same as Schram, and let them stay on the form for at least a day, and most of the time a few days. Key is to have the forms in an area in which the epoxy can cure correctly.
- When coating the threads, I mix up a batch of epoxy, then put a lump of bluetac on both ends of the length of thread (enough to go around the form with a few inches on each end to spare) and coat the thread fairly liberally. Then just using my fingers, I rub in gently the epoxy, and try to get it almost all out of the surface. I'm just basically trying to get the inside of the thread all coated, and as little on the outside as possible, so as to reduce the weight. Then I hang the coated thread by the bluetac on the end off to the side, clean off my hands, and then start wrapping on the form. You really don't want to have gobs of epoxy all over the forms, and with a long curing epoxy, you have plenty of time to coat and wrap two outlines from one batch.
- I cut a very small slot at the bottom point of the blade form, and start by setting the thread in the slot (make sure that you didn't forget to have your release agent in the slot… if not, makes for a mess getting things off…). Then just carefully wrap around the form, trying to keep things centered as much as possible at this point. After the whole way around, put the other end in the slot, and cut off the ends to an inch or so. I usually then spend a minute or two fiddling around getting the outline centered on the form. The better the job you do here, the better the end result. My forms all have a hanging hole at the top, and I just hang them up to dry after adjustments.
- After drying, I separate the thread from the form using a length of .015 music wire, running it between the form and the outline. Works well, even if you get to a spot that seems to be stuck. If there is excess epoxy on the outline, I try to clean it off with a new razor blade. If you are pretty careful coating the thread, and put it on with clean hands, there shouldn't be too much, but you can correct small excesses if you need to.

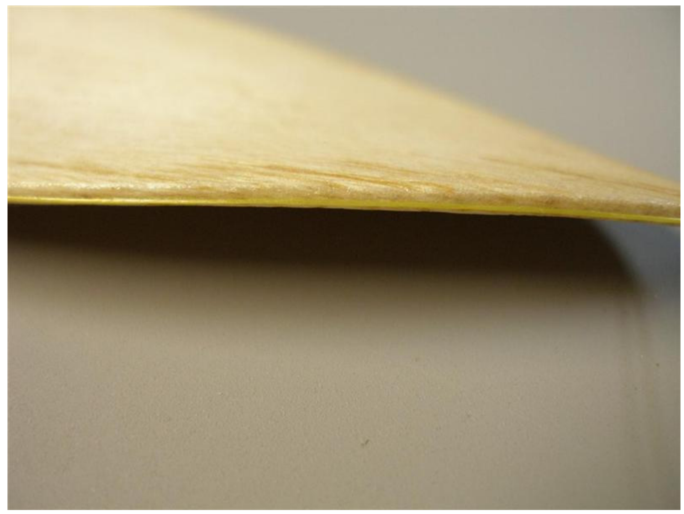
- I also made duplicate forms with notches to attach the ribs while on a form. I am basically trying to keep as much stress as possible off of the outline, so that the helical shape is retained. After the outline is dry, and ready for ribs, I put it on this form, held in place with very thin (1/64' or so) strips of blue painters masking tape around the outline. Ribs are cut and glued in place, and when cured, the tape is removed and the outline is carefully removed, and the spar glued on. I also use a small triangle of .020 or so at the base to hold the intersection together.

My outlines have been around 25mg or so, complete with ribs and the gusset. This seems pretty close to "normal" construction weights, and I think that they are very strong, and much less fragile than a balsa outline. And to this point, none of the props have lost any of the blade twist, which is what I was going after originally.

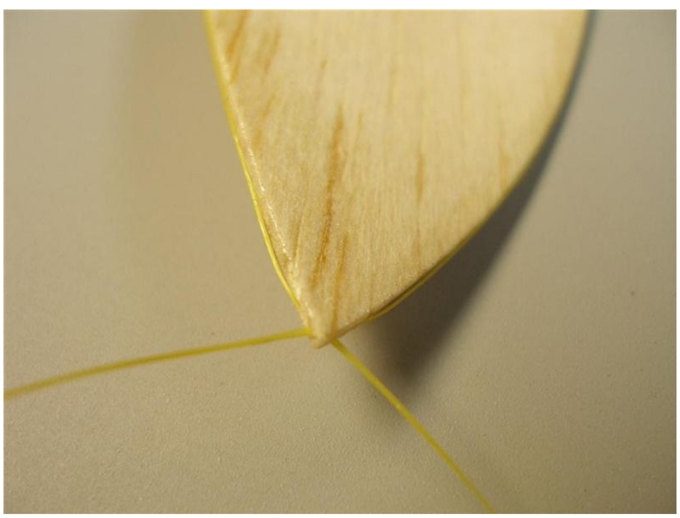
Now I should probably quit fiddling around, and start flying…



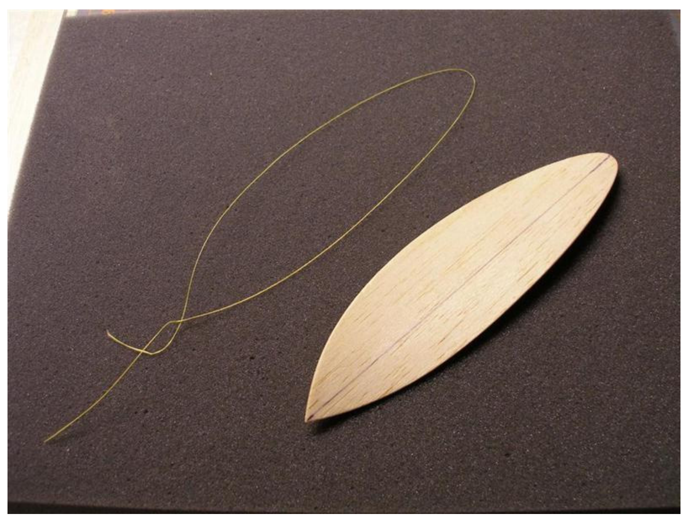
FORM, WITH OUTLINE WRAPPED, READY TO DRY



OUTLINE POSITIONED ON EDGE OF FORM

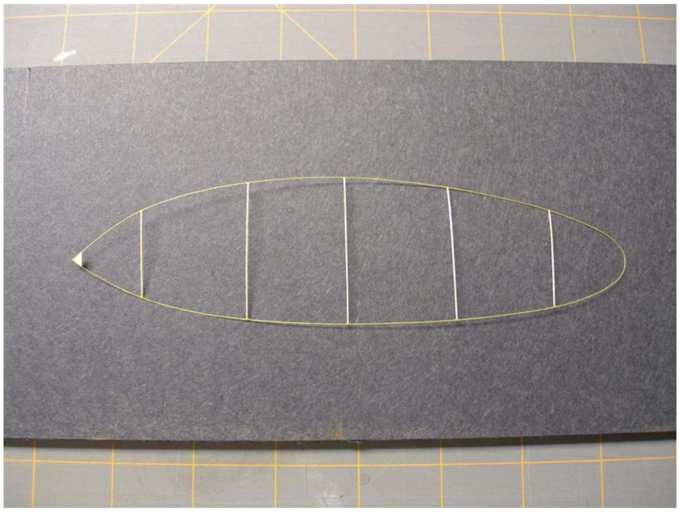


SLOT AT THE ROOT OF THE BLADE

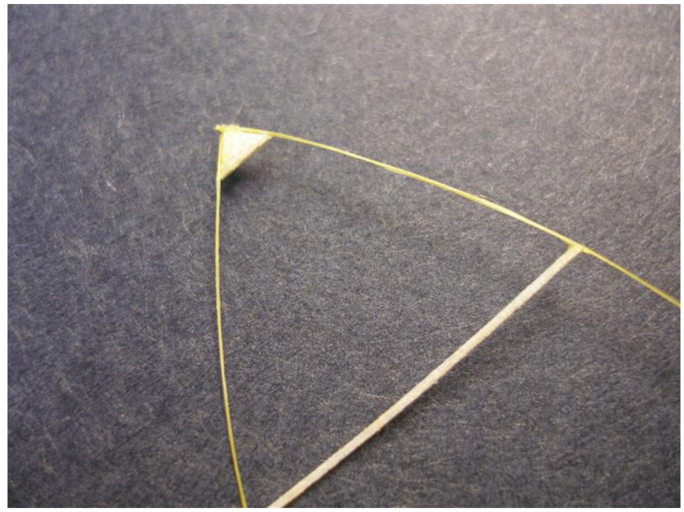


OUTLINE REMOVED FROM FORM

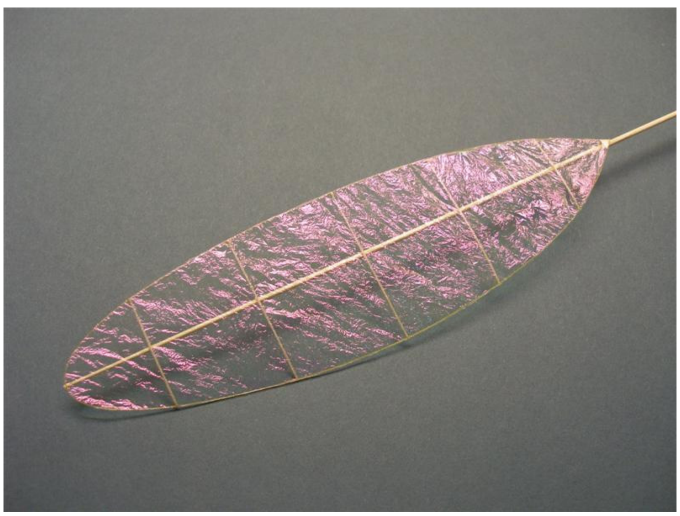
Kevlar F1D Prop Outlines - Another twist...



Outline, with ribs and gusset



Close-up of outline



Covered blade with spar

Final weight of blade

Final completed prop

THE VARIABLE DIAMETER INDOOR PROP

Jim Richmond

The plane is launched and it climbs away with the prop ticking over at only 35 rpm Team captain Larry Calliau comments admiringly about the slowness of the prop. The Film Flam climbs slowly for 10 minutes to a safe altitude of 80 feet where it levels off still 25 feet below the girders. After 20 minutes flight time the plane has descended to 50 ft. and has drifted to one side of the building where it is steered away from potential trouble. Rodemsky stops by and seeing the plane now at 35 feet with only 25 minutes on the watch comments that it's not looking so good. But wait! The prop is suddenly going faster and it looks shorter. And yes, the plane is actually climbing again! It goes up a few feet, does another cruise, and then descends to finally land with a time of almost 40 minutes!

This was the first and longest flight of the Film Flam in Nagoya, Japan in 1984 and was the first world champs flight ever made with a variable diameter prop. The basic mechanism was developed in 1965 for use on a paper stick model but the benefit for this type plane didn't seem to offset the extra weight involved. Then in 1983 the idea was resurrected when it was realized that there was room in the F1D minimum weight requirement of one gram to accommodate the mechanism weight of about .06 grams. The 2 props made were first used to set a national and a world FID record and then they were introduced to the indoor world champs crowd at Nagoya where they became an instant sensation (see photo) by helping to win the event. Since then they have been used to win 2 additional world championships and set numerous records. They have been found to be an excellent match for the new 55 cm F1D planes which, because of the limited motor allowed (.6 gin.), need to make efficient use of all of the turns available. Recent successes with these planes have stirred up a renewed interest in the VD prop.

ADVANTAGES

Originally I thought the concept might be outlawed, but instead, the variable pitch prop mechanism was developed by Cezar Banks and others. This has a similar benefit and has become very popular but the ability to change both the diameter and the pitch gives the VD prop a slight edge in my opinion. You need only to watch one in a steep climb and note the slowness oft he prop to realize how efficiently those high torque turns are being used. It's like having a two speed automatic transmission without the associated weight and friction (yes, I've tried that too). One of the nicest things about this particular variable diameter mechanism is that it is made with familiar materials and building techniques to produce an excellent low weight device. A big advantage is that it can do it's thing safely under the girders, but another big plus is that the anticipation of the fold and the following second cruise makes these flights far more interesting and enjoyable. Of course rafter banging can be interesting too, but the associated danger and stress makes this type of flying less than enjoyable in my opinion.

OTHER DESIGNS

Numerous other variable diameter prop mechanisms have been designed for use on both indoor and outdoor models and even full scale aircraft. Many of these actually worked as intended, but were not suitable for indoor use due to weight, drag, or mode of operation. For instance, some outdoor types rely on centrifugal force to enlarge the diameter, but this couldn't work on a low speed indoor prop. Having never seen any of these other designs in the winner's circle, I can only conclude that their deficiencies outweighed their advantages.

OPERATION

The operating principle involves the use of a 2" center section in the prop spar with a hinge at each end, allowing it to rotate 180 degrees. A small rubber band urges the prop to fold shut to the 18" length while the motor torque urges the prop to open to the 22" diameter. It uses parallelogram filaments (.001 polyester) to make both blades operate in unison and it has cam shapes for a rubber band called the flip loop to pull against to promote a quick fold. Without these, the folding process is gradual, and Z- shaped props have been found to be less than desirable. The prop itself starts out as an ordinary 22" dia. 46 pitch indoor type with at least 6" of bare spar in the middle. The center 2" is the part that gets the special treatment, of course, and should be replaced with a slightly stronger material due to the stresses involved. The key members are the hinges with their associated cams and stop arms. The hinge design was derived from my wire prop bearing, using loops of wire at each end with a straight wire pivoting in them. The hinge pins in my props are made parallel with each other and this produces a pitch change of about 10" (46" to 36"). If desired, various pitch change effects can be achieved by skewing the hinges somewhat.

THE CAMS

The so-called cams are simply balsa members that the flip loop wraps around to space it the right distance from the hinge pin. Their purpose is to regulate the torque being applied to the folding action by the pull of the flip loop. At the start of the fold sequence, the cams keep the torque fairly constant to avoid a premature actuation due to small disturbances. At this time, when the prop is almost ready to fold, it can be noted that the descending blade shows the beginning of a slight fold angle while the ascending one does not. This characteristic is due to the weight of the blades and is an indication of the sensitivity of the design and the need for minimal friction. In a short time, it will be noted that both blades are flexing in unison. When the increasing angle of this flexing causes the cams to space the flip loop further from the hinge pin, the added torque then drives the fold to instant completion.

THE FLIP LOOP

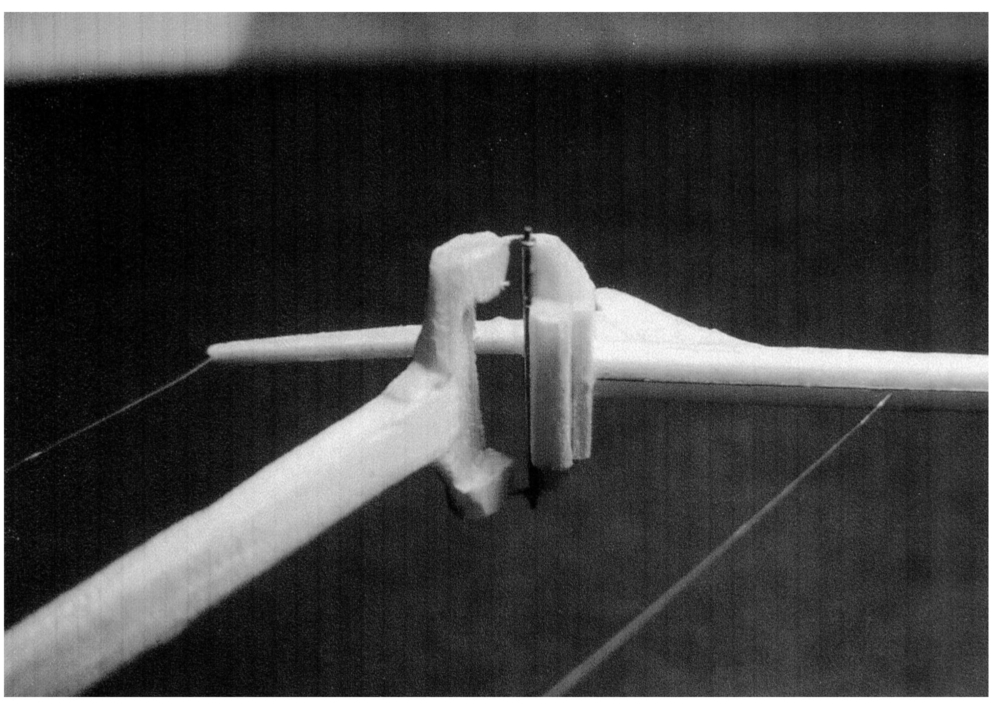
The rubber flip loop is about 1" long and has a cross section of about .020" X .020". A number of similar ones are prepared to cover a variety of possible needs. An excellent stretch ratio of 10 to I or so (like Tan II) is desired in order to minimize the change in pull force during operation. The flip loop is easily loaded onto the folded prop by expanding it and sliding it over one of the prop blades and attaching it over the hooks provided in the stop arms. The right flip loop strength relative to the motor torque can be found by the use of a run down stand or by flying with 1/4 motors. Flip time accuracy is not critical and any actuation near the mid-point of the flight will usually produce good results.

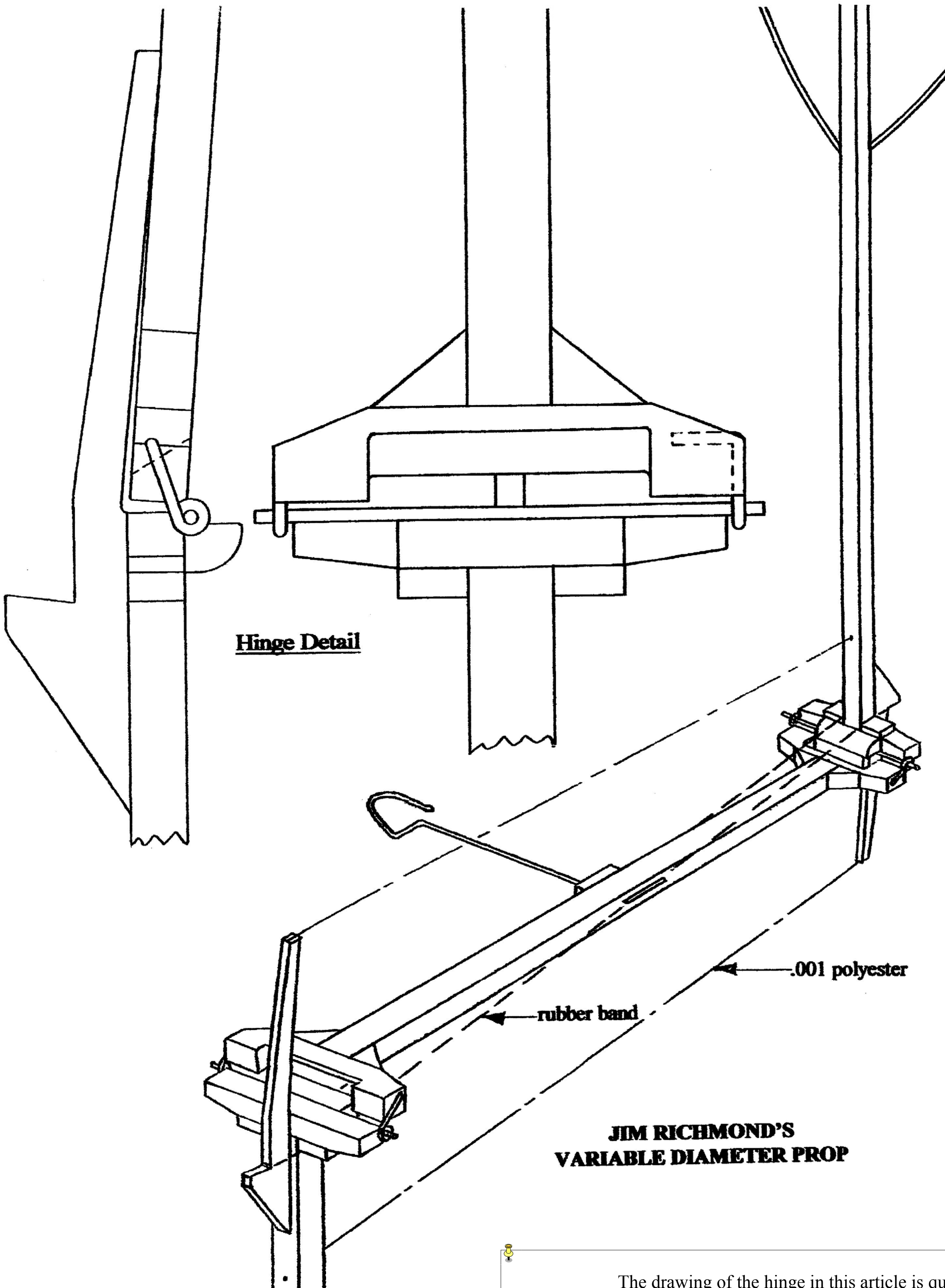
The .020x.020 flip loop rubber strips can be made by attaching double sticky tape to a piece of cardboard, then attaching .040x.020 rubber strip to it, and then dividing it a little at a time using a new super sharp razor blade. It's not easy, but not much is needed. Really sharp blades can be found in cheap plastic safety razors.

INDOOR FLYING

Many people avoid indoor duration flying, as I once did, because they perceive the activity to be slow paced, dull, and uninteresting. Nothing could be further from the truth, but the only way to find out is to try it. You can't tell by watching as I know from experience. I tried indoor rubber back in the 1960s only because the Aeronuts cut off the glider flying at noon and there was nothing else to do. And now I can tell you that the most fantastically exciting moments in my life occur when my model is at high altitude in a major competition, getting into trouble. Several well known indoor flyers have been known to actually leave the building on such occasions rather than endure the stress.

So put some excitement in your life. Try indoor duration flying, and for an added kick, use a variable diameter prop.



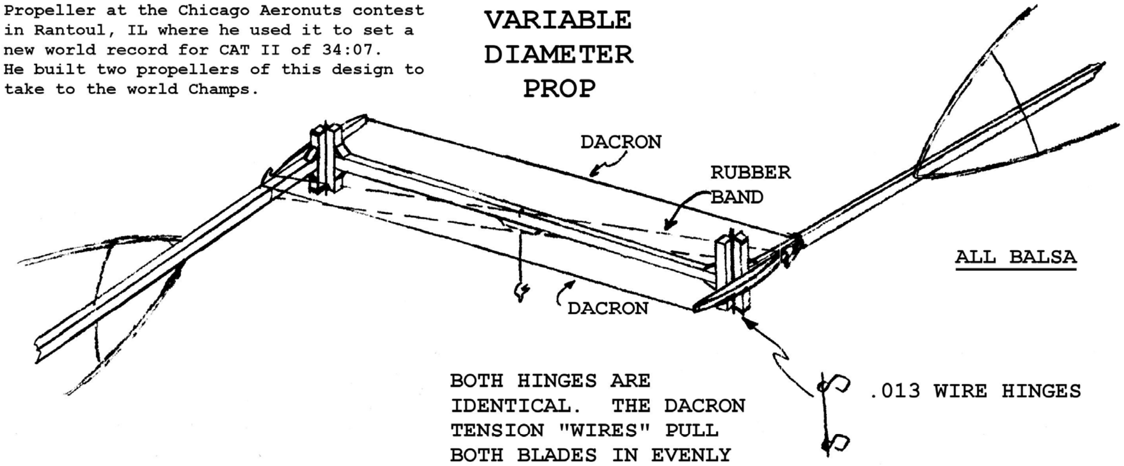


The drawing of the hinge in this article is quite accurate. As a reference in scaling, the spar is .090 X.060

Drawing of Richmond VD by Richard Doig - from December 1984 INAV

I saw Jim Richmond's Variable Diameter Propeller at the Chicago Aeronuts contest in Rantoul, IL where he used it to set a new world record for CAT II of 34:07. He built two propellers of this design to take to the world Champs.

RICHMOND'S
VARIABLE
DIAMETER
PROP



BOTH HINGES ARE IDENTICAL. THE DACRON TENSION "WIRES" PULL BOTH BLADES IN EVENLY
22 INCH EXTENDED DIAMETER
18 INCH FOLDED DIAMETER

DRAWN BY: R.DOIG

VARIABLE DIAMETER PROPS
(From the INAV Archives)

February, 1985 - Article by Richard Doig

VARIABLE DIAMETER & PITCH PROPELLERS
When I saw Jim Richmond's Variable Diameter Propeller last September in Rantoul, IL I asked him why he was using it and his reply was that it was a more reliable way to change the pitch than changing. the blade angle. Which brings us to the heart of the matter, when this type of propeller folds you get a dramatic reduction in pitch.

BACKGROUND
Variable Diameter Propellers are nothing new, as Hewitt Phillips and Jim Clem have been experimenting with them for many years. (See accompanying articles.) Up until very recently, however, no one had succeeded with a variable diameter prop without incurring a severe weight penalty. That all changed last September 29, when Jim Richmond broke the CAT II World. Record using one. (34:07 under 44 feet) This flight had an interesting flight pattern in that the model climbed to 20 feet or so and cruised for 10 minutes. Then over the next 2-3 minutes the prop folded and the model climbed to a peak altitude of 40 feet. This was advantageous as the ceiling height was 44 feet with lights which hung down 2 feet and there was noticeable drift close to the ceiling. Richmond succeeded in staying below the drift. At the World Champs in October, Richmond was able to fly top times without touching the ceiling and with-out risk of hanging up, while everyone else bashed the girders. His prop was clearly the hit of the World Champs.

DOIG VARIABLE DIAMETER PROPELLER
Richmond's prop made extensive use of bent wire hinges and other parts - which he is very good at making. I took a different approach, using Micro-X teflon washers as hinge bearing surfaces around straight pieces of wire. As originally built this prop would not completely open but stopped 15˚ short. However it still flew well enough to win the Balsa Bug's MI Stat8 Championships in October - 23:43 at 60 feet in 50 F air.
The propeller has since been modified to reduce the distance that the rubber has to stretch for full opening and this corrected the problem. (see figure 1) This mechanism added about .0040 ounce to the weight of the prop (mostly in Hot Stuff required to repair the many breaks caused by my clumsiness during building). Properly done, this mechanism should add about .0015 - .0020 ounce. Opinion seems to be very strong concerning Variable Diameter & Pitch Propellers. Those who oppose them are adamant that the extra work involved will reduce participation even further. Those who favor them can see their value at making models last longer because you stay out of the girders. It does take less time to build one of these props than a replacement model. Most flyers don't see any benefit from Variable Diameter & Pitch Propellers in high ceilings (CAT IV) at this point. However in lower ceilings, especially those with cluttered ceilings -girders, lights, sprinkler systems - the benefits are staying several feet below these obstacles are great.

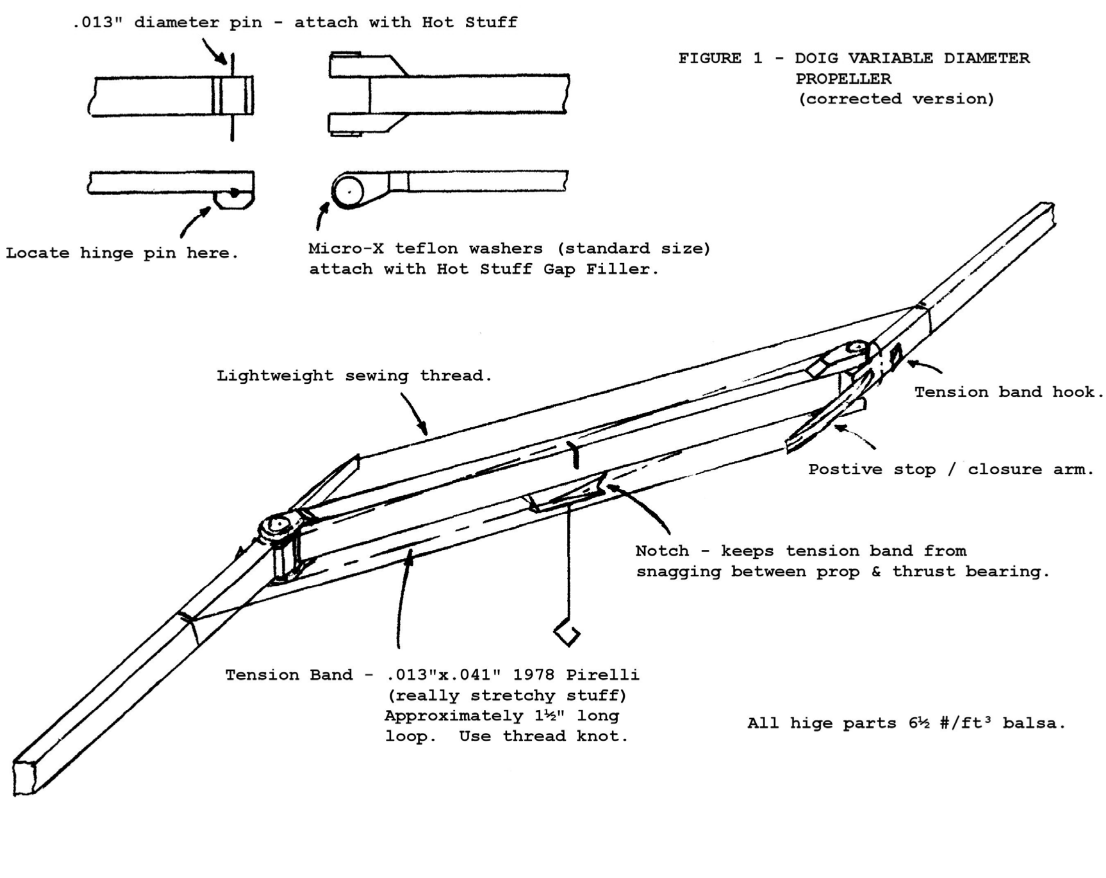


FIGURE 1 - DOIG VARIABLE DIAMETER PROPELLER (corrected version)

Please note that this type of propeller is specifically outlawed in the A.M.A. Rulebook for Novice Pennyplane and Manhattan Cabin.

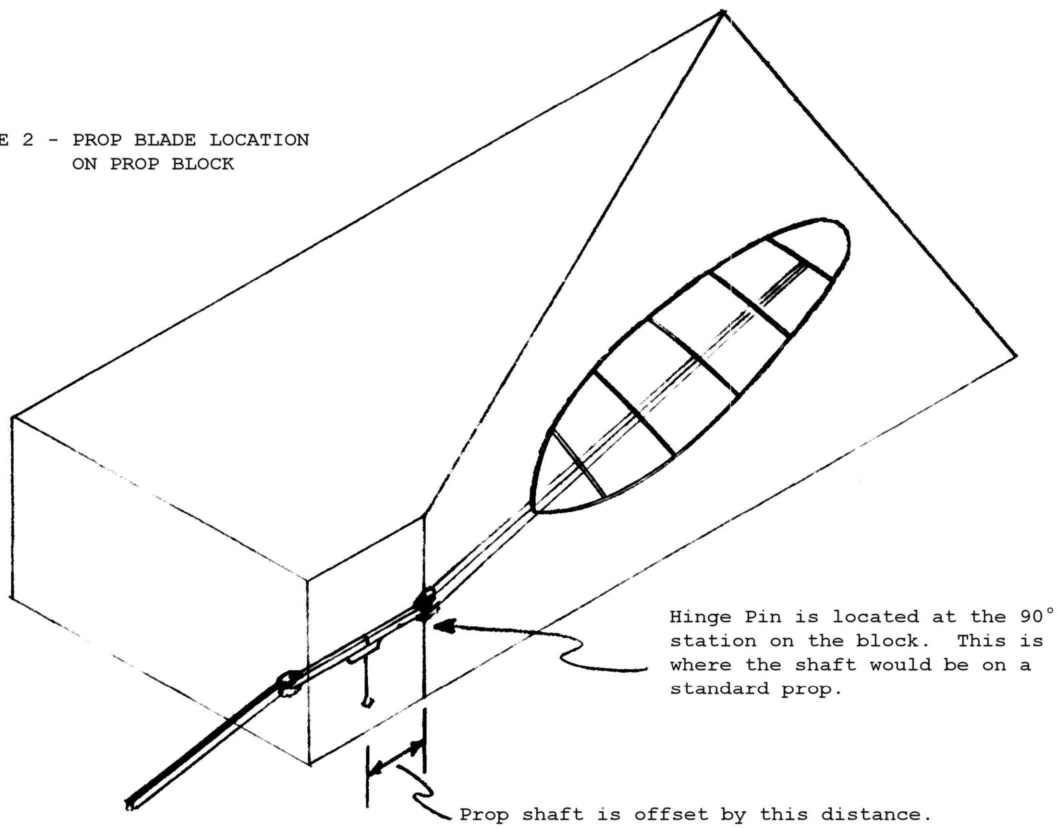
HOW THE CHANGE IN PITCH WORKS

In Jim Jones' accompanying article he discusses pitch change as the blades are folded inward. How-ever he presumes that the pitch was helical when the prop was fully extended. This is not necessarily the case. When I asked Richmond where he placed the blades, he was non specific except to say that helical pitch occurred part way through the fold. In the case of my own prop I set true helical pitch to occur when the prop was halfway through the fold. That is, I glued the blades onto the spars with the hinge pin at the point on the pitch block where I normally put the hook, see figure 2. (Actually this is the only way it would fit.) This creates a situation where when the prop is fully extended the pitch is very high at the hub and decreases toward the tip and the average pitch is higher than the prop block. The higher pitch at the hubs slows the R.P.M. way down while keeping the tip at a shallower pitch so the tips don't stall. When the prop is fully folded the opposite is true. The pitch is low at the hub and increases toward the tip and the average pitch is much lower. The R.P.M. increases dramatically due to reduced drag and if you are high enough on the rubber's torque curve the model will begin to climb again. This prop construction gradually folds to approximately 90° over a long period of time. 2-3 minutes or more. When the mechanism gets to 90 and goes over center, the next 90° of travel happens very quickly and abruptly taking 2-3 seconds. If properly done, the fold will not begin until 10-12 minutes into the flight (or even longer).

WHAT DOES THIS ALL MEAN ?

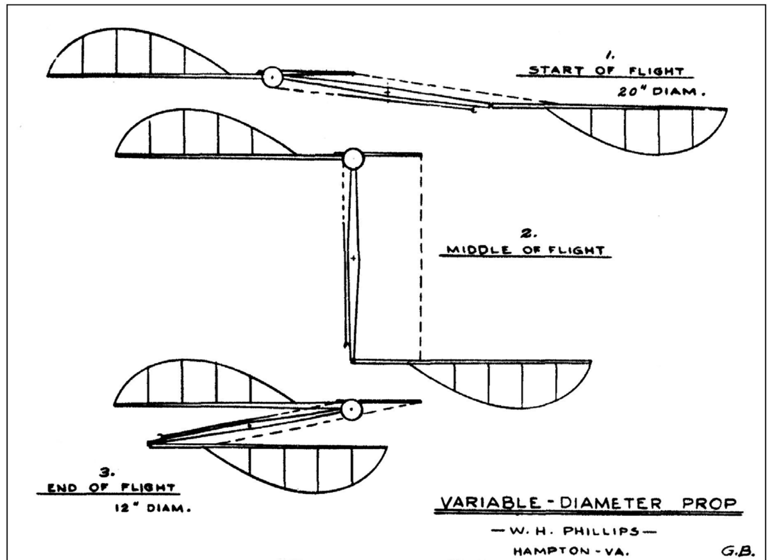
Only experimentation by several modelers under a variety of flying conditions will provide the answers along with discussion amongst modelers, especially if we are to come up with mechanisms which are easy to build and lightweight.

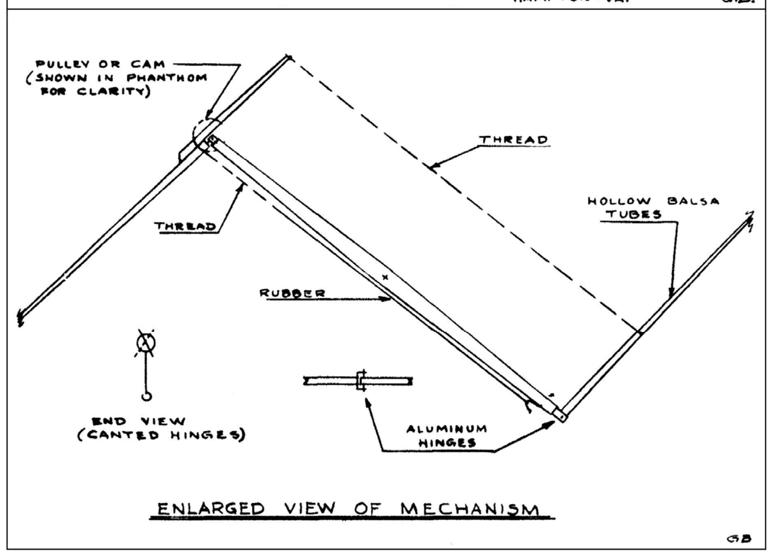
FIGURE 2 - PROP BLADE LOCATION ON PROP BLOCK



Reprinted from Indoor News & Views, April 1966.
Look at what it has taken us nineteen years to learn!

The Variable Diameter Prop
by Hewitt Phillips





I have built two or three of the variable diameter props, and they really work. However, the additional weight and drag of the mechanism would be more of a penalty on today's models than it was in the old days.

The principle of operation is shown on the attached sketches. The two blades are kept in the same relative position by a parallelogram linkage (absolutely essential, as discovered on the first trial when one blade would stay full out and the other full in). The blades wind out against the tension of a fine rubber band wrapped around a small pulley. The rate of climb or descent of the model depends solely on the tension in this rubber band and is independent of the winds or torque of the rubber motor. Thus, the model may be adjusted to fly level throughout the flight by carefully adjusting the tension in this fine rubber band.

Variations in the characteristics may be obtained by changing the pulley from circular to elliptical or cam-shaped. Usually, it is desirable to obtain some climb at the start followed by a long level cruise. Otherwise, the drafts near the floor will eventually bring the model down.

Also, blade angle change may be obtained simultaneously with diameter by canting the hinges. This may be used to compensate for twist of the blades under high torque at the start of the flight.

It is perfectly easy to obtain peculiar effects, such as a descent at the start under full power, with the prop stretched out to maximum diameter, followed by a climb near the end of the flight with the blades pulled in and the propeller buzzing around like a beginner's ROG. This condition obviously should be avoided for endurance.

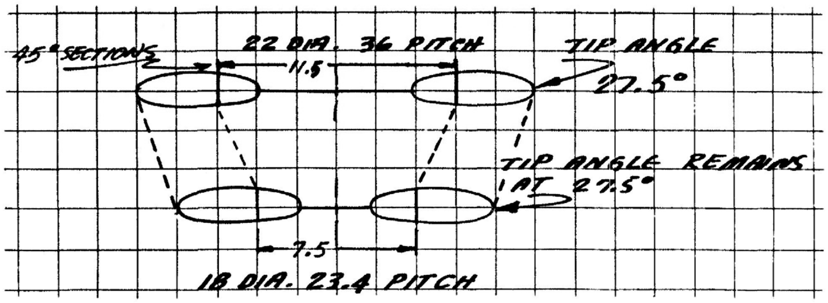
In Boston, we flew in the old Irving- ton Street Armory which had a 55′ ceiling. The variable diameter prop was really advantageous under these conditions. I don't think it would compete with fixed diameter props in ceilings above about 80 feet.

F.Y.I. (FOR YOUR INFORMATION) by Jim Jones

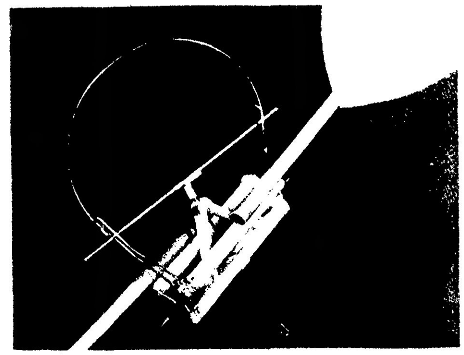
Since Jim Richmond won the Indoor World Championships in Japan, I have seen two published drawings of his winning model - One in N.I.M.A.S.'s INAV & the other in my latest edition of "Bat Sheet". Both articles mention the variable pitch prop but they refer to it only as a variable diameter. When the diameter changes, the pitch also changes, & it happens like this.

For the sake of explaining this condition. I will assign a pitch of 36 inches to the fully extended 22 inch position. The 45° section of a true helical pitch prop exists at 11.5 inches. When the blade are retracted to the 18" diameter minimum, the 45° sections also retract. These 45° sections now exist at a diameter of 7.5 inches. The pitch now is only 23.4 inches, but it is no longer a true helical pitch. To illustrate, the tip angle of a 36" prop at a diameter of 22 inches is 27.5 . When this prop retracts to its 18" diameter minimum, this tip angle remains the same. When you figure the pitch of a blade with a diameter of 18 inches, & a tip angle of 27.5 it calculates out to a pitch of 29.5 inches. This prop now has a pitch of 23.4 inches at the 45° section and a pitch of 29.5 inches at the tip.

These calculations are based on the premise that the blade extends & retracts in a straight line without rotating on its axis. It also is figured without taking into account any of the flexing that an indoor prop has to endure. To summarize, from the center of the hub to the 45° section the angles will be less than they would be if it were a true helical pitch, & from the 45° section outboard the angles are just a bit higher than they should be. But the change is great enough to allow the prop to pick up a few RPM’s & extend the cruise, when the conventional fixed pitch & diameter prop would be slowing down too much to maintain lift.



(Reprinted from NFFS Free Flight Digest, May,1976)
INDOOR PROPS - VARIABLE PITCH AND VARIABLE DIAMETER
by Hewitt Phillips



Ever since the days of hand-carved balsa indoor props, attempts have been made to build in a distribution of area and structural stiffness which would allow the blade to "flare" at the start of the flight to slow down the climb and prop R.P.M. during the initial kick of the rubber motor. The slower climb was especially beneficial in low ceilings, but as performance of indoor models improved, it was found. that under good conditions, models without a flaring prop would climb too high for even the tallest dirigible hangers. Thus, most all modern microfilm props are designed to increase pitch at the start of the flight.

The conventional prop with flexible spars is definitely limited in the amount of flare that can be provided. If the spars are made too flexible or the prop area is centered too far forward, a disastrous type of instability sets in under full power. One blade will diverge to a full high pitch condition but this will slow the R.P.M. to a point that the other blade will twist to low pitch. The resulting unbalance will usually shake the model out of the air.

Several prop designs have been suggested and tried in past years which allow much greater pitch change without the instability. These systems usually added some weight, which, for models without a minimum weight rule, almost always outweighed any advantage that might be obtained from the device. In the case of FAI models, Pennyplane, etc., in which the minimum weight is specified in the rules, a device weighing a few thousandths of an ounce can frequently be accommodated without exceeding the specified weight. In fact, a weight at the nose may often be beneficial from the stability standpoint. The interest in Variable-pitch propellers is therefore growing.

A variable-pitch propeller was described in an . article by Jeff Annis in the 1975 Symposium volume of the NFFS. The feature of this propeller which allows a greater pitch change than that of a conventional flaring prop is that the change in pitch of the two blades is kept equal through a linkage. Another prop design incorporating this principle has been proposed by Bob Meuser (figure 1). Both these prop designs should prove very beneficial whenever the ceiling height is less than that of the very biggest hangers.

Theoretically, more efficiency could be obtained by increasing the prop diameter rather than the pitch at the start of the flight. A larger diameter prop acts on a larger volume of air, thereby losing less energy in slipstream velocity. Also, a blade stall may occur if the pitch increases excessively. A method of increasing prop diameter was proposed many years ago by John P. Glass, and was tried by the author in several different versions.

The method of varying prop diameter is shown in figure 2. The propeller blades are synchronized through a parallelogram linkage, and the blade position is determined by balancing the torque against the tension of a thin, rubber band wrapped around a pulley. By changing the shape of the pulley from a circle to an arbitrary cam shape, most any climb profile for the model may be obtained. For example, the model may climb rapidly to 20 feet altitude, then cruise at this altitude for the rest of the flight until the propeller reaches its minimum diameter. So long as the propeller is in this "regulating" condition the climb of the model is not affected by changes in motor torque. The effect of reduced torque due to breaking in the rubber is therefore eliminated. To offset these advantages, however, the propeller spars have high drag and the overall efficiency is generally less than that of a conventional prop. A final possibility that may be mentioned is to change both pitch and diameter simultaneously by skewing the hinges of the blades.

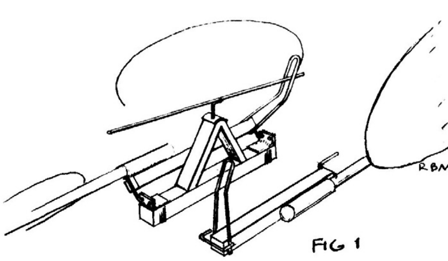


FIG 1

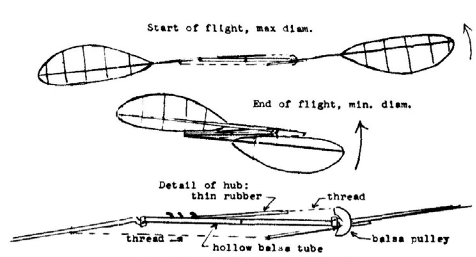
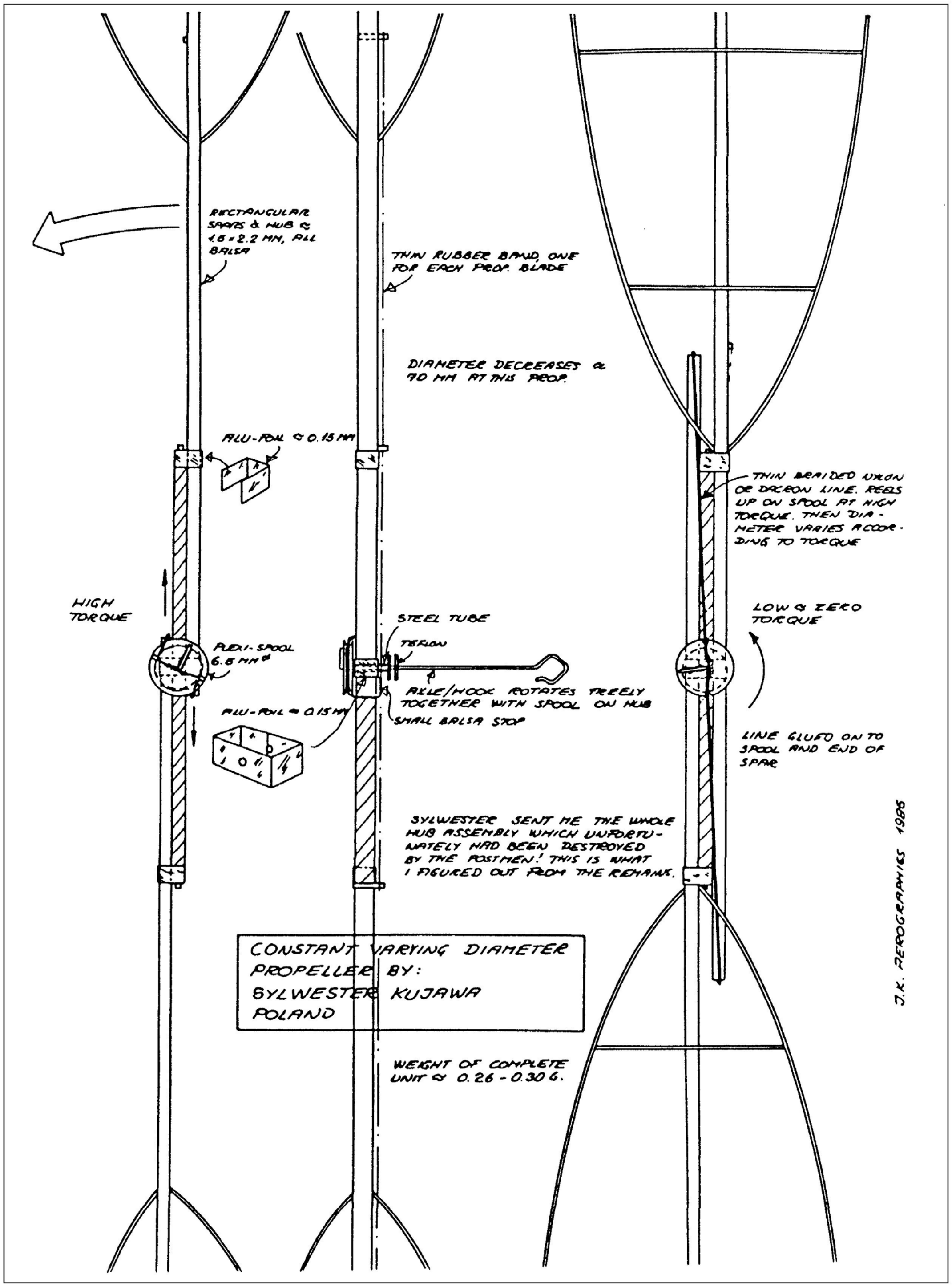


Fig. 2 - Variable -diameter indoor prop.

January, 1986



A PROPELLER WITH CONSTANTLY VARYING DIAMETER
from Sylwester Kujawa by Jwrgen Korsgaard

In September I got a letter from Sylwester containing the hub and some part of the blades of his newly developed C.V.D. prop. Unfortunately the postal services had been rather brutal to the envelope, so quite a lot of bits and pieces fell out, when I opened it! I tried to put the prop together again, and on the drawing you can see what I figured out.

Editor's Note: Bud Romak was in Romania this autumn and saw Kujawa's props up close. He says that Korsgaard's drawing is correct. This prop appears to be much easier to build than the hinged versions by Richmond or Doig.

April, 1987

Richard Doig

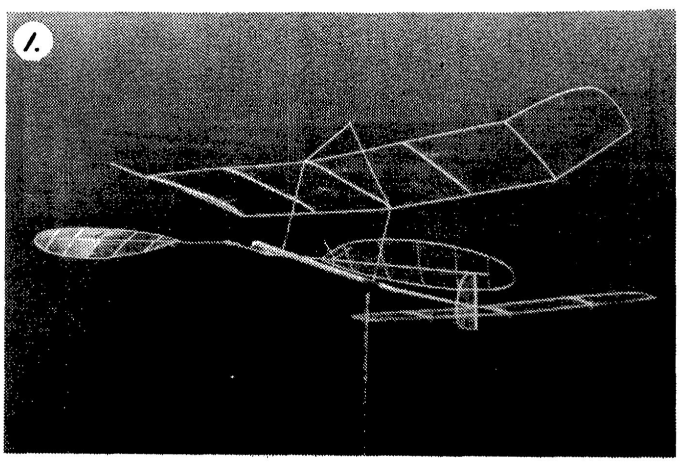
Some additional notes on the design:
1. The CG is too far forward. That particular model required almost 1/2" of "up" elevator to float properly, and would not climb higher than about 90 feet without severe stalling during the climb. I've since moved the wing forward moving the CG to 74%, but I have not had the chance to fly this combination yet.
2. I have also built and flown a second version with an 18" motor stick. This model is balanced at 77% and I found the extra motorstick length was needed to get the wing far enough forward while still having adequate clearance between the prop and wing. The previous climb problems look like a thing of the past.
We also supplied some photos to Model Aviation with the article (these were not used, so we are presenting them here).

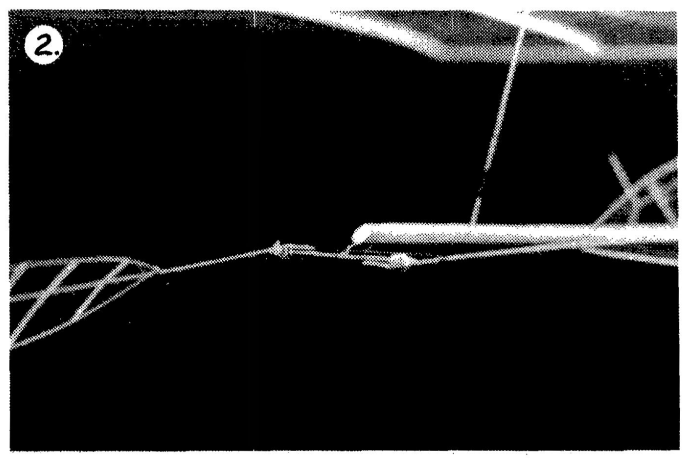
PHOTO CAPTIONS
1. Complete model - propeller fully extended.

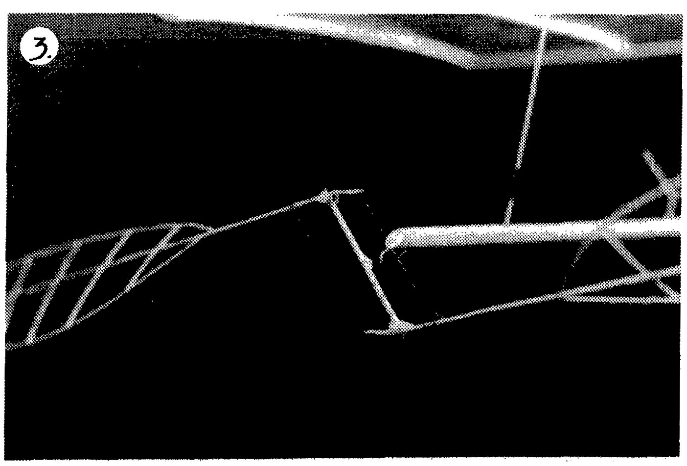
2. Close-up of prop mechanism in fully extended position.

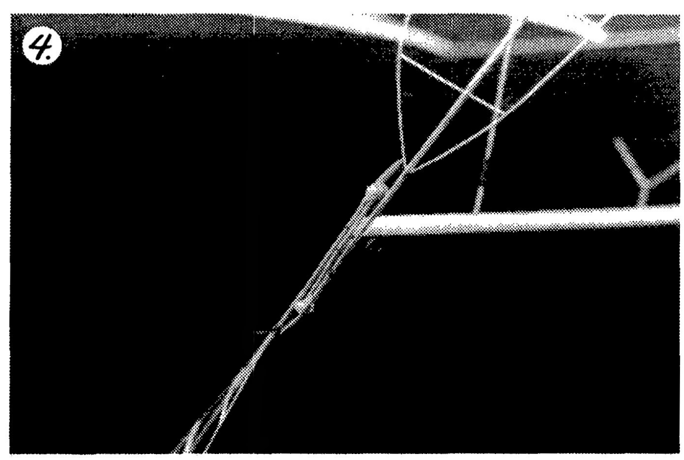
3. Close-up of prop mechanism half way through fold. The small rubber band has been removed from its hooks and is visible on the lower prop spar.

4. Close-up of prop hub assembly fully folded.









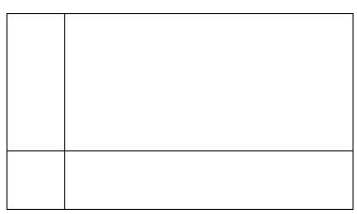
Making a Propeller Blade Sectional Forming Block

Matt Payne - propellerman@sbcglobal.net

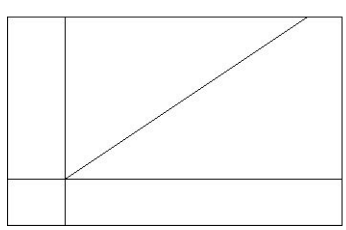
This method of fabrication is designed for, but does not require, a band saw and a belt sander, and does not utilize a saw jig or fixture as with the method devised by Fujikawa and Zceleczky. The forming block consists of individually cut pieces which are set into a box frame. Think of a forming block sliced into sections and reassembled. A hand-held power saber saw (jig saw), a regular jig saw, or a miter saw and box can be substituted. The jig saw and/or a rasp file and a sanding stick can be substituted for the belt sander. The sander can be hand-held or bench-type. Off-the-shelf stamped steel straps are used as guides for final sanding of the bevels. Corrections are easy by sanding, piece substitution or wood filler putty. Completion time is about two hours, depending on tools used.

Balsa, or any soft wood such as cedar, white pine, or basswood can be used for the sections making up the forming block. Season-dry, fence-grade cedar is recommended because it is easier to sand than pine, and more durable than balsa, and you can easily stick a push pin into it for pressing the blade to the block for forming. Cedar is usually rough-sawn on one or both sides, so may need sanding to ensure a close fit between the pieces. A single standard 1” x 6” fence board will provide material sufficient for two blocks. Use 1” x 6” smooth pine for the box frame base plate. Make sure it is not cupped or warped. Use 1” x 2” pine for the box frame sides.

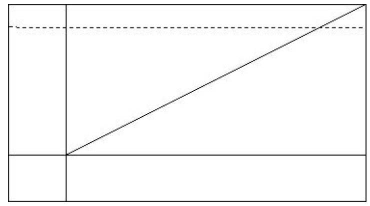
A forming block with a seven-inch long blade capacity will require a stack of nine to ten pieces, depending on the thickness of the wood used. You can rip a 1 x 6 in half down its length, (if pine, less one foot for the base), then cut those halves into five-inch long pieces. Number each piece on the top edge at one end, which will be at the rear. Use a carpenter’s square or 90-degree edge rule to mark lines parallel to the bottom and one end on both sides of each piece, as illustrated below. The distance from the edge to each line should be the same, from ¾” to 1”, for ease of set-up for cutting.



Using a pitch/tip angle chart, select a tip angle for the end block. Use a protractor to mark that angle on the outside face of the end block. The point where the lines cross is the x,y point. Draw the angle line from that point to the top edge of the piece.

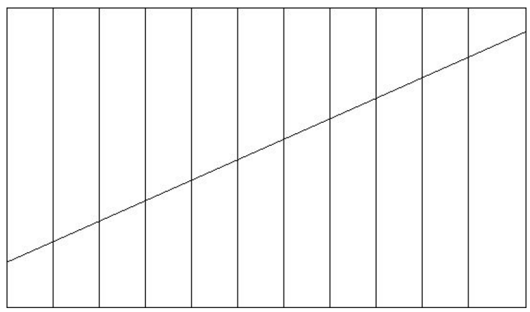


There should be a little space between the intersection of the angle line at the top of the piece and the rear edge of the piece. If necessary, saw the top off all the pieces at this height. See drawing below.

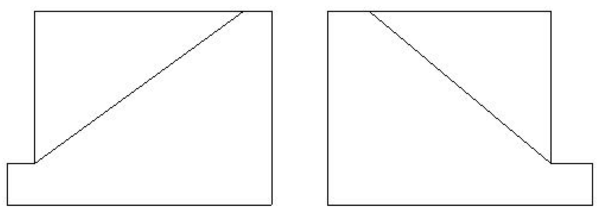


Make the box frame with the 1-foot section of 1 x 6. Cut it to five inches wide for the base plate. Place all the pieces on the plate, and frame them in on all sides with 1 x 2 or similar.

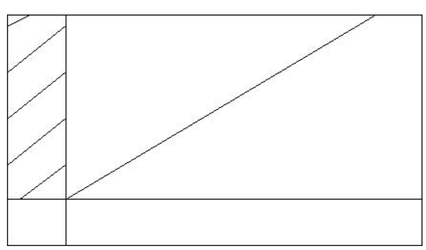
Mark the diagonal line across the top of all the pieces from the tip to the root. Start where the angle line on the outside of the tip-end piece meets the top edge of that piece. End the line at the root end where the vertical line you drew on it meets the top edge of the piece.

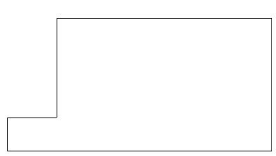


Remove the pieces from the box frame and draw the angle line on both sides of each piece, from the x,y point to the point where the diagonal line across the top of each piece meets the sides of the piece.

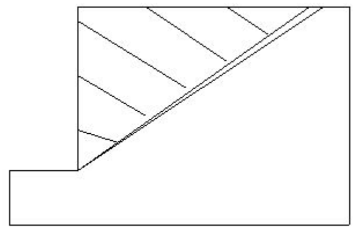


Now cut off the section of the front of each piece, leaving the “toe,” as illustrated below.

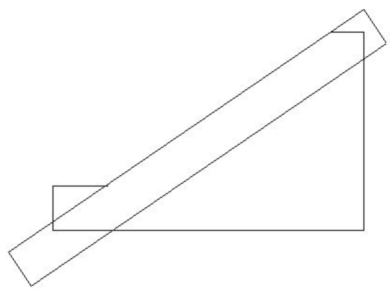


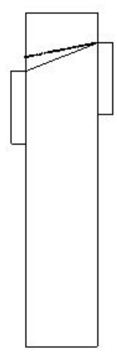


Next, cut off the triangular-shaped excess above the angular line on the left, or root side of each piece. The remainder, the bevel, will be sanded off.



Use the steel straps to control the sanding of the bevels. Clamp the straps to both sides of the piece, each strap aligned with the angular line on that side. Sand level with the straps.





When all the pieces are done, align them in the box frame, check for fit and finish sanding as necessary. Do not be concerned if all the joints are not perfectly smooth. Glue the pieces together as a unit using clamps, and fasten it to the box frame. Finish the assembled forming block with a water-resistant coating.

Push pins can be used to hold the blade to the block. If the wood is hard, the push pins can be tapped in with a tack hammer, or pilot holes for the pins can be drilled with a suitably-sized pin drill. In the alternative, scrap wood bars crossing the blade vertically can be used. The bars can be pinned or fastened with small wood screws. Depending on the orientation of the grain of the wood you are forming, you may find that the blade requires compression in the middle near the root. Bars vertically crossing the blade should correct this. In the alternative, modeling pins with a spacer cut from an eraser or a cork can be stuck through the middle of the blade into the forming block to compress the blade. If dry-forming laminations with a foaming polyurethane glue, there may be bleed-through of the glue, so in order to prevent the laminations from sticking to the block, use wax paper or cereal box liner bag material between the laminations and the block. If the blade/laminations to be formed are soaked and are very soft, a dry piece of balsa or plywood over the wood will protect it from being dented at the edges by the push pins and bars.

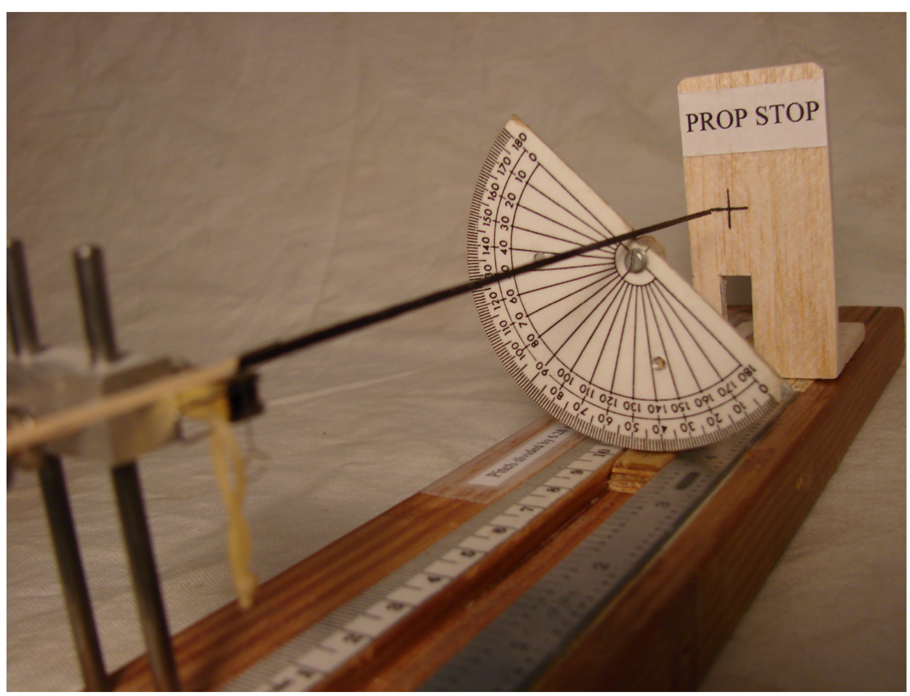
Prop Blade Installation Made Easy

Larry Coslick

Over the years I have tried a number of different ways to make the job of gluing the prop blades to the prop spar easier. One day while building a new prop, I picked up the pitch gauge and held it vertically to inspect the protractor. I already had the spar and prop stop in place and POW, I saw the solution that had eluded me for years. By holding or mounting the gauge vertically in a vice, this allows me to look at the back side of the blade and easily lay the blade against the spar. The pitch gauge shown is from Indoor Model Supply and has a sliding protractor.

I use a small free standing table vice to hold the pitch gauge in an almost vertical position. Block up the front of the vice about 15 degrees, and while clamping the tip end of the pitch gauge in the vice, tilt the back edge of the gauge toward you. This allows you to lay the blade on the spar line without it moving off of the spar. Practice this procedure without glue until it becomes comfortable.

A line is drawn on the back side of the blades to show the spar location. The protractor on the pitch gauge is set at 45 degrees and the number of inches from the prop shaft. (Pitch divided by 6.28 will give you this number). Install the spar on the pitch gauge and **tack** glue the spar to the top center of the protractor. Place the prop stop to the desired radius of the prop. The stop is made from scrap balsa and slides in the same track as the protractor. Mount the gauge back on the vice and place seven or eight small dabs of slightly thinned Aliphatic, (carpenters glue) from the hub to the tip of the spar and immediately install the blade. Start by laying the tip against the prop stop, and then attach the blade to the tip of the spar and finally the hub. Let the glue set for about fifteen seconds, then lightly pinch the spar against the blade, along its length. Let the Aliphatic glue dry for one half hour and then melt the glue on the tacked spar. Figure one shows the prop spar lying alongside the spar line and is not glued in place. The spar is painted for contrast.



If you have multiple pitch blocks and camber forms its important that you note the particular ones that you build your prop on, especially if you build a lot of props.

L Coslick 4/07

OUT OF THE ARCHIVES...

November, 1967

INDOOR PROPS - PRACTICE

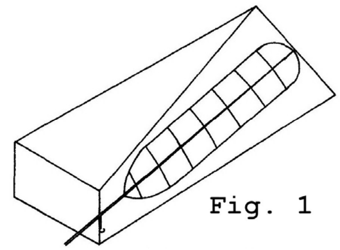


Fig. 1

The basic definition of prop pitch (pitch of any part of the blade) is: 3.14 x diameter of prop at station in question x geometric tangent of the blade angle. The most common propeller construction method is the one popularized by Joe Bilgri - the prop is built on a carved block as shown in Fig.1.
Fig. 2 shows dimensions of such a block as related to the design formula for the block:

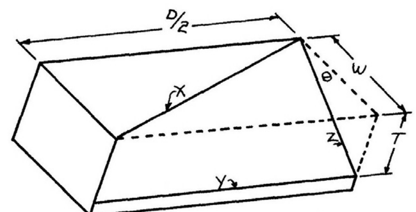


Fig. 2

PITCH (of block) = 3.14 x D x T / W
Note that the tangent of angle ? in Fig. 2 is T/W, which relates the block design back to the basic formula mentioned above. That is, arc tan T/W is the blade angle of a prop blade element at radius D/2, if the prop was built on the block in Fig. 2.

To design a prop block, it is more convenient to rearrange formula 1 to one of these:

2. T = P x W / 3.14 X D

3. W = 3.14 x D x T / P

Formula 2 is used if the block you have is wide enough to use the full thickness of the block; if the thickness is a limiting factor, use formula 3. Once the block has been designed, mark lines on the block (lines x, y and z on Fig. 2) to guide your carving. Carving an accurate block takes care and skill, but the sketches below show shortcuts used by some NIMAS members (reprinted from earlier INAV's).

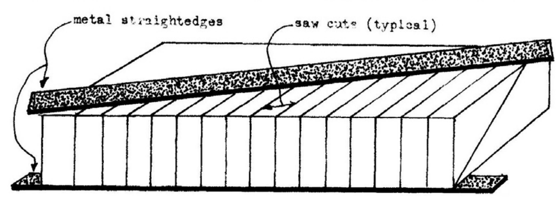


Fig. 3

Bill Graham suggests that metal straightedges be laid along lines x and y (see Fig. 3), then saw cuts can be made down to the metal. A few quick cuts with a knife will take off most of the excess wood, then a round sanding block will finish the job.

Ed Hicks accomplishes the same thing while using a bandsaw and a plywood stop as shown in Fig. 4, For each cut, tilt the block forward into the saw until you reach the diagonal line (x). Adjust the plywood stop so that the saw just reaches line y; the result is the same as with the method in Fig. 3. Dick Ganslen suggests that plywood be put beneath the block also; if the stop is mis-adjusted or rides forward, you can hear it hit the plywood.

One final suggestion: be sure that you are through carving before you begin to sand the block. If you ever try to carve down a high spot after sanding on it, small bits of grit from the sandpaper will ruin your blade.

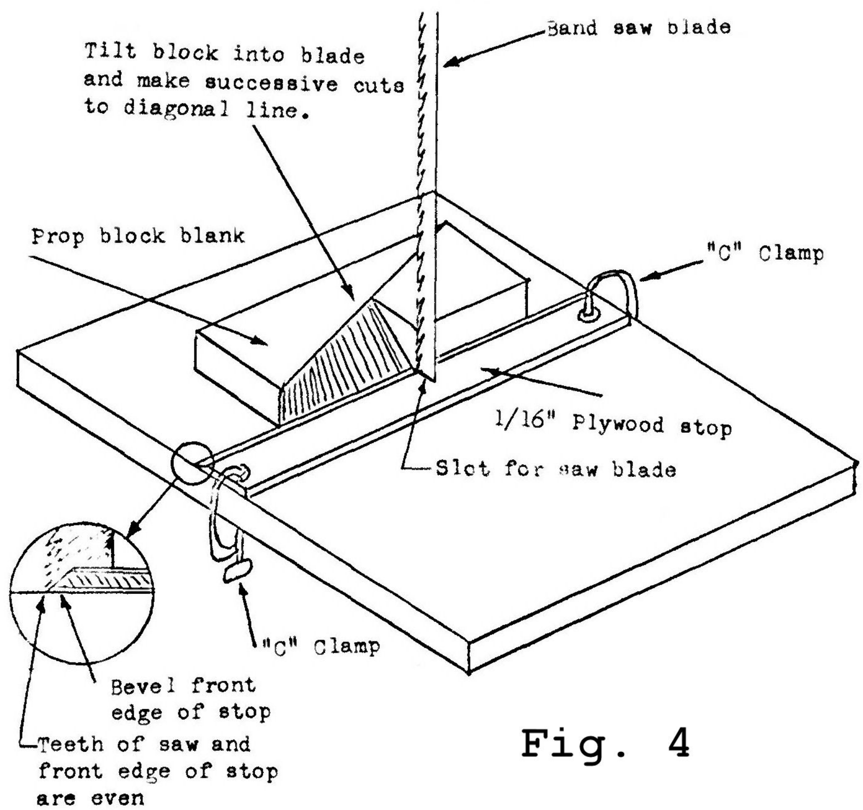


Fig. 4

December, 1967

INDOOR PROPS - PRACTICE
Part II - Prop Framework

Since the prop is the most important part of the model, careful and consistent construction techniques pay off in better flights. Some builders spend almost as much time building the prop as for the rest of the model, and the time never seems to be wasted.

The majority of your prop building time should go into the spar. The spar controls the prop behavior almost entirely, since it carries all bending and flaring loads. Therefore, the spar must bend equally well on either side. Fig. 1 below shows a basic jig which can be used to check spar deflection. It is sometimes convenient to substitute 6" scale on the right so you can record both the test load and the deflection for future reference. The slot at "A" should be a smooth snug fit for the spar (or adjustable to fit different spars) so the spar does not "rock" or move in the slot. Round spars should be checked for deflection four ways - rotate the spar 90 deg. between checks. Also the deflection must be exactly the same on either end of the spar. The process of balancing the deflection is lengthy, and calls for selective sanding and checking the diameter until everything matches.

Construction of the basic spar is two-piece as shown in Fig. 2 and Fig. 3 below. First choose a piece of wood just more than half the length of one prop blade; then cut and sand the wood to a smooth taper as shown in Fig. 2. Now cut two spars with a uniform taper as shown in Fig. 3. Fig. 4 shows how the two segments are spliced to form the spar. This procedure insures maximum uniformity of wood on either side of the hub, which greatly eases the matching of deflection as outlined above. Most people make a spar with round cross section, carefully rounding the basic spar shown above. The other spar choice is to use a square or rectangular spar such as those used by Charlie Sotich or Jim Richmond (see July '67 INAV for details of Richmond's spar). This type of spar is cut exactly the same way as other spars, except greater accuracy is needed to minimize the problem of equalization. A rectangular or square spar is checked for deflection only on the side and from the front; a square spar should have equal deflection in both directions.

The blade outline should be made from wood which is uniform along the entire length of the strip. It is best to choose "B" grain wood about 6 lb/cu. ft. density so the outline, will be springy. Make the outlines in pairs, using strips which were adjacent to each other in the wood they came from. If the strip is square in cross section, be sure the strips are turned the same way while forming the outline. If the corner of the sheet is beveled as shown in Fig. 5, each strip you cut will have a bevel to show how the strip came off the sheet.

The outlines customarily are formed in pairs around a form as shown in Fig. 6. Soak the strips in warm water, anchor one end of both strips. with a pin and a pad of balsa to avoid crushing the strips, and pull the pair of strips around the form. Be sure to maintain tension on the strips - if you relax the tension as the strip bends around a curve, it will kink. Secure the strip to the form in several places and allowed to dry.

Prop ribs should be matched closely in size, and then out to length in pairs. A small plastic box is handy to store the second rib of each pair while you build the first blade.

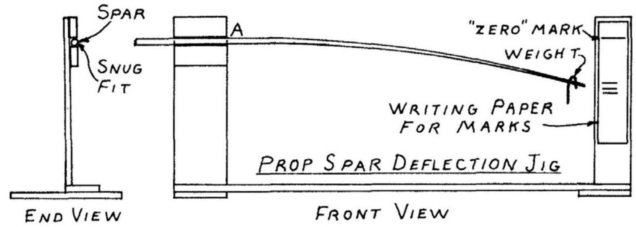


Fig. 1

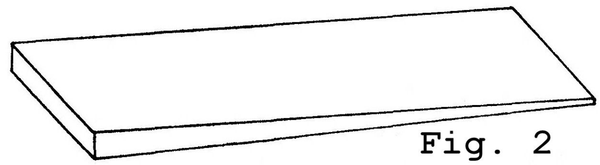


Fig. 2

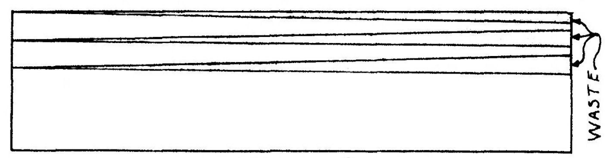


Fig. 3

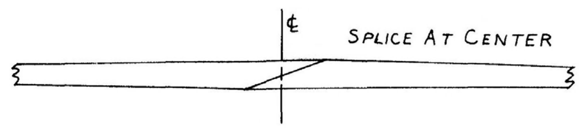


Fig. 4

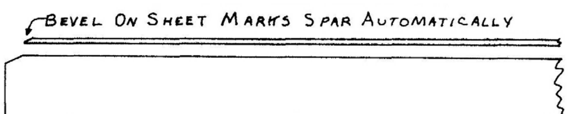


Fig. 5

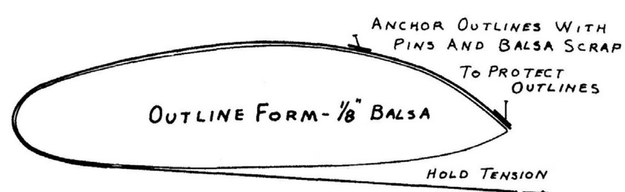


Fig. 6

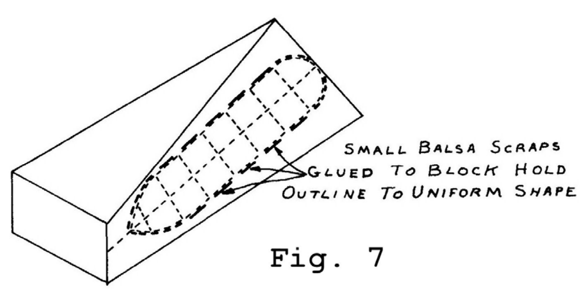


Fig. 7

When the prop is assembled on the block, the outline should be wet again and. allowed to dry to set the helix before the outline is glued to the ribs.

Although matched outlines and ribs help maintain uniformity between the prop blades, the block should have small balsa scraps just outside the outline to help hold the outline in the proper place (see Fig. 7).

INDOOR PROPS - THEORY
Recap - Part 1

Comments from readers about a portion of Part 1 show that a clarification of the definition of pitch would be beneficial. That is, the statements made were correct, but didn't tell the whole truth. The following definitions may state the case better:

1. Effective pitch = The distance the model moves forward during one revolution of the propeller. (Fig. 1, Part 1)

2. Design pitch = The distance the propeller would move in one revolution if it were operating in a solid substance with no slippage. This equates with the basic definition of pitch shown in Part 1: Pitch = 3.14 x Dia. x tan Blade Angle, but the derivation was omitted. In Fig. 1 below a blade element at radius r moving with no slippage would generate a helix as shown. Fig. 2 shows the relationship of elements of the prop and helix; the hypotenuse of the triangle represents the helix, the base of the triangle represents the circular path at radius r and the third side represents the distance moved by the prop (pitch, by the definition). Angle ? is the blade angle, and by using trigonometric relationships the pitch can be determined from the blade angle. This same relationship is diagrammed in INDOOR PROPS - PRACTICE (page 2, Nov. '67 INAV) as part of the prop block discussion.

It should be noted that effective pitch can also be defined in terms of velocity and propeller speeds

Effective Pitch = Velocity (inches/sec.) / Prop rev./sec.

Note that the time parameter (/sec.) divides out, leaving pitch defined in inches/revolution, which is correct.

Another clarification of Part 1: The table of RPM and pitch vs. velocity was figured at a specified radius for a good reason. When you use the method shown in Figs. 1 and 2, adding 7 deg. angle of attack to blade angles at different radii will give different pitches. For example:

A prop with 30" pitch has a blade angle of 67.3 deg. at 2" radius and 25.6 deg. at 10" radius. Adding 7 deg. to each gives 45" pitch at 2" radius and 39" pitch at 10" radius.

Next month a study will be made of non-standard pitch arrangements of the type used by Stan Chilton's model (p.3).

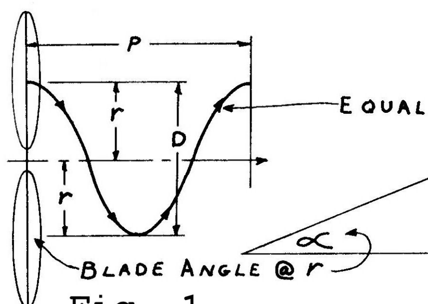


Fig. 1

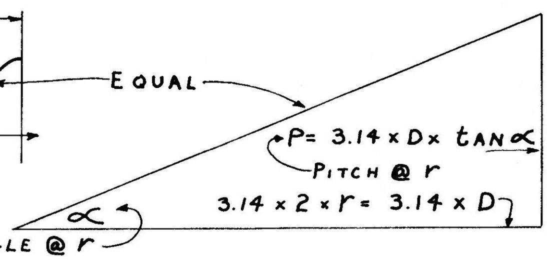


Fig. 2

INDOOR PROPS - PRACTICE
Part III - Covering

One of the more difficult tasks in building good props is covering the finished framework. It is quite easy to distort a well-built prop while covering it, so the blades should be covered one at a time and then placed back on the building jig to dry thoroughly. Some builders then use heat to tighten the film on each blade before removing it, further insuring an undistorted blade. As usual when heat-tightening film, you should use considerable care to avoid over-tightening.

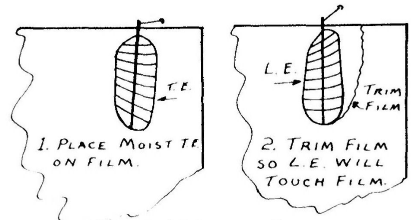


Fig. 1

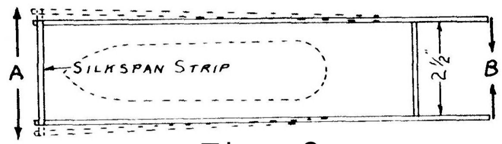


Fig. 2

Probably the most common way to cover props is shown in Fig. 1 below. The entire blade except the spar is moistened with water or saliva (saliva sticks better and dries slower) and the blade trailing edge is stuck to slack film on a hoop. The film next to the trailing edge is then trimmed loose to permit the rest of the outline and ribs to touch the film. This takes a light touch to avoid stressing the blade and a steady hand to avoid pulling the blade loose while trimming the film. To repeat: immediately place the wet blade back on the block to dry thoroughly before covering the other half of the prop.

Fig. 2 shows a prop covering frame. When building it, spread the ends at "A" while attaching the silkspan strip. This permits the silkspan to slacken when the frame relaxes. To cover the frame, squeeze the "handles" ("B") to tighten the silkspan; use rubber cement adhesive and aged microfilm. When the frame is cut loose, the frame will relax and slacken the film to make covering easier.

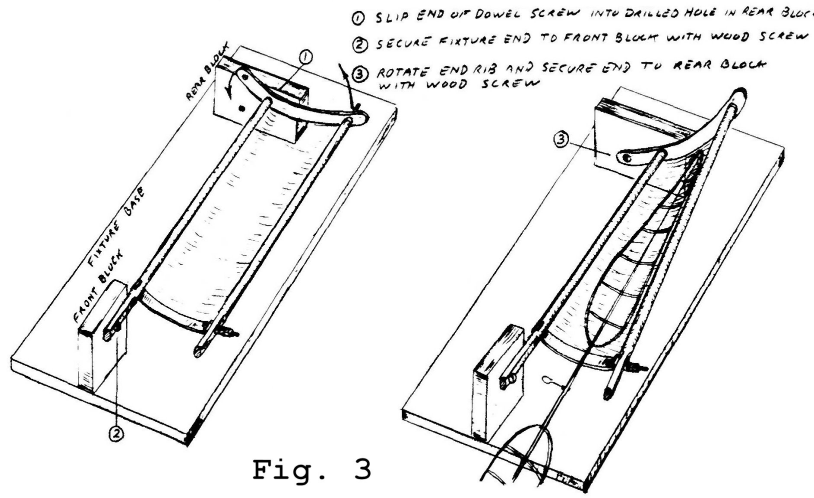


Fig. 3

Fig. 3 details a prop covering fixture designed by Harry Lerman. The drawing and text is self-explanatory, and the device is quite good as long as the fixture is covered with very loose film.

Fig. 4 shows a modification to Harry's fixture which greatly eases the problem of slackening the film. Instead of covering the fixture on the bottom, install two strips of heavy silkspan across the top of the fixture, and cover it on top using rubber cement as adhesive. Thus, when the helix is twisted in (step 3, Fig. 3), twist the right hand dowel counterclockwise to slacken the film (Fig. 5)

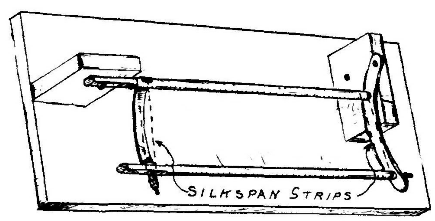


Fig. 4

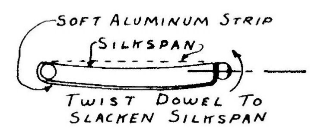
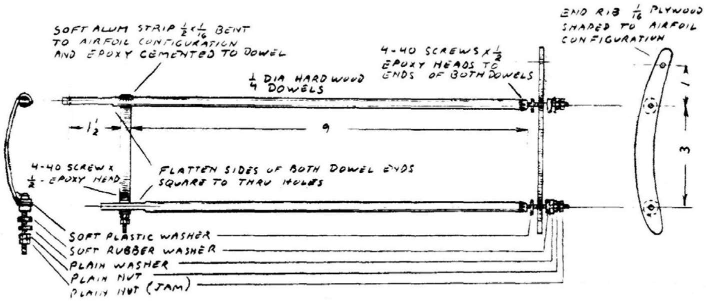


Fig. 5

A special vote of thanks to Harry Keshishian for making the photographic positive used in Fig. 3 and Fig. 4.

ASSEMBLE COMPONENTS OF FIXTURE AS SHOWN IN SKETCH. TIGHTEN THE PLAIN NUTS UNTIL THE RUBBER WASHERS LOAD AGAINST THE FIXTURE PARTS SO THAT, WHEN IT IS TWISTED IN OR OUT OF A HELIX, THE FIXTURE WILL HOLD THAT FIXED POSITION. THE SOFT PLASTIC WASHERS SHOULD HELP THE FIXTURE TO TWIST SMOOTHLY. A PLAIN NUT JAMMED AGAINST THE FIRST PLAIN NUT WILL PREVENT LOOSENING. COVER THE STRAIGHTENED FIXTURE WITH MIC, THEN SLIP INTO FIXTURE BASE BLOCKS AND SECURE WITH WOOD SCREWS, ① + ②. CAREFULLY TWIST THE FIXTURE INTO HELICAL POSITION AND SECURE TO BASE BLOCK WITH WOOD SCREW. ③. THE TWISTED FILM SHOULD NOW CONFORM TO MOST PROP BLADE CONFIGURATIONS. LAY A PROP ON THE FILM AND PROCEED TO COVER IT AT YOUR LEISURE.

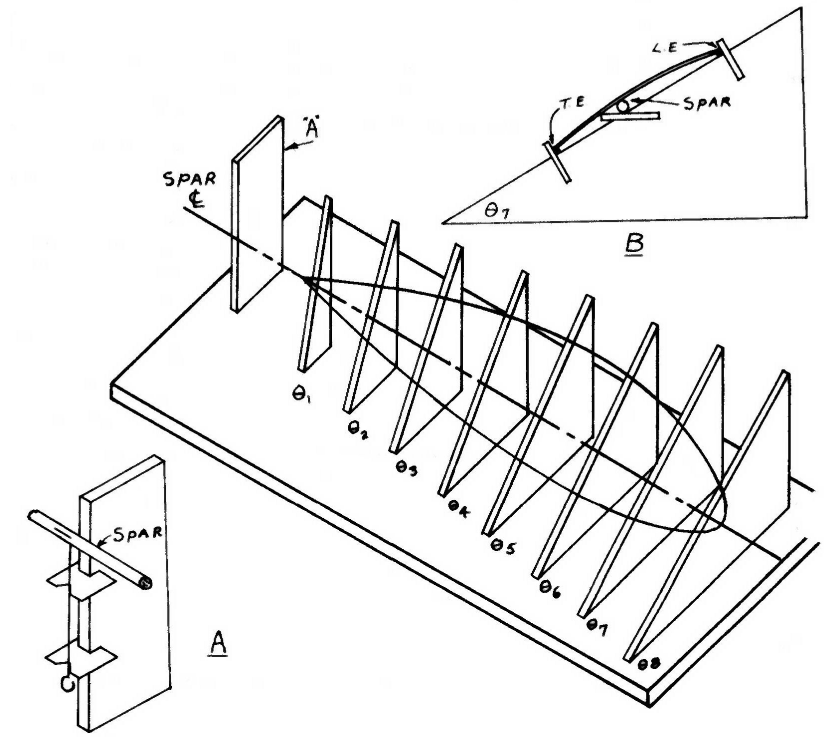


INDOOR PROPS - PRACTICE
Part IV - Prop Jigs

Part I (Nov. '67 INAV) dealt with conventional prop blocks, design and construction. Carved prop blocks have several disadvantages. They are difficult to carve with ordinary tools, the block for a big prop is expensive, and you need so many if you build many different sizes of models. If you wish to experiment with non-helical pitch distribution (the THEORY series has implied that a prop which has a constant angle of attack will have a non-helical pitch distribution), it is difficult or impossible to carve a block to suit.

The prop jig below was submitted by Hardy Brodersen; he did not claim origin and I don't know who built this type of jig first. Nonetheless, this type of jig can be used to build props of any type of pitch distribution, and it can be quickly modified to produce a prop with different pitch at only one or two stations.

The design of this jig is done graphically - see the graph in THEORY (above). Each triangle in the jig below corresponds to a triangle in the sketch above, with like stations numbered alike.



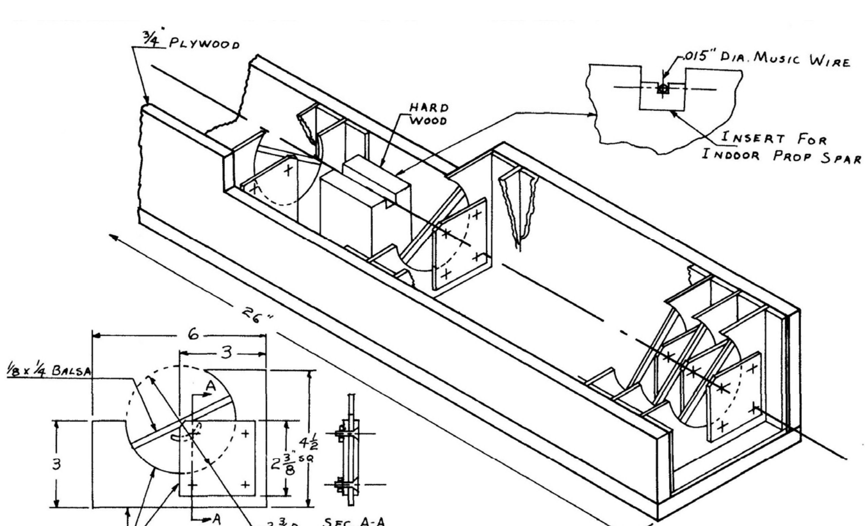
Cut the station triangles carefully to insure accuracy. Measure their locations carefully on the baseplate. Glue []1 and []8 in place and pin a piece of 1/16" music wire or tubing to those two stations in the position shown by the centerline on the sketch. If you then glue the other stations in place just touching the wire, the whole jig will have proper alignment. Block "A" is located at the center of prop spar, to give a vertical reference for the prop hook. Two sheet metal pieces can be inserted in "A" to give a better reference (see sketch A). Each rib station needs to have three pegs installed on it (see sketch B). The center peg supports the prop spar during construction, and the other two define the blade outline.

March, 1968

INDOOR PROPS - PRACTICE
Part IV - Prop Jigs

The prop jig below was designed and built by Ed Cenkner for Wakefield props. The blade angle at each station is adjustable according to whatever design scheme you prefer. To build indoor props on the same jig, an insert is put into the center block. Note that a music wire peg is used to align the spar during construction, then the prop shaft is installed after construction.

Since the drawing was made, Ed has added a pitch scale to the end stations. The pitch is then set at each end, and a string stretched between them. For helical pitch, each intermediate station is set tangent to the string.



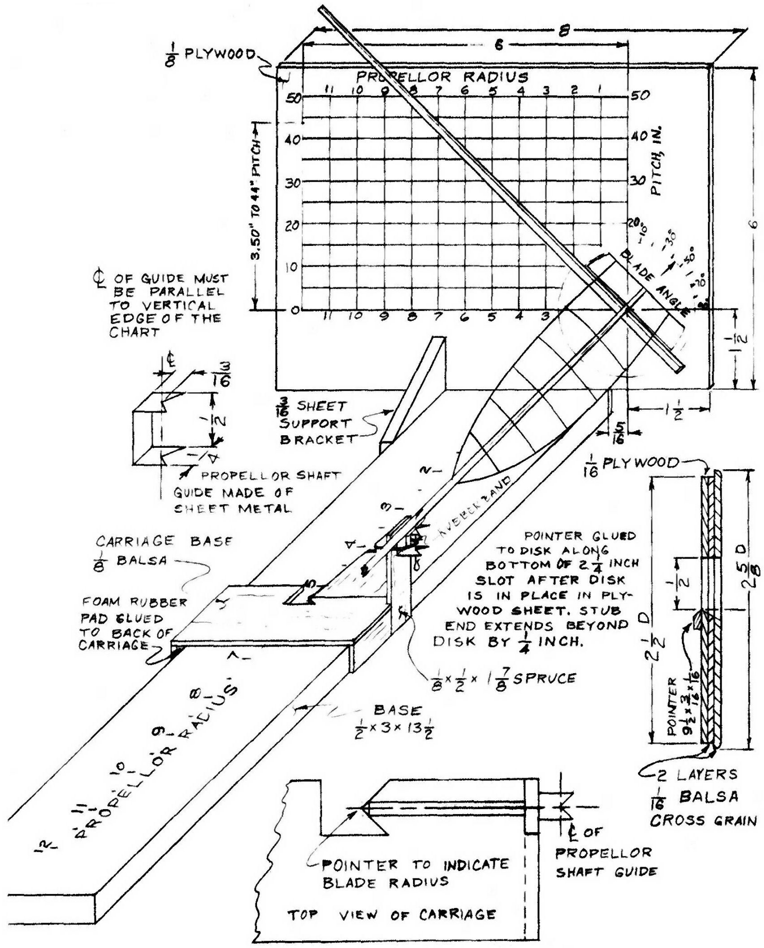
CENKNER'S PROP JIG

INDOOR PROPS - PRACTICE

A Direct Reading Pitchmeter

by Charlie Sotich

With the device shown it is possible to measure prop pitch directly at any point along the blade (starting about 1.5" from the hub). This makes it possible to compare props directly instead of assuming each is exactly like the block it was built on, and thus determine why different flight results are achieved with props that are supposed to be identical. The pitchmeter is easy to use:



1. Remove the carriage from the base and mount the prop, using a small rubber band to lightly pull the prop shaft into the bottom of the Vees.

2. Mount the carriage on the base with one prop tip in the slot of the disk. Rotate the disk to give clearance for the blade as you move the carriage to the desired radius for measurement, and stop the disk so the bottom of the slot is parallel to the bottom of the prop blade.

3. Read the blade radius from the scale under the carriage. Read down the chart along the line corresponding to this radius until you reach the top edge of the pointer. Now move horizontally to the side of the chart and read the pitch.

A few notes on the construction of the pitchmeter:

1. The axes of the chart must intersect at the center of the disk for accurate readings. Draw sharp lines on the plywood to mark the edges of the chart before cutting the opening for the disk.

2. Lay out the chart with radius increments of 1/2" spaced 1/4" apart. Lay out the pitch scale in increments of 1" pitch. Determine the spacing of the pitch scale by dividing 3.5" into 44 parts so each part 1" of pitch.

3. The centerline of the Vees which hold the shaft must be parallel to the vertical lines on the chart. Mount a straight piece of wire in the Vees, and file on the Vees until the wire is parallel to the chart lines.

4. Lay out the prop radius scale on the base after assembly, using a ruler to measure from the face of the disk to the centerline of the Vees, and place marks on the base at the carriage pointer.

HINTS AND KINKS

One of the major drawbacks to the prop jig type shown below in Fig, 1 is the difficulty of cutting accurate triangles. No matter how you run the wood grain, you always have one cut across grain that must be accurate. The easy way is to assemble the station from two pieces of 3/32" x 1/2" balsa, as shown in Fig. 2. Except for glue drying time, this method is much quicker; it is far more accurate than cutting wood to the right angle.

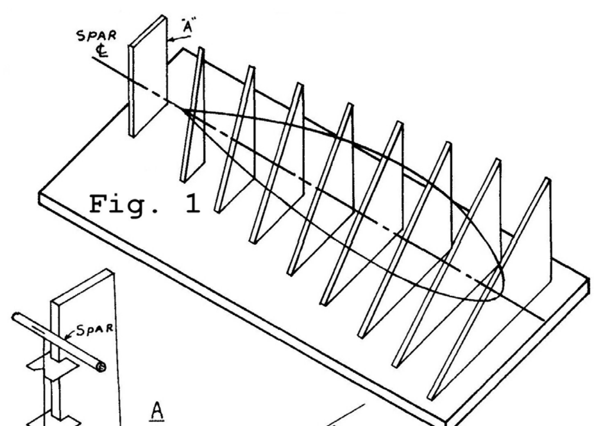


Fig. 1

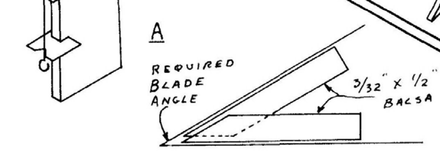


Fig. 2

Can Formed Props

Taken from Norwind News - October 1994 #24 and December 1994 #25

PROPS FROM CANS WITHOUT CALCS
by Joe Maxwell

Forming on a can, or other cylinder, is generally regarded as a simple, if somewhat inexact, method of producing the twist in the blades of Indoor propellers. However, the geometry involved if one cares to delve into it, is by no means simple and,. perhaps because of its complexity, has led to the publication of a number of erudite dissertations on the subject.

The authors I have in mind are, in chronological order:
Max Chernoff..Model Aeronautics Yearbook 1964/65
Bob Meuser..NFFS Symposium Report 1973
Ron Williams .... Building & Flying Indoor Model Airplanes 1981
Hermann Andresen.. Phoenix MAC Newsletter, August 1986
Bud Tenny...Model Aviation, August and October 1988
Bill Henderson ....Model Aviation, September and December 1989
Kai Halsas ....Indoor News, April 1994

All of them explain, in different ways, how to calculate the diameter of the can and the angle of the sloping line. To do this, they employ a combination of formulae, graphs, tables and even computers. In contrast, the method described here requires little or no calculation.

As a preliminary, it is necessary to consider pitch distribution. All the writers, with the exception of Andresen, agree that, in can-formed props, the correct pitch occurs at only one or two locations along the length of the blade. (Andresen gets round this by using scimitar shaped blades). They disagree, however, on where those locations should be. Chernoff and Williams opt for hub and tip. Henderson, root and tip. Meuser, some distance in from the root and tip. Tenny and Halsas, at the 45° set-up angle.

I suggest a rather different approach. It is usually accepted that the most effective part of a prop blade is around 70% of the overall radius. Therefore, is seems logical for the correct• pitch to apply at that position.

Before starting on the practical process, the following must-be decided.

- The propeller overall radius and hence the 70T-radius.
- The Pitch and hence the pitch angle at 70% radius.
- The maximum blade width.
- The camber, as a percentage of the blade width.

Pitch angle can be obtained from the equation Tan Pitch/6.28 Radius, or from the tables at the back of Ron Williams' book (Note - in those tables "radians" should read "degrees").

Start by marking the maximum blade width on a line. Then, on another line, bisecting the first, mark the camber height. Now, with a compass, find, by trial and error, the radius which passes through the three points. This gives the diameter of the can. (Fig 1).

Select a can of about the right size and fix it to a flat base of chipboard or similar. A few spots of cyano glue will hold the can, yet break away easily when required.

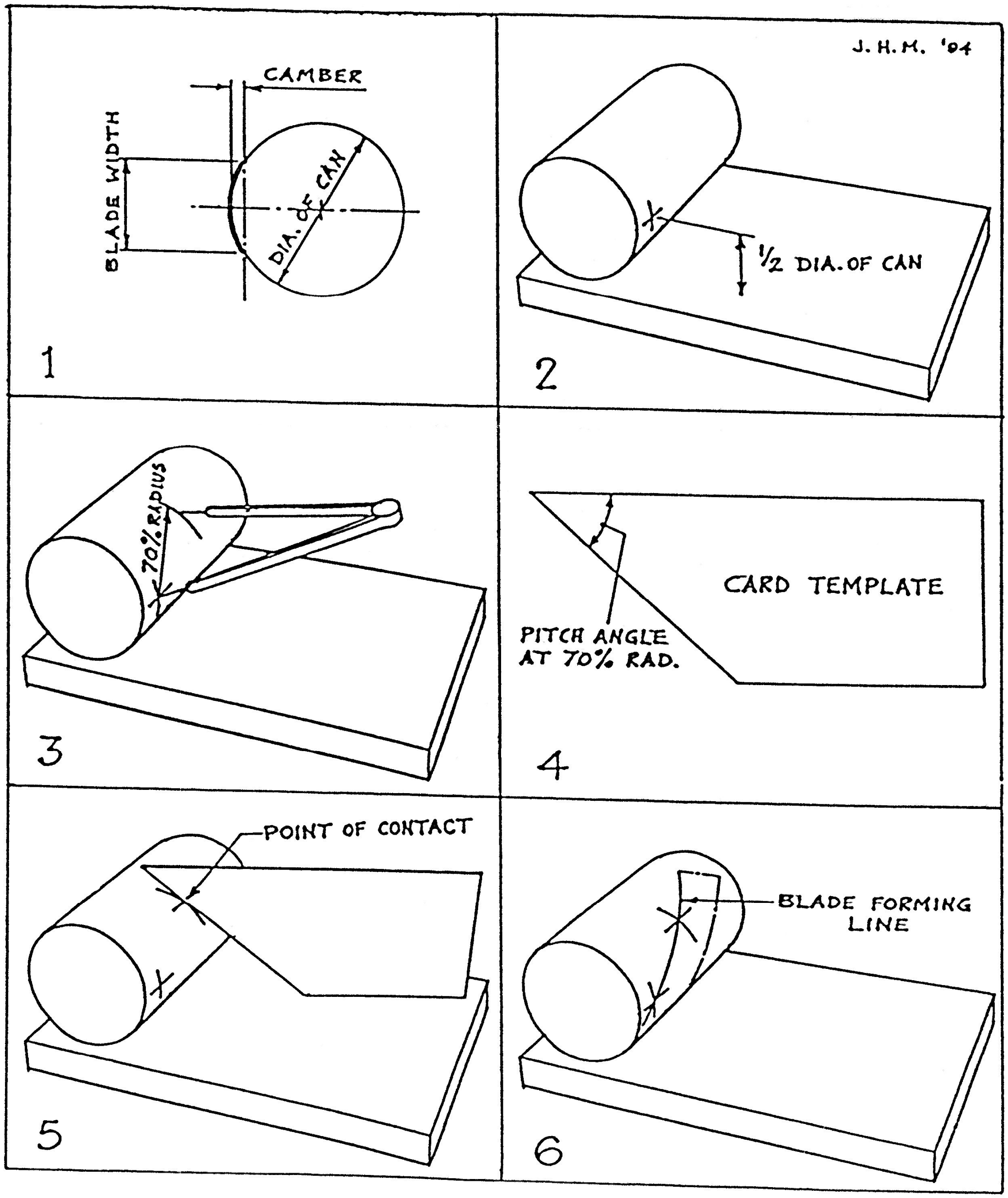
Make a mark on the can at a height above the base board equal to half the can diameter. (Fig 2). With this as a centre, and compass or dividers set to the 70% radius dimension, draw an arc on the can. (Fig 3).

Now make a template in stiff card, of the pitch angle at 70% radius. (Fig 4). Cut the sides using a sharp knife and a straight-edge to ensure that they are perfectly straight. (Later, when the prop is being assembled in a jig the same template gives the blade set-up angle).

Rest the template on the base, tangential to the arc and slide it towards the can until it touches. Hark the point of contact. (Fig 5).

With a strip of thick paper as a ruler, draw a line through the two points on the can and extend it to include the tip. (Fig 6). Small patches of double-sided tape will prevent the paper slipping. This is the Fine on which the blade centre lies when being formed.

In a way, this method is more accurate than the others because it allows for the fact that sections through the can, in line with the blade chords, are ellipses. The calculated methods assume them to be circles. (J.H.M.)



Can Formed Propellers

Early in the summer we had a request from Joe Maxwell for a couple of articles on can formed propellers, the combined Yates/O'Donnell archives provided him with this information. Soon after, Kai Halsas sent a learned dissertation and nomogram for determining can size and angle, since published by Indoor News (issue 28). Knowing his interest this was passed to Joe Maxwell, who then submitted his own down to earth thoughts on this subject. Like wood testing there were several minds engrossed on the same problem, a touch of deja vu. (DY)

CAN FORMED PROPELLERS
John Barker

It is necessary to say one thing straight away. Can formed props are very inaccurate, particularly at low P/D ratios, if you are trying to produce a 'true helical pitch' propeller. Therefore a lot of clever calculation or lengthy tables do not produce a better propeller - they produce a more accurate inaccurate one if you see what I mean! However I have looked at their layout in the past so I would like to comment on the references quoted in the October 94 Newsletter and Joe Maxwell's article and then try to contribute something myself.

Max Chernoff (Zaic 1964) did not seem to appreciate that the method is not accurate and indeed states that it assures true pitch values. As he does not consider any root cut off the results of his tables would not be good.

Bob Meuser (.NFFS Sympo 1973). As is usual with Bob Meuser, a masterly treatise that says it all. A full discussion of the errors and the best way of handling them. I suppose the only trouble is that because it was comprehensive it looked a bit daunting and so probably wasn't read as much as it merited.

Ron Williams (his 1981 book). This excellent book unfortunately managed to make the can forming calculations look difficult. It made no mention of how the inevitable inaccuracies affect the calculations but at least, in a footnote, it did admit that there were inaccuracies.

I do not have the September 1989 'Model Aviation' but the bits by Bud Tenny and Bill Henderson in the other issues don't say anything new. Indeed Bud Tenny's spread sheet computer approach really confuses things. I don't doubt that it was done with the best of intentions and that the underlying formulae are correct but the strange choice of input values makes most of the output a nonsense. The most amusing thing to me in Bud's column was that someone has produced for sale a block in the shape of a tin can for producing can form props! How crazy can things get?

Regarding Joe Maxwell's own approach. It is a novel idea to slide the angle template up to the can. Extending this idea, I think that using templates with the correct angles for several stations along the blade would enable one to draw a curved blade similar to what I assume to be the Andreason approach. There are a couple of other points with which I would take issue. First, by ignoring the fact that most indoor propellers blades are cut off some distance from the root, the method gives a blade angle distribution which is less good than it could be. (This will be made clearer later on.)

Second, I do not think that basing the can diameter on the aerofoil camber is a practical idea. In any case the approach in the sketch is not correct because the section of the can forming the camber is an ellipse. Joe mentions, in his last paragraph, that the cross sections are ellipses but ignores it as it affects the-camber.

INACCURACIES

Refer to Figure 1. This shows the angle variation of a helical pitch propeller for P/D ratios of 1, 1.5 and 2. There is also a dotted, straight line on the graph representing the angle variations of a can formed blade. The problem is to match the straight, can formed, angle variations to the curved, helical pitch, angle variations. The straight line can be moved up and down the graph by choosing a suitable setting angle when we mount the blades on to the hub. The slope of the straight line can be varied by varying the slant angle at which the blade blank is mounted on the tin can. What we cannot do is change the straight line into a curve (unless we use something like Andreason's scimitar blades).

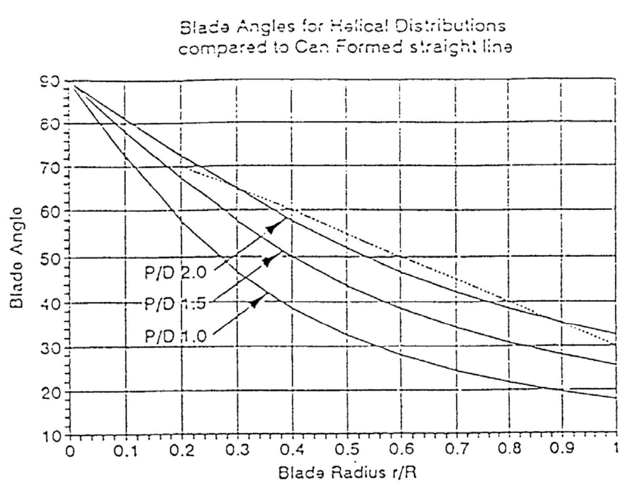


Fig. 1

You will notice that the angle variation for helical twist is greatest near the hub. However, if the blades do not start from the hub, as with most indoor propellers, then this area of high twist can be ignored. I recommend that the blades are started at 0.2 radius to give the can forming a reasonable chance and the following procedures are based on this figure. It is now only necessary to match the straight line to the curved region between 0.2 radius and the tip. This is somewhat better but the errors are still significant. Without wasting space on the proof (which is well covered in Bob Meuser's paper) it can be stated that at a P/D of 2 the total error in blade angle will be 6°, at P/D of 1.5, 8° and at P/D of 1, 10.

THE REQUIRED TWIST

If the blade angles for helical twist are checked at the 0.2 radius and at the tip we get the following figures.

The last column gives the total twist along the blade and it will be noticed that it varies by only 1.75 degrees over this wide range of P/D. In what follows I use 40° as a constant. It is easy to use the precise figure if you want to (as shown in the next paragraph) but is it worth it when the other inherent errors are so much greater?

P/D	0.2 R. Angle	Tip Angle	0.2 R.-Tip
1.0	57.86	17.66	40.20
1.5	67.27	25.52	41.75
2.0	72.56	32.48	40.08

WHAT WE NEED TO DO

All we have to do is to lay the blade on the can so that it is twisted by 40°. If we were calculating this, (which is the easiest way!), we would need to calculate L=R8 where R is the tin radius 8 is 40° in radians (0.698) and L is the distance we wrap the blade around the can. However, as most people seem to prefer a graphical approach, I have drawn Figure 2 which gives the wrap around for different can diameters. If you want to draw your own diagram, .8 is the amount of twist and the scale (although marked can diameter for convenience) is the can radius multiplied by 8/tan 8 where 8 again is in radians.

DOING IT

1. See Figure 3. Lay a strip of paper on Figure 2 at the chosen can diameter and make marks on the edge of the paper where it crosses the sloping lines.
2. See Figure 4. Wrap the strip of paper around the can and make marks on the can in line with -the marks on the strip_ Draw two vertical lines - on the can in line with marks.
3. See Figure 5. Do whatever you do to the blade blanks as regards to soaking etcetera and fasten them to the can. with the centre. points at each end of the blade aligned with the vertical lines. You do NOT need to draw slanting lines. Note, as mentioned previously, this assumes that the hub end of the blade is at 0.2R
4. Attach the blades to the hub at an angle that distributes the errors in the way. that you. prefer. To amplify that. A can formed .blade has more angle at the centre than a helically formed one. For example at a P/D of 2 the error is 6° as mentioned earlier. If the centre of the .can formed blade is set at the correct angle for a P/D of 2 (46.7°) then the root and tip will be washed out by 6°. It may seem sensible to set the centre at 49.7° to average out the error but do not forget that the root and tip are much less effective than the centre and you may finish up with too high an effective pitch.

CLOSING COMMENTS

I leave the choice of can size to you. It soon becomes obvious what size of can is going to produce a decent prop and clever calculations are not warranted. I also do not think that it is worth trying to pick the can to give blade camber.

The steps given here to set a blade on the can only take about fifty seconds to carry out - and that includes measuring the can diameter! However, do not get the impression that this method is some quick and dirty approximation. It is accurate as far as can formed propellers can be accurate and must be more accurate in use than any of the methods which try to draw a sloping line at a precise angle on the outside of a cylinder.

So much has been written about can formed props that they now have a mystique which I do not think is warranted. It is a useful way of turning out a propeller in a hurry. If, sometimes, the result is as good as a propeller produced by more conventional means, then it is a matter of pure chance and not because the method has any particular aerodynamic merit.

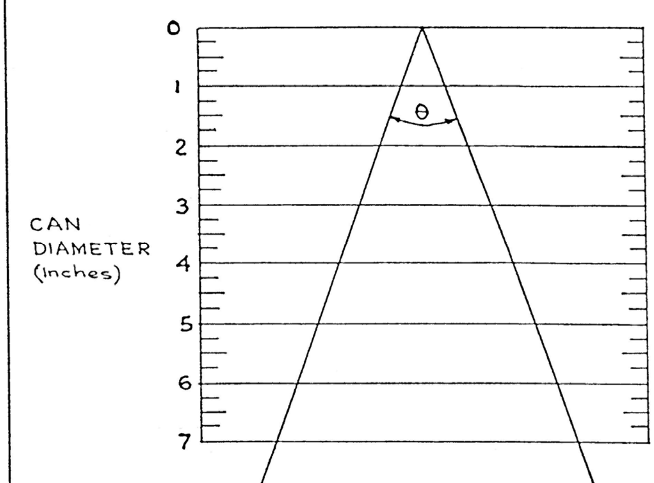


Fig.2

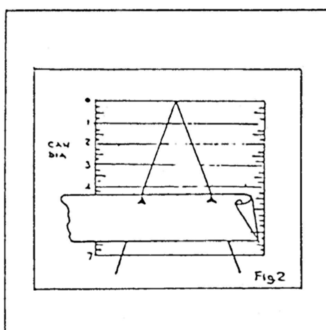


Fig.3

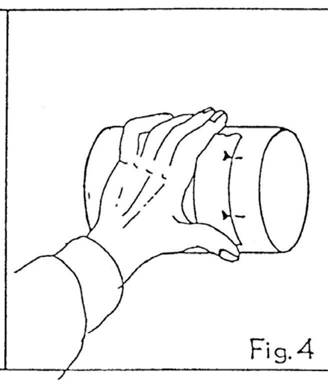


Fig.4

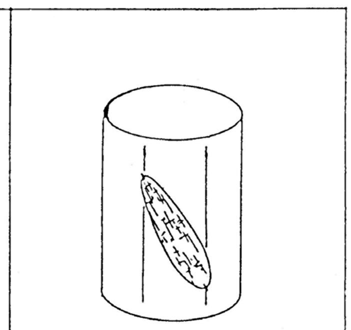


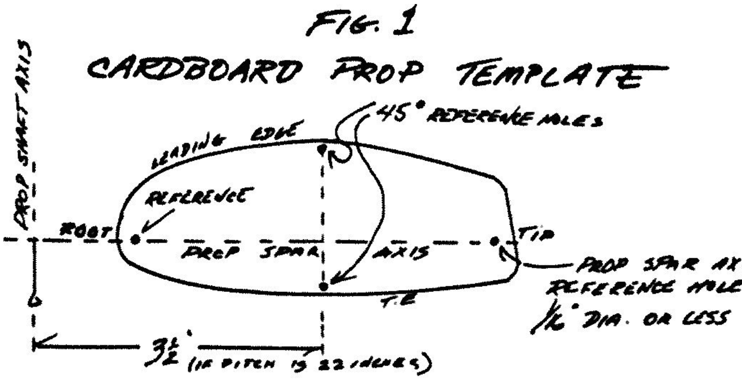
Fig. 5

Pennyplane Props

By Jack O'Leary - Originally published in Minneapolis Modeler July/August 2001

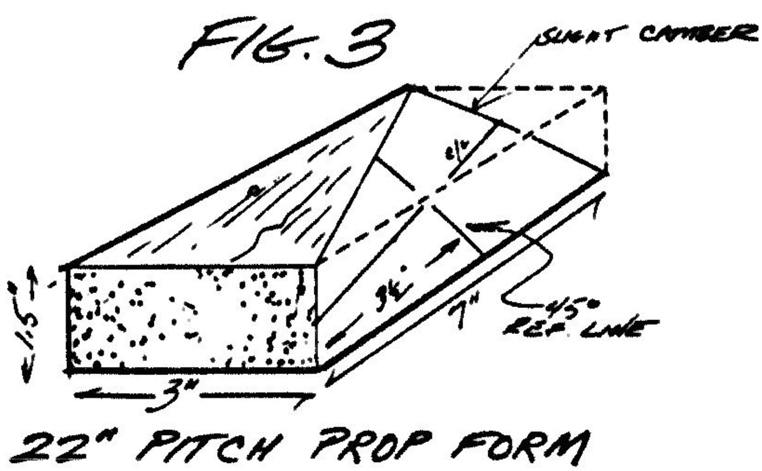
Novice Pennyplane props are governed by rule which limits their diameter to 12 inches. The chord of the prop is usually a generous 1.5 to 2 Inches. Pitch ranges from 20 to 26 inches. Generally the prop axis is positioned from .55 to .7 chord to increase flare In the power burst resulting in a less vigorous climb to cruise altitude.

Let's make a Pennyplane prop. Carefully select 1/32", C-grain stock, about 5 to 7 lb. per cu. ft. Cut the prop blades to shape using a cardboard template which has 1/16 dia. reference holes to mark the prop spar axis and the 45 degree pitch angle reference line. If you determine that you want a 22 inch pitch prop these 45 degree reference holes will be 3.5 inches from the prop shaft axis. See Fig. 1.



Stack the blades and sand perimeter to get identical blades shape, then lay flat and sand to get a bade root thickness about .030" tapering to approx. .010" at the tip. Now reposition the cardboard template over the blades and using a fine felt tip pen or very soft pencil, mark through the template to establish your prop axis and 45 degree angle reference points on the backside. Now connect the points with a light line.

Okay, still with me? Now we select an appropriate prop pitch forming fixture, i.e., a pre-carved block of your selected pitch. I'll stick with 22" for the purposes of this article, here are the dimensions, Fig. 3. Or if you choose, you can get excellent results with a can or jug formed prop about which much has been published (Linstrum, Meuser et all) or a J. Jones fiberglass prop form (my preference) which are available in many pitches.



Jim Jones has an excellent article in the August 80, M.A.N. which provides all the necessary Info. on carving helical pitch prop forming blocks.

Prepare your pitch forming block by giving it about four coats of dope, and tracing the prop axis, the 45 degree reference lines and the prop outline in the correct position. I go a step further and contact cement (3M Sprayment, now under a new name, 3M Craft Mount) Glad Wrap material on top of the doped surface.

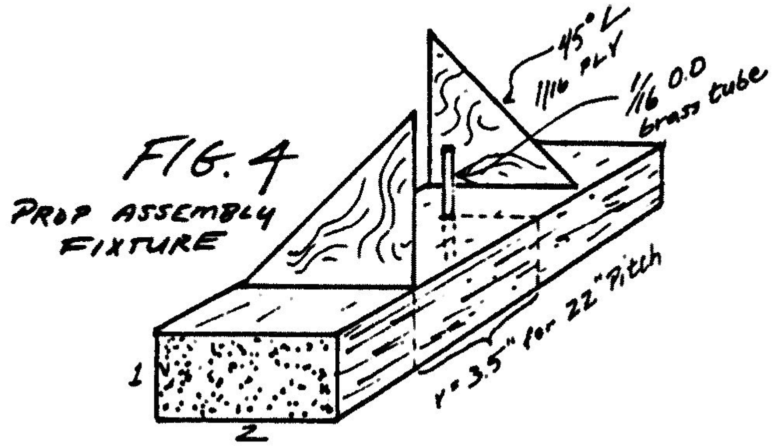
Now soak your blades in hot water for 10 to 15 minutes and lay up on the form by strapping with dressmaker's elastic tape or some old 1/4" gum band. Protect the top of the blades with blotter material which you have cut slightly oversize to the prop blade template. I generally make two props at a time, so I lay up four blades on the pitch forming block. If you're making EZB props put an intervening layer of jap tissue between the blades which will facilitate separating them after the blades are oven cured.

With water, re-spray the blades which are strapped to the pitch forming block and place in a 180 degree-200 degree F. oven for an hour. For the energy conscious, I've found that an electric fry pan works equally as well if you raise the "stuff" on a trivet. Let the blades cool down completely before un-strapping, and separating the blades from one another.

Select some tough, springy 8-10 lb., 3/32 sq. stock for the prop spar. Sand to a round cross section which tapers from .08" root to approx. .02" diameter at the tips. Bob Mouser had a neat method of achieving a tapered round spar which he reported in his "No Non-Cents" Pennyplane article about three years ago in "Model Aviation". Match the two prop spars for flax, weight and size. The prop spar should extend to 1/2 to 2/3's along the prop spat axis. Attach the prop blades to each of the prop spars with the glue of your choice. With Pennyplane, because of the liberal weight rule, glue choice is not particularly important. In EZB, however, because minimum weight is crucial, I'd stick to Micro X products or acetone thinned Ambroid.

Construct a prop assembly fixture as per Fig. 4.

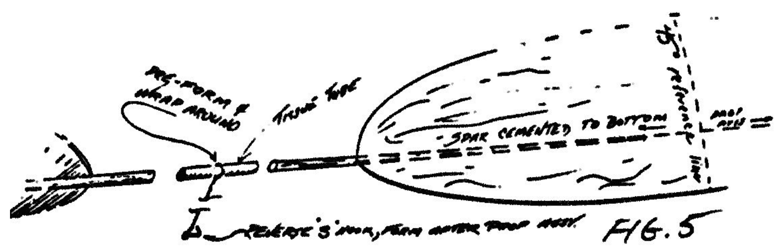
Make a number of jap tissue hubs by selecting the correct size music wire (generally 3/32" dia. for Pennyplane). After polishing so no burrs remain on the cut end, rub the music wire with wax paper or silicone treated release paper (which works better). Cut strips of Jap tissue approximately 3/4" wide by 1-1/4" long. Moisten the short end of the tissue and wrap around (once) the music wire. Carefully apply thinned cement to the tissue and roll the music wire between your fingers, applying more cement as needed. Take care not to get cement on the music wire which will make it difficult, if not impossible, to remove from the tube. Let the tube set up on the music wire for 30 seconds or so and push the tube off the end of the music wire. Let dry completely before cutting to length (about .75") 2 hours to overnight. You'll find that you'll goof the first five tubes but by the end of the evening you'll be making them like a pro.



Pre-shape the music wire prop shaft so the wrap around portion matches the O.D. of the paper hub. Do not form the rubber hook at this time.

We are now ready to assemble and complete the prop. Take the two prop blades with spars attached. Trim the prop spar at the root so that they will join at the center. Position the prop shaft over the tissue tube but do not glue at this time. Insert prop shaft into tube in fixture. Push (should be a moderately tight fit) both prop spars into the tissue tube hub and twist the blades so that the 45 degree L reference lines coincide exactly with the 45 degree L plywood reference plates on the fixture. Now, tack glue the blades at the 45 degree L plates and carefully hot stuff the prop shaft and prop spars to the paper hub. Cut away the tack glue areas and free prop from the fixture. Now form the reverse "S" rubber hook and your prop is complete. See figure 5.

I hope this article encourages fellow club members to get into Pennyplane. Our participation has stagnated to where only three of us are flying P plane at the indoor meets. Making indoor props is relatively simple after you've tooled up to do the job. Took me a week to write this damn article but I can knock out a half dozen P. plane props In an evening with ease.

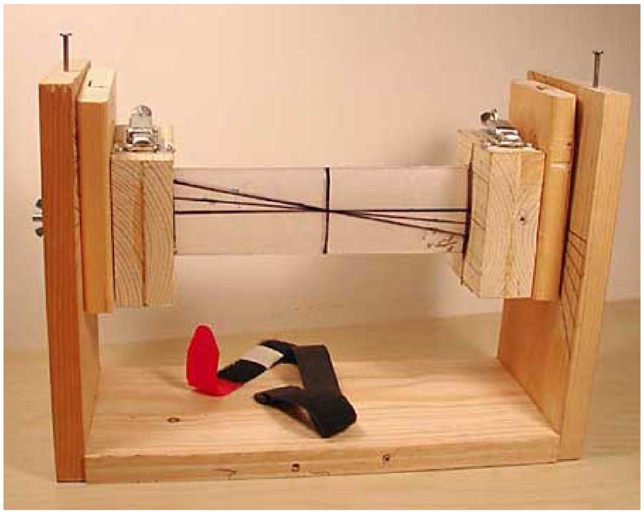


THE TWISTER

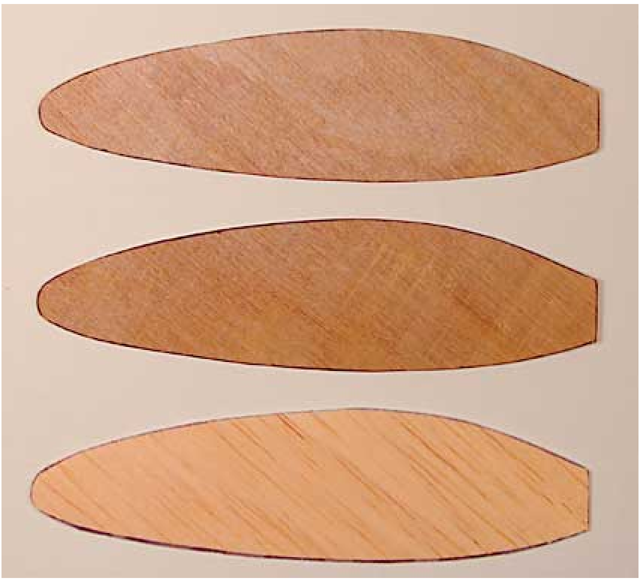
Dave Aronstein

OVERVIEW

This article describes a device and method I developed for forming laminated blades for props for rubber-powered outdoor free-flight model airplanes. The idea behind the device was a “moldable mold” that would enable the forming of blades of varying convexity (undercamber), degree of twist and conformation. While twisting away on the problem, and some sheets of wood veneer, I hit upon the idea of the “Twister.” I am confident that this jig and laminating method make a valuable contribution to the art of forming propeller blades.



The “Twister” is essentially a wooden frame with pivoting clamps that hold convex polycarbonate sheet formers. It includes adjustable stops to control the amount of twist, and a “pull-down strap” to control straightness of the prop blade. Prop blade laminations are first cut to shape and glued together. Then they are placed between the polycarbonate sheet formers (called the “twisting sheets”) which form and compress the laminations as they are twisted end-to-end by the pivoting clamps. The clamps hold the sheet ends together and limit bowing of the sheets while allowing them to shorten when twisted. The pull-down strap is used optionally to form larger square-tipped and paddle-type blades and blades with washout by pulling down the twisting sheets. This straightens the blade leading edge and reduces the twist toward the tip.



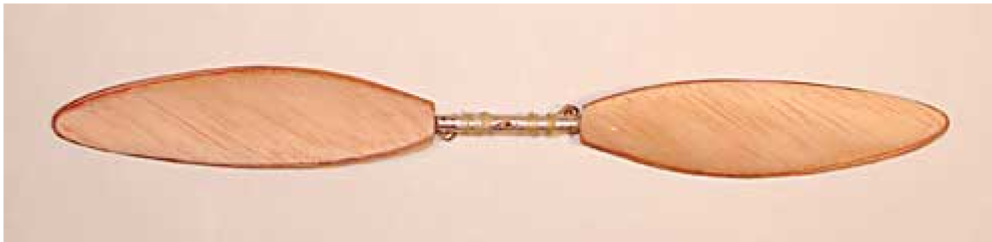
The “Twister” is built from materials available at hardware stores, and can be made at home with ordinary shop tools. The plan for this article shows the jig with a capacity for blades up to seven inches long and two and one-half inches wide. The pivoting clamps will accommodate twisting sheets with a formed radius of three inches or larger. Clamps and twisting sheets of a different radius can in any case be substituted. The “how-to” part of this article gives a method for forming twisting sheets of any radius as well as instructions for using the “Twister.”

The laminating method is a three-layer bias-grain lamination consisting of one layer of 1/32-inch thick sheet balsa (or 1/16” for larger blades) as the top layer over two layers of 1/64-inch thick aircraft plywood. The grain of the laminations is oriented on a 40- to 45-degree angle in relation to the lengthwise axis of the blade, such that the grain slants inward and downward from tip to root when looking at the balsa-layer side of the blade (which side will face away from the fuselage for a tractor prop), with the leading edge at the bottom. Orienting the grain of the laminations this way allows for easy twisting, resists untwisting and coning under load, and allows for backward flexure to help avoid breakage. It also avoids buckling of the blade at the twist transition point if the blade is pulled down for washout. I use a pattern and a ballpoint pen to draw the blade shape on the balsa and the plywood, and cut the wood with scissors. The laminations are glued with polyurethane glue (Gorilla brand or Elmer’s). This glue is very strong, lightweight, and sands down easily and smoothly. The plywood allows for a very thin trailing section without causing reflex of the trailing edge.

A thin blade (thickness-to-chord ratio under .10) performs as if its pitch is lower than nominal, and the convexity (undercamber) compensates for the relatively thin section and adds rigidity. The radius selected for the twisting sheets depends on the blade planform, length, twist (pitch) and planned application of the prop. Where thickness-to-chord ratio is .10

or more, I use twisting sheets with a radius of about nine inches. This produces a nearly flat bottom, for reduced drag. For thinner-section blades, depending again on the planform, etc., I use formers with a radius of 3 ½ inches or 5 ½ inches. The whole idea behind the jig is to facilitate experimentation.

The "Twister" and this laminating method can produce a thin, strong blade of any degree of twist and convexity that is axially straight (flat) from root to tip. It can produce blades with wash-out or wash-in (hypotwist). Using the instructions and the plan which follow, you can make your own "Twister," and then make blades and props quite possibly unlike any you have made before. Like me, soon you won't just be flying planes, you'll be "flying props." If you aren't up to making one, but want one, contact me on the web.



MAKING AND USING THE "TWISTER"

MATERIALS

Wood

Frame: 1″ x 6″ pine or similar, kiln-dry, smooth, knot-free, straight.
Backplates: 1″ x 4″ pine, or similar, k-d, smooth, etc.
Pivoting clamps: 1 ½″ thick tight-grain, kiln-dried, smooth, knot-free hardwood (mahogany, oak, other) or good-quality dense softwood such as southern yellow pine or Douglas fir. (¾″-thick wood can be laminated and substituted.)

Polycarbonate (trade-name: Lexan)

Two (2) pieces 2 1/2″ x 11″ x .093″ thick.

Hardware

Two ¼″ x 2″ carriage bolts, washers and nuts.
Two draw hasps (draw clamps) (National N 208512V35 - 2 ¾″; or Ace 5300231 - 2 ½″).
Two 1 ½″ x 2″ to 2 ½″ tight-pin desk hinges (National N 211-870).
One 4″ x 5/8″ steel "mending plate" (National N-114-405), or similar.
Six ½″steel washers.
Flat-head (bugle-head) wood deck screws (deck screws), #6 x 1 5/8″.
Pan-head wood screws, 5/8″ to ¾″.
Two 10 d. (10 penny) nails.
One Velcro 18″ heavy-duty cinch strap. (Sold two to a package.)
Sheet-metal vent pipe, 6″ to 10″ diameter x 14″ long, (cut down from two-foot standard length), or flat metal sheet, 20-guage or thinner, 7″ x 14″. (Used for forming polycarbonate twisting sheets.)
Wood glue (Gorilla or Elmer's polyurethane) (for frame and laminations).
Six to eight spring-loaded v-clamps (Craftsman # 65942) (For clamping twisting sheets)

FABRICATION AND ASSEMBLY

(See Construction Plan)

Book-end Frame

Frame Base Plate: (One) 1”x 6” x 12 ½”.

Frame Upright Ends (“Frame Uprights”): (Two) 1”x 6 x 10 ”.

Mark the centerline top to bottom on one side of each frame upright. Mark for drilling on the centerline 3 ¾” from one end, which will be the top. On one upright, which will be the right side upright, use a carpenter’s square to draw a line at 90 degrees to the centerline at the 3 ¾” mark across the face of the upright. Next, from this centerpoint, using a protractor, draw lines at five (5) ten-degree intervals below the 90-degree line (at 80, 70, 60, 50, and 40 degrees) in the lower right quadrant of the upright, as shown in the photo below and on the plan. Drill through the 3 ¾” centerpoint on each upright with ¼” drill bit. Butt-joint the frame uprights to the ends of the base plate. The upright with the degree lines goes on the right, with the lines facing in. Make sure that the uprights are at 90 degrees to the base plate, and that the holes in the uprights line up. Apply wood glue and fasten with 1 5/8” wood screws. Using a 9/64 drill bit, drill a hole about 2 ½” deep into the top of each upright toward the front corner for keeper-holes for the 10 d nail stop-pins.

Pivoting Clamps

Each complete pivoting clamp consists of the hinged clamp attached to the backplate. Each clamp has mating halves. The backplates are made first, then the clamps are made and attached to the backplates.

Note in the photo above that the clamps can be wider than the backplates. “r 5 ½” denotes the radius of the slot arc.

Backplates for Pivoting Clamps (Two)

3 ½” wide x 5 1/2” long by ¾” thick. (Use standard “ 1’ x 4’”, usually 3 1/3” actual width. Exact width unimportant.)

Mark the centerline top to bottom on the face of each backplate. Extend the line across each end to the back side. Mark one backplate, which will be the left backplate, for drilling on the centerline at ½” and at 3 ½” from one end, which will be the top end. Drill through the ½” point with 9/64” bit (for a 10 d nail). At the 3 ½” point, use a 5/8” spade blade to drill a 3/16” deep hole (for the head of the carriage bolt), then drill through with a ¼” drill bit. Install the carriage bolt, and pull it into the hole with a washer and nut. Check to see that the bolt head is below flush. Set aside. On the second backplate, which will be the right backplate, mark for drilling on the centerline 3 ¼” from one end, which will be the top, and drill with the spade blade and the ¼” bit as before. Install the carriage bolt and set aside.

Clamps (Two)

3”x 4” x 1 ½” overall. Each has mating halves. Note “A” and “B” halves (sides) on the plan. Cut wood with grain horizontal for the “A” sides if wood strength doubtful. (Clamps can be made from ¾”- thick pieces joined together. A method of cutting and assembly is illustrated on the plan.) The plan shows the clamps with an arc radius of 3 ½ inches, and an arc length of 2 ½ inches. (These clamps will accommodate twisting sheets with a larger radius. Large-radius sheets can be ground off to fit the clamps.) Hold the clamp halves together in a vise and fasten the hinge to one end with wood screws. Mount the hinge flush with or set in from the edge of the clamp. Turn the clamp over in the vice and fasten the draw hasp to the top of the clamp with wood screws. Mount the hasp body on the “A” side, and the hook on the “B” side of the clamp, as shown on the plan. If using the National brand arm-type hasp, the flat spring-steel “arm” of the hasp will straighten under tension, so leave a gap between the hasp and the hook when mounting. If using the loop-type draw clamp, watch that the hook base, when attached to the top of the clamp, does not overhang the edge of the clamp on the side of the clamp abutting the back plate. If it does, it will bind with the backplate. The hook base can be filed off in any case.

Fastening the Clamps to the Backplates

Position the first clamp on the left backplate (the one with the 9/64” hole near the top) with the “A” side on the right and such that the carriage bolt head is centered in the arcing slot of the pivoting clamp. The bottom edge of the clamp should be flush with the bottom edge of the backplate so that the hinge does not impinge on the backplate. Holding it in this position, turn it over, and drill two pilot holes with a #6 countersink wood bit through the back side of the back plate and into the clamp "A" side, about ¾" from the top and bottom of the clamp, and about ¾" in from the outside edge, and fasten the "A" side to the back plate with the 1 5/8" flathead wood screws. Countersink the screw heads. For the right pivoting clamp, position the second clamp on the remaining back plate with the "A" side on the left, with the carriage bolt head centered in the arcing slot. Fasten to the back plate as above.

Install the pivoting clamps on the frame uprights. Do not put a washer between the backplate and the frame upright. Install a washer and nut on each bolt, tighten moderately, and check for binding or resistance. If binding occurs, it could mean the bolt hole isn't straight, or the clamp mounting screws are not below flush with the back surface of the back plate, or that the frame upright is cupped or warped.

Pull-Down Strap Anchor

(4" x 5/8" mending plate) This will be used to anchor the Velcro pull-down strap. Mount it flat, with three washers between it and the edge of the base plate to create a gap for the strap. Fasten to the center of the edge of the base plate on the side adjacent to the pivoting clamp "A" sides with pan-head wood screws.

Pull-Down Strap

(Velcro 18" heavy-duty cinch strap) Pass the strap down through the gap between the strap anchor and the base plate so that the lead end points away from you with the "fuzzy" side facing down. The buckle of the strap will be brought beneath and up over the twisting sheets, so that the tag-end is pulled up through the back of the buckle and down on the outside facing the rear of the jig to cinch.

Drill the Left Pivoting Clamp Stop-Pin hole

Remove the right pivoting clamp. Put the left clamp in the vertical position. Use a 9/64" bit to drill through the hole near the top of the backplate into and through the frame upright. This hole is for a 10 d nail stop pin.

Mark the Locations for and Drill the Right Pivoting Clamp Stop-Pin Holes

See first photo under "Fabrication and Assembly." Remove the left pivoting clamp. Reinstall the right pivoting clamp, and rotate it away from you, counter-clockwise, so that the hinge is facing you and the "B" side of the clamp is facing up and is parallel to the base plate. Align the centerline you drew on the bottom edge of the backplate with the 90-degree line you drew across the face of the frame upright. Use a pencil to draw a line on the frame upright along the upward-facing edge of the clamp "B" side. The line parallels the 90-degree line you drew across the face of the upright, and intersects the vertical centerline of the frame upright at 90 degrees. Next, rotate the pivoting clamp to align the centerline on the bottom edge of the backplate with the 80-degree line on the lower right quadrant of the upright. Again draw a line on the frame upright along the edge of the clamp "B" side, facing up, as you did with the 90-degree line. Repeat this for the 70-, 60-, 50- and 40-degree positions. Remove the pivoting clamp. Next, drill a hole with a 9/64" bit at each degree-line in the upper left quadrant. Make the bottom of each hole right at each line, so that the stop pin will stop the pivoting clamp at each line. The 90-degree line hole will be toward the outer end of the line, near the edge of the frame upright. Each succeeding hole should be moved in, so that the pattern roughly forms an arc, as shown in the photo and on the plan.

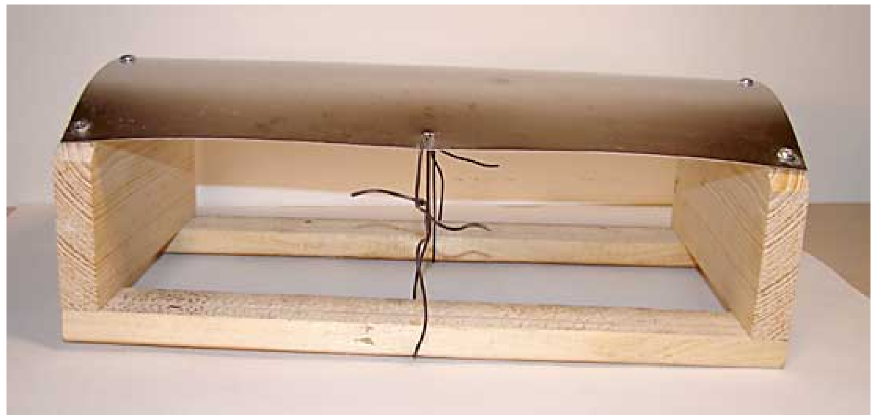
Reinstall the pivoting clamps. Do not put washers between the backplates and the frame uprights.

"Twisting Sheets": (Two)

"Lexan" polycarbonate .093 gauge (3/32"). Commonly available in precut sheets 11" x 14". Have your supplier cut it into strips 2 1/2"x 11". It can also be cut with a radial-blade (fine tooth) table saw or with a jig saw, or by scoring deeply with a utility knife and breaking it over a table-edge. Remove the protective plastic after cutting and remove any roughness from the edges. Forming is done on a sheet metal vent pipe ("stove pipe") or a form in an oven at 325 degrees F., one sheet at a time. Sheet metal vent pipes are commonly available in diameters of five to ten inches and two- to three-foot lengths. A seven-inch diameter pipe is a good size to start with, unless you know that you want a larger-radius form. Cut the pipe to 14 inches long with tin snips. Place the pipe in the oven on an open rack, front to back, chock to prevent movement if necessary, and preheat the oven to 325 degrees. Place the polycarbonate on the top centerline of the pipe. It should conform in a few minutes. If it doesn't conform in a few minutes, raise the heat just a little. If it starts to bubble, open the oven door to cool it. As soon as it conforms, using heat-resistant mitts or leather gloves, remove the pipe from the heat, and allow it to air cool. If the polycarbonate sheet begins to curl, hold it down with your gloves. The sheet will slide off the pipe after it cools. If overheated, polycarbonate will bubble, curl, and shrink. The bubbles and pocks will make undesirable indentations in balsa laminations. (As a precaution, open a window and remove any pet birds from the oven area when heating plastic.)

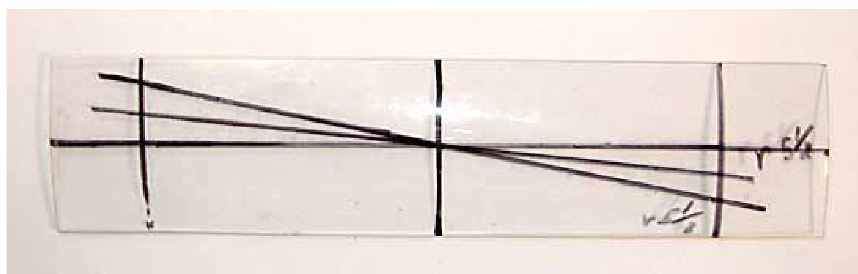
If a stove pipe of a desired diameter is not available, or, if you want to make twisting sheets of various radii without buying a lot of pipes, you can make a forming "buck" of wood and sheet metal with replaceable ends for different radii.

Making a Forming "Buck" for Forming the "Twisting Sheets"



The "buck" is a wood book-end frame with a rounded sheet metal "roof." The frame consists of two wood end pieces with a round top of the desired radius mounted on two wood rails. The ends can be cut from stock plywood "rounds" or from stock 1" x 8" or 1" x 10" pine or similar. The rails are made from 1" x 2" pine. The ends measure seven inches wide at the base, and four inches high at the sides to the beginning of the rounded top. The top is cut to the desired radius. You can use a stove pipe for the sheet metal, or flat sheet galvanized or stainless steel, 20- to 24-gauge. The sheet metal is cut to 7" x 14," and is screwed to the frame ends in the middle and at the corners. Holes are drilled in the sheet metal at the edge in the middle of the frame span, and uncoated wire is inserted through the holes and wrapped under the rails to pull down the sides of the sheet metal. The wood frame can withstand the preheating and heating time without igniting.

Mark the "Twisting Sheet" Forming and Reference Lines



After forming the twisting sheets, use a sharp-pointed black permanent marker to draw lines on the underside surface of one twisting sheet bisecting the sheet horizontally and vertically. Next, using a protractor, draw a diagonal line bottom-left to upper-right as viewed from the top at 6 and 12 degrees to the horizontal centerline, using the intersection of the bisecting lines as the centerpoint. These are forming reference lines.

Install the twisting sheets in the pivoting clamps. (Grind off any spots that bind with the clamps.) Close the draw hasps. Using the marking pen, draw a line on the surface of the top twisting sheet at each end along the face of the pivoting clamps. (See picture above.) These are visual reference lines.

Testing the "Twister"

Put the left pivoting clamp in the vertical position and insert a 10 d nail through the hole in the backplate through the frame upright. Now rotate the right pivoting clamp counter- clockwise 90 degrees to expose the hole at the 90-degree line. (If twisting with your bare hands is difficult, use a ¼" drill bit to drill a hole down into the top of the right clamp backplate for a helper tool.) Insert a 10 d nail from the back side of the upright through the hole in the backplate as before. Observe that the reference lines on the top twisting sheet at the face of the clamps are no longer parallel to the clamps.

Hold a six-inch straightedge rule to the top side of the sheets along the horizontal midline (the zero-degree forming line). Observe the bowing along that line. Now hold the straightedge to the surface along the 12-degree diagonal forming line. Pivot the straightedge in an "x" motion to find the angle at which you have a flat line. As the twist of the sheets is reduced, the flat line will be at a smaller angle to the horizontal line, and as the twist is increased, the flat line will be at a higher angle. When forming a blade, to achieve a flat centerline from tip to root without using the pull-down strap, the centerline of the blade will placed on the diagonal angle appropriate for the degree of twist (plus two degree or so depending on the recovery characteristics of the laminations used). For example, the 12-degree line is the approximate line for 70 degrees of twist.

Turn the "Twister" on its side. Hold the straightedge to the bottom side of the sheets, along the horizontal centerline [Figure 1]. Observe that there is a large gap at the middle between the straightedge and the surface of the sheet. A blade formed with its centerline along the horizontal midline at 90 degrees of twist will be strongly bowed down, as if formed on a cylinder.

Pivot the straightedge to the 12-degree line. Observe that the line is flat.

Now pull down on the sheets until the top side of the sheets looks flat [Figure 2]. Hold the straightedge to the bottom side along the midline. Observe that there is still a small gap in the middle.

Now pull down on the strap until the top side of the sheets is slightly concave [Figure 3]. Hold the straightedge again to the bottom side. With the straightedge touching the sheets at the center and held level, there are gaps at the ends of the straightedge between it and the sheet surface. Pivot the straightedge to the 12-degree line. Observe the large gap in the center. This means that a blade formed with its centerline on the horizontal midline with this amount of tension of the pull-down strap will be washed out, because the result of pulling down to this degree is a straightening of the blade leading edge and a decrease in the twist from the blade mid-point to the tip.

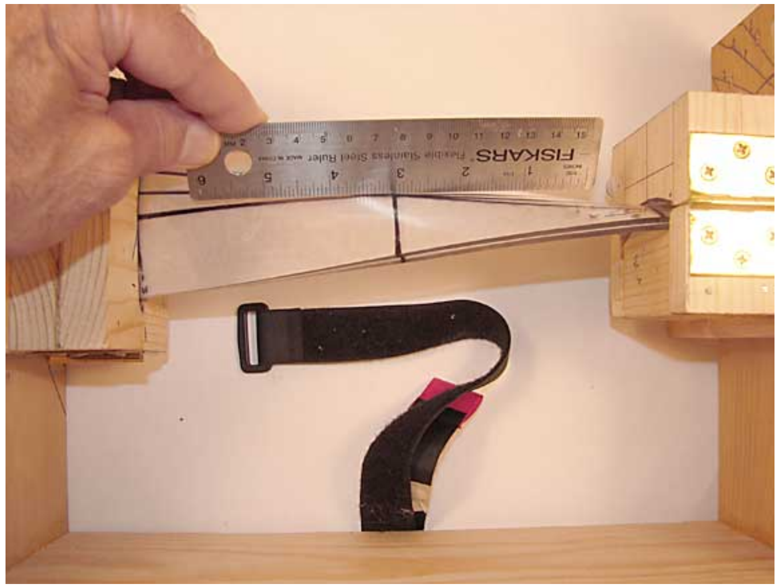
A blade with mild washout can also be formed without the strap by placing the centerline at a higher angle than nominal for the given degree of twist.

The size of the blade you can make depends on the forming angle. The maximum size for a blade formed at 15 degrees is six inches by one inch. As the forming angle is reduced, the blade size can be increased. See figure 1 below.

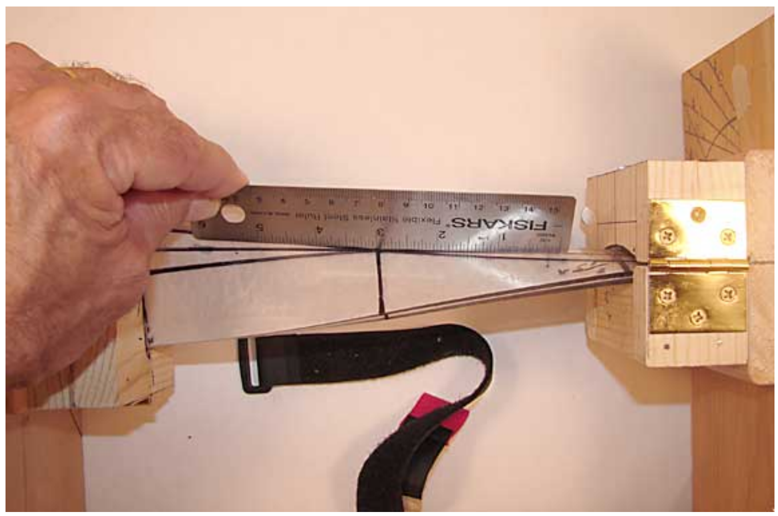
In Figure 4, the inside, smaller "blade" measures 1" x 6" and the outside, larger "blade" measures 1 5/8" by 7 inches. Maximum blade side is 2 ½" x 7 inches.

Next, cut the laminations to the desired shape, but do not glue them. Place them between the sheets on the 12-degree forming line, lock them into the clamps, and twist to 90 degrees, then 80, then 70, 60, and 50 degrees. Observe that the deflection of the vertical reference lines on the top of the sheets at the face of the clamps is greater than with no laminations between the sheets, and that it decreases from 90 to 50 degrees. The degree of deflection will vary with the thickness of the laminations and the degree of twist.

Find the "flatline" at 90, 80, 70, 60, and 50 degrees of twist. Note that the flatline is at a lower is at a lower angle as the twist is reduced. The forming line for any given degree of twist will be the angle at which the blade centerline is flat end-to-end, plus two degrees or so to account for the rebound of the lamination materials.



SHEETS SHOWN TWISTED TO 90 DEGREES AND STRAIGHTEDGE HELD TO TOP SIDE OF SHEETS ALONG HORIZONTAL MIDDLE (ZERO-DEGREE FORM-



SHEETS TWISTED TO 90 DEGREES AND STRAIGHTEDGE HELD TO TOP SIDE OF SHEETS AT ABOUT 10 DEGREES TO THE HORIZONTAL MIDLINE. NOTE FLAT SURFACE.

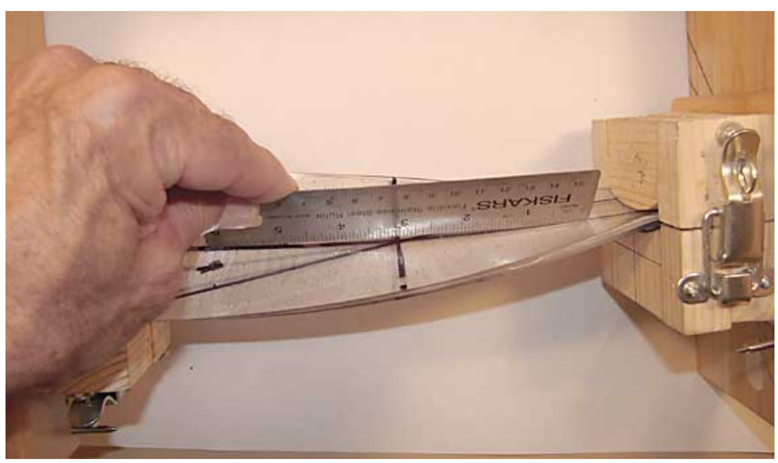


FIGURE 1

Release the twisting sheets and the laminations, and place the laminations with the centerline on the 6-degree forming line, and twist as before. Note at what degree of twist the centerline is flat. Repeat for the horizontal midline (the zero-degree line), and try the pull-down strap.

The degree of twist can be increased incrementally by shimming under the right side nail-pin.

Making a Blade

Tape a wax paper fold to the top side of the bottom twisting sheet so that it can be folded over the laminations. Make the fold open to the top. Apply the glue to the laminations and place them on the wax paper with the top layer facing up, the root end on the right, and the leading edge facing you, and with the centerline on or two degrees above the diagonal forming line appropriate for the planned degree of resultant twist. (See chart at end). Tape the ends of the laminations to the wax paper to hold them in place.

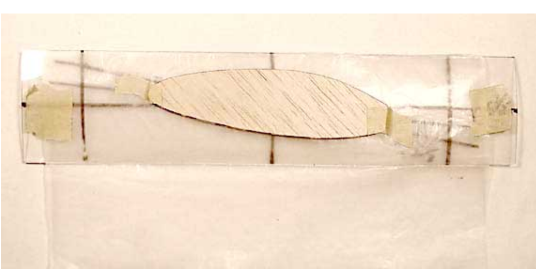
The top sheet is put on, the sheets are locked into the clamps, and the pin is inserted for the left pivoting clamp. The right clamp is then rotated to the desired degree and pinned.

If the laminations slide off each other, remove and use a little masking tape on the edges at the corners. The location of the “flat line” is checked with the straightedge and the laminations are repositioned in the sheets if desired. The spring-loaded, rubber-tipped v-clamps are then used to clamp the top and bottom edges of the twisting sheets to make sure that the edges of the laminations are tightly closed.

Polyurethane glue foams a few minutes after application. The foaming pressure may push the edges of the laminations apart if too much glue is used and they are not well-clamped. It hardens in ten hours. To release the blade, remove the right-end stop-pin, release the draw hasps, the sheets and the blade. Allow the blade to rest for an hour after removal before sanding.

Look at your blade blank from tip to root and at the leading edge profile. The lengthwise axis of the blade should be straight, as in an axle between two wheels. For a washed-out blade, there will be a slight concavity of the top lengthwise axis of the blade, and a consequent lowering of the rate of twist from the blade mid-point to the tip.

If practicable, measure the end-to-end twist graphically by holding the root end flat to a flat surface and measuring the lift at the tip from the trailing edge to the leading edge with a ruler. Draw it on graph paper, and measure it with a protractor. Or, use a pitch gauge. Keep track of the laminations used, the grain orientation, the twist applied, etc., for reference.



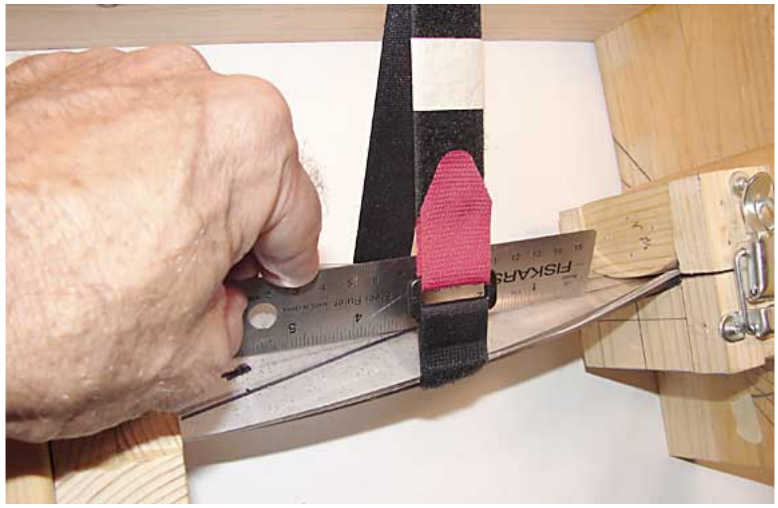


FIGURE 2

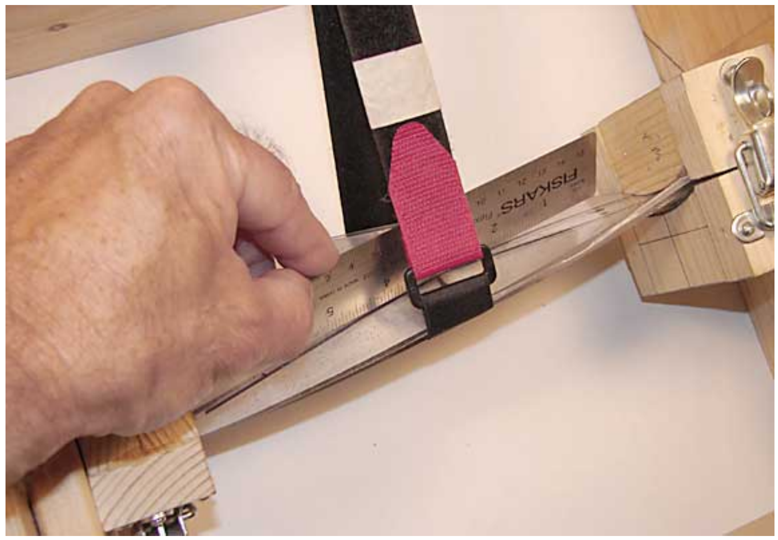


FIGURE 3

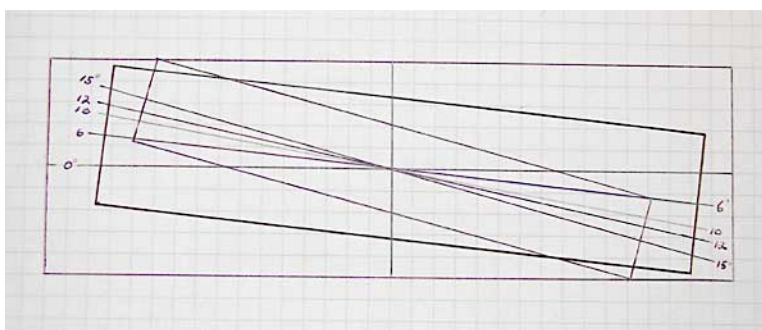


FIGURE 4

The twist (pitch) and twist profile resultant from any given degree of twist (and degree of pulling down of the blade) will depend upon the location of the blade centerline in relation to the forming line, the lamination materials, the planform and length, convexity, and whether and the extent to which the blade is pulled down for washout. The consistency of these factors will determine the consistency of the results. If you really want to find out if you are creating a good blade profile, after sanding, cut the finished blade in half along the chord line.

Below are data on the results of twisting all-balsa and plywood-backed balsa laminations measuring 1" by 6".

All-balsa (1/32" over 1/32")

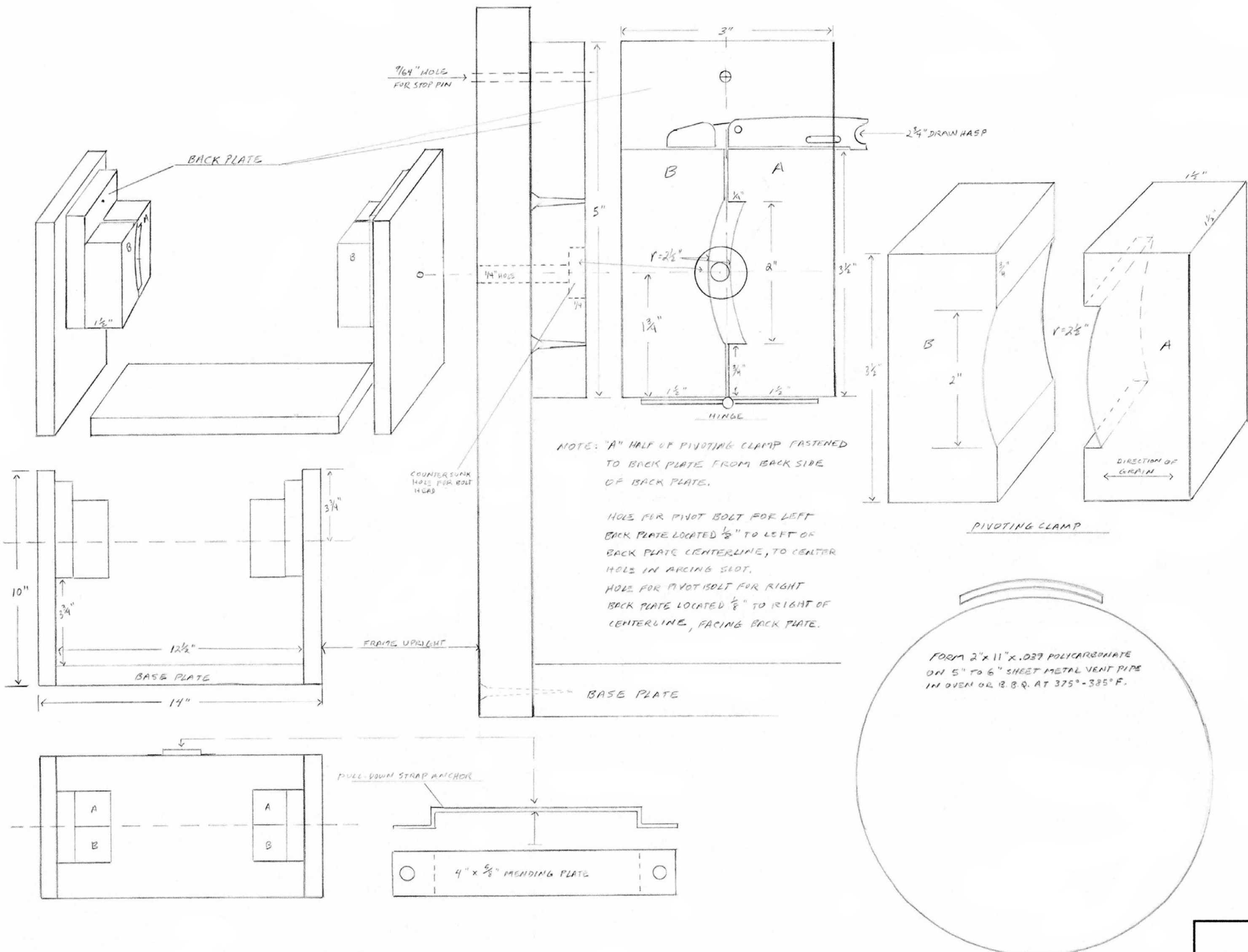
Radius	Twist Applied	Forming Line Angle	Resultant	Resultant as % of Twist
8 7/8	90	0	39	43 (1)
3 ½	90	0	39	43 (2)
3 ½	90	12	27	30 (3)
3 ½	90	12	27	30 (4)

1. and 3. Grain parallel.
2. and 4. Grain on 40-degree angle.

Balsa-plywood (1/32 over 2 layers 1/64)

Radius	Twist	Forming Line Angle	Resultant	Resultant as % of Twist
1. 5 ½	90	0	39	.43 (1.)
2. 5 ½	90	15	38	.42
3. 5 ½	80	12	34	.425
4. 5 ½	70	12	32.5	.457
5. 5 ½	60	9	26.5	.43
6. 5 ½	50	9	22.5	.44

1. Pulled down with strap.
Radius in inches.
Twist, angle, and resultant in degrees.
Results measured graphically.
Note: to get twist resultant in degrees per inch, divided resultant by six.



THE "TWISTER"
PROPELLER BLADE FORMER

MATTHEW B. PAYNE
DESIGNER

SCALE	APPROVED BY	DRAWN BY MBP
DATE 11-16-05		REVISED
		DRAWING NUMBER

Double Twister Propeller Jigs For Indoor and Outdoor Models

Carl Bakay

When Matt Payne's article for a Twister came out on the Small Flying Arts website, I built one right away. Most of the pine boards were already in my garage workshop, but it was also a lot of fun rummaging around the hardware aisles of the home supply stores, looking for all of the little hardware items. The most difficult to make items in his design were the 3/32" thick Lexan formers, which had to be oven-heated and curved to get a camber on the blade, but Matt was happy to make a few and send them to me. Everything else was simple wooden construction. If you can make a birdhouse, you can make a Twister in a single evening.

Working with the Original Twister

There were changes made by yours truly, however. I didn't see any reason to use hinges and clasps on the end blocks, so I drilled mine out to use four-inch long bolts to hold the halves of the clamps together. Now I know there was a method to Matt's madness, and it is that after a twisted prop is made, and you try and release it from the Twister, there are a lot of stresses involved with that very tough plastic.

Figure 1 Bolted Block Halves

Matt wanted a quick-release so the finished blade would not be damaged as the Twister tried to snap back to the zero position, and take the finished blade with it. The bolts shown here in the Figure 1 are simpler and cheaper, but more of a hassle when release time comes around. One half is glued to the back plate, while the other half is run against it with the bolts.

Next, I used his original design to make some Gollywock blades for a 13-inch outdoor propeller, and much thinner limited Pennyplane blades for my Chuck Slusarczyk model. For outdoor, I remember that the late George Perryman used a sheet of 1/16 and a sheet of 1/32 for everything when he made molded propeller blades (both balsa, I think, but one could have been plywood in some cases). So I used 1/32" ply and 1/32" balsa for the Gollywock. For indoor, I watched Chester Wrzos (pronounced Ross) make LPP props at USIC from two crossed-grain sheets of balsa shavings with a sheet of condenser paper in the middle. I used two sheets of 0.020" indoor balsa. Also, I used thinned Elmer's Carpenters Glue exclusively, with a curing time of 24 hours. And this is summertime in Louisiana. If it's wintertime in Michigan, you might want to set your jig on a warm, sunny windowsill while it sets up. I wouldn't try using contact cement, Duco, or CA, because you need an adhesive that's squishy at first to allow the blade sheets to slide a little when you apply the twist. Otherwise they will buckle if the adhesive sets up too soon.

A Whole Propeller at Once
Part 1 – We Clone a Peck

The Twister was designed for outdoor folding propellers, and it makes great blades, good looking and very tough. But there are as many uses for freewheelers, so my goal became making a whole propeller at once.

Like many things in our hobby, someone has already been there. David Dodge of the Glastonbury Aeromodellers makes a lot of quickie blades for simple rubber-powered helicopters. The jig on the upper right of Figure 2 takes a wet bow-tie of 1/32" or 1/16" balsa and forms it into a nice prop. David found there was quite a bit of wood splitting near the hub, so he designed the offset jig shown in the lower right picture, which is kinder to the wood. The nice thing - it is very easy to make it in reverse for counter- rotating propellers. He does tell us that with single un-laminated sheets, the blades will lose their shape in a year or two. A coat of dope or Ambroid will help with this, according to the Alamo Squadron.

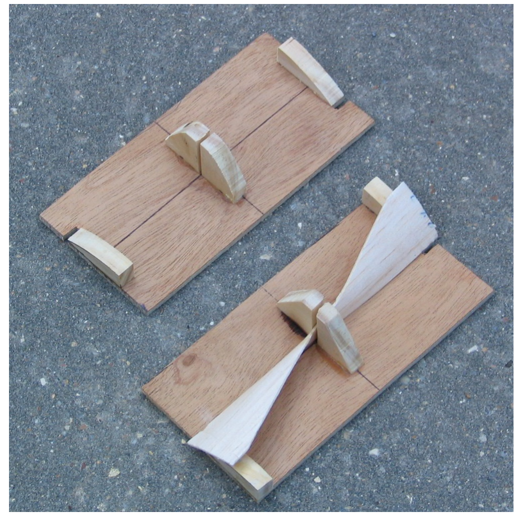


FIGURE 2

It would be hard to find an item which has been in wider use over the years than the Peck Polymers gray plastic propeller. It is supplied over a huge range of sizes, and is still widely available. I have a few dozen stashed away myself. There are better choices for specific applications. The 6" black Tern and 5 7/8" red IGRA are very efficient in that size. And the Czech yellow 9" is perfect for P-30 out of doors. But for FAC and AMA indoor and outdoor scale and sport flying in general, the gray Peck propeller is a good and popular choice. However, plastic is heavy for indoor, and shaving blades is a chore. We wondered - Could you clone a Peck plastic job in balsawood?

Using the David Dodge idea would be a logical choice, but since pitch distribution is important for efficient flight, we improved upon it. We cut an 8" Peck plastic propeller at the 2" and 3.5" distances from the hub, and traced the camber at those stations onto ¼" sheet wood. This is shown in Figure 3. They were then cut out and glued in place under an actual plastic propeller, and wooden uprights installed at the hub location, one wood thickness back from the prop shaft. This shown in Figure 4. Now the jig fixes our pitch in three places instead of just two.

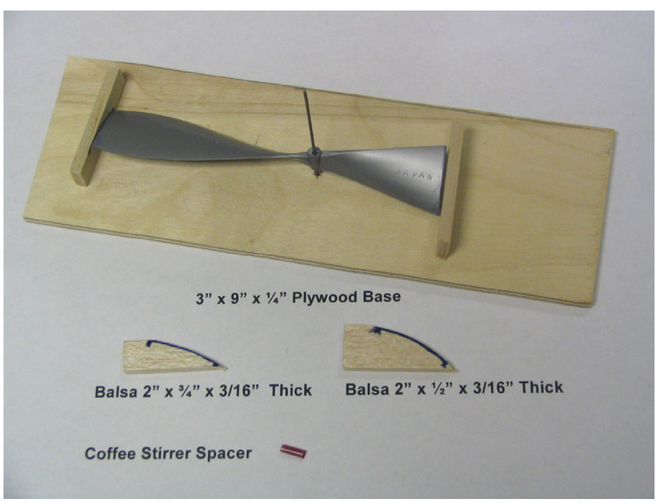


FIGURE 3 TRACE CAMBER AT 2" AND 3.5" FROM HUB, USING THE PROP YOU WANT TO CLONE

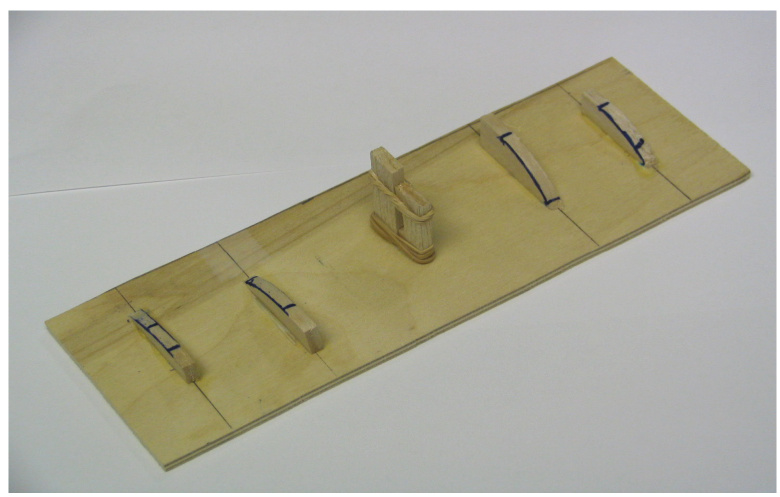


FIGURE 4 CUT OUT AND GLUE IN PLACE. ADD A CENTER BACKPLATE 1/20" BACK FROM THE SHAFT

Playing with different woods, something like 1/20" (or 0.050") B-grain 8 to 9 ppcf balsa from Lonestar Balsa or Solarbo gave in to our torture the best. Start by making a cardboard template by drawing around an actual propeller, and use it to cut out two prop blanks. Soak them in hot water for an hour, blot to an even dampness, and coat with thinned Titebond or Elmer's Carpenter's Glue. With the 3/64" prop shaft inserted into the block, poke it between the two sheets in the hub area. Work the two sides down gradually over the form, putting in the extra twist near the hub area with your fingers. Wrap in several places with rubber bands, Scotch tape, or masking tape. Secure the hub area tightly above and below the wood with rubber bands. Put in a warm place to dry overnight.

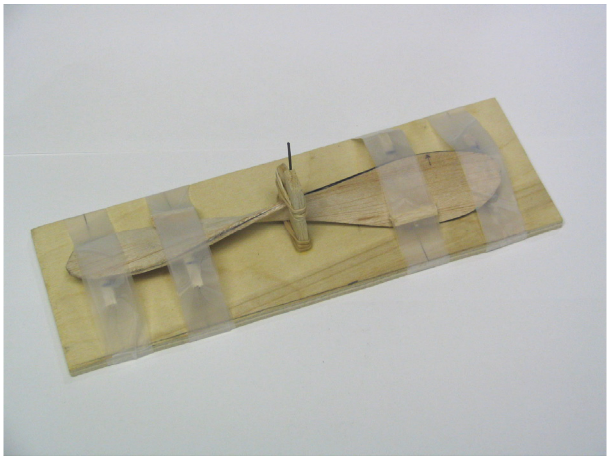


FIGURE 5 TAPED DOWN TO DRY OVERNIGHT

FIGURE 6 THE FINISHED PROP WEIGHED 41% LESS

The result we achieved was a nicely formed balsa replica of a Peck 8-inch plastic prop. There was no splitting of the wood, and good bonding of the two sheets. Sanding and 2 coats of clear nitrate dope gave a 2.2 gram propeller (as compared to 5.3 grams for the plastic variant) with a dead true shaft hole as a bonus. If you can do without the nose weight of a Peck propeller, one of these on your next indoor scale job will provide performance plus significant weight savings.

Part 2 – We Double the Twister

We made a double Twister by simply making a bigger base. We replaced the 12.5" baseboard with an 18" board, giving a jig with a 19.5" overall length. Just like in the Peck cloning jig above, we added an upright at the hub location, and a backing plate attached to it with wood screws. You can use the end plates from the original Twister on this one, and they work fine.

It would be difficult to use curved Lexan plates here, because they would have to curve in opposite directions. It also helps to have something more flexible and easy to cut with a bandsaw. So we switched to flat pieces of 0.080" Plexiglas. First they were cut in 2" strips, but the result had a very non-helical pitch distribution. This is because the twist is uniform from root to blade tip. But to have a helical pitch, the twist needs to be high at the hub and lessen towards the tips. So we made a bow tie set of formers, as shown in Figure 8, being 1" in the middle and 2" at the tips. This was much better, and probably good enough for most flying.

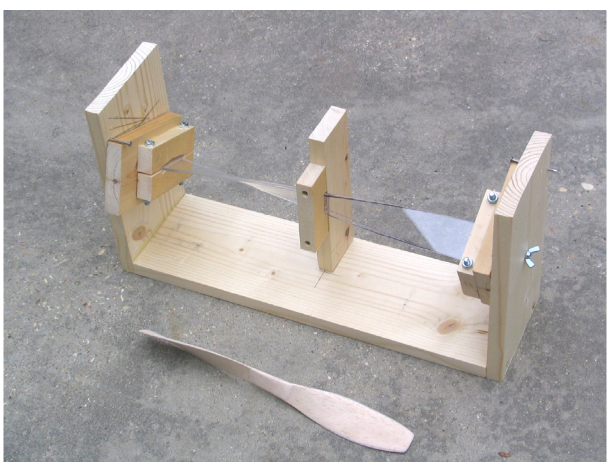


FIGURE 7 THE DOUBLE TWISTER WITH RESULTING PROP

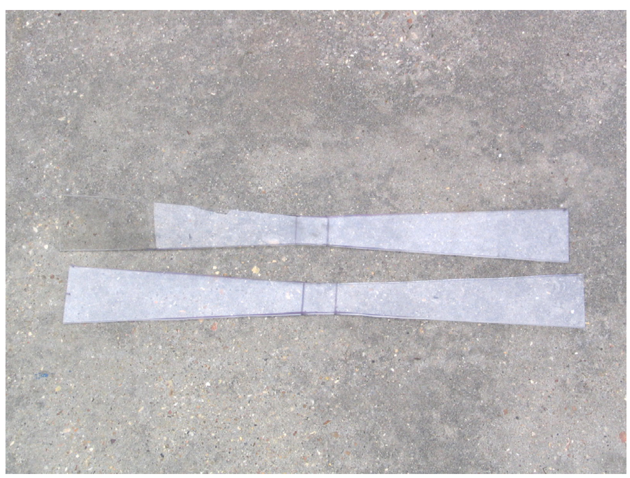


FIGURE 8 PLEXI BOW TIE FORMERS CUT WITH SAW

During this time, I hooked up with Gary Hinze of San Jose, California, and he worked out the problem using torque and the pitch/diameter ratio. He came up with the following table.
I can provide the derivation Gary sent me, if you are interested, or you can contact him directly at DGBJ@aol.com.

According to Gary,
"(We find the) blade width quadratically related to station along the radius. The shape is controlled by the term ((pi(r/R))^2/(P/D)+(P/D)). If we use P/D = 1.8 and calculate ((pi(r/R))^2/(P/D)+(P/D)) as a function of r/R, we get

r/R	((pi(r/R))^2/(P/D)+(P/D))	Normalized to 2"
0.0	1.80	0.23
0.2	2.02	0.55
0.4	2.68	0.74
0.6	3.77	1.04
0.8	5.31	1.46
1.0	7.28	2.00

"What is important here is the relative width. Changing the width will change the torque required to produce the desired twist along the length and at the ends, but not the distribution of blade angles."

The third column is mine, and it tells me that if I have something 2" wide at the ends, I need it to be ¼" in the middle. But really, if you are making a 10" to 13" propeller, one has a 1 to 1.5" hub area in the middle, so we can use the first station at 0.2 and say our bow tie can be ½ inch in the middle, and 2" at the ends. This is very do-able, and when we made formers like it, the resultant pitch distribution was very nearly perfect.

I would like to close by saying that this was much more than a fun exercise for me. I consider Matt's Twister an important new tool for the hobbyist. It is limited only by your imagination. He will provide you with all the help you might need, and for a small fee will make finished folders for you, to your specifications. The Alamo Squadron, Glastonbury Modellers, and Gary Hinze have been fun to work with. Because of them and David Dodge, I have cloned the Peck Polymers propeller in balsa, something I have always wanted to do. It came out really well.

If you have any questions, suggestions, comments, or new ideas, do not hesitate to call or write.

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Gary Hinze
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San Jose, CA 95124-2705
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Lancaster, TX 75134 www.lonestarmodels.com
Info: (972)218-9663 Order: (800)687-5555 Fax: (972)218-9211

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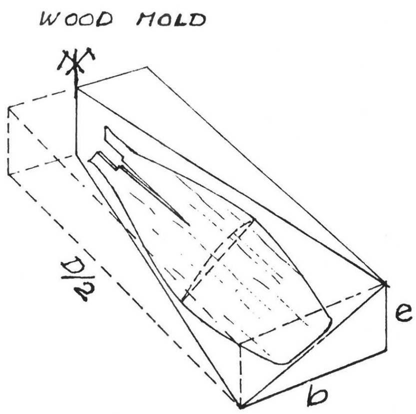
Miami, FL 33142
Tele: 305.634.537 Tele: 305.634.537
www.solarbo.com

Adjustable Pitch Propeller

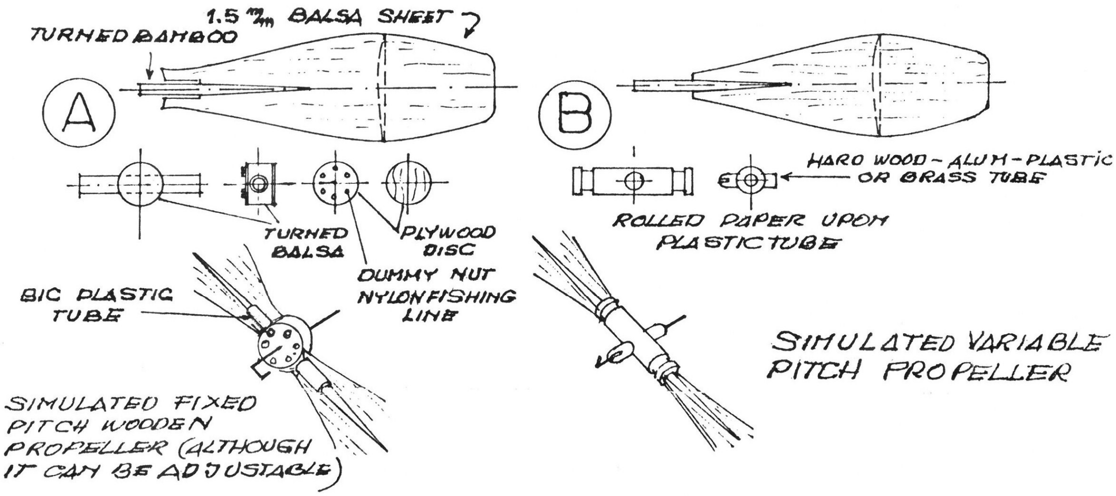
Ulises Alvarez

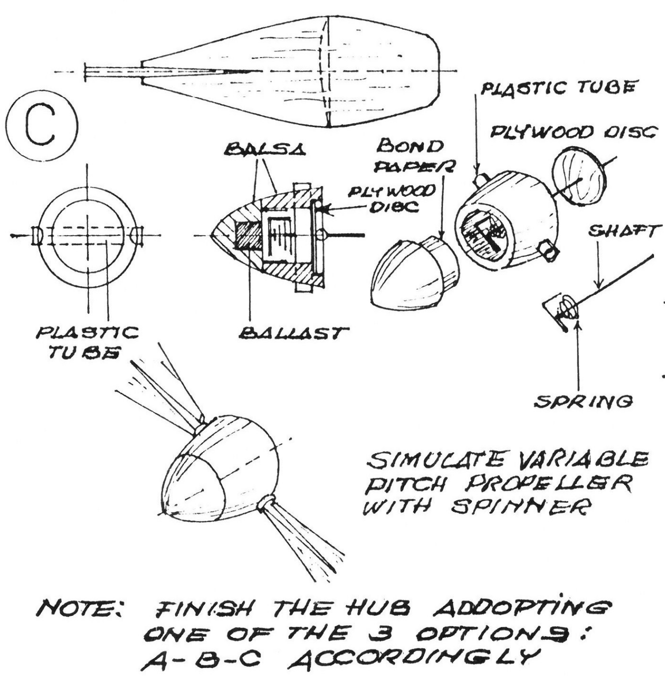


BLOCK DIMENSIONS TO OBTAIN A MOLD FOR RELATIVE PITCH PROPELLER BLADE Pr.

- $P_r = \frac{\text{ABSOLUTE PITCH}}{\text{PROPELLER DIAMETER}}$
- e = ARBITRARY DIMENSION i.e. 10 m/m.
- Pr = 1.30 ∴ AVERAGE VALUE IN THE CASE OF AN ADJUSTABLE PITCH PROPELLER.
- D = PROPELLER DIAMETER.

$$b = \frac{e \cdot T}{P_r}$$





- CUT 2 BLADES FROM WOOD 1.5 m/m AND GIVE THE APROPRIATE PROFIL USING SAND-PAPER.

WET ONE BLADE EACH TIME, PUT THE WET BLADE OVER THE MOLD AND WRAP IT WITH ELASTIC BANDAGE; LET IT DRY.

- MAKE A SLIT IN EACH BLADE AND GLUE THE BAMBOO DOWEL IN IT, USING EPOXI
- ADJUST THE BAMBOO DOWEL TO FIT INTO THE PLASTIC TUBE
- IF IT IS LOOSE, ADD SOME COTTON STRANDS TO THE DOWEL TO MAKE IT ADJUST TIGHTLY.

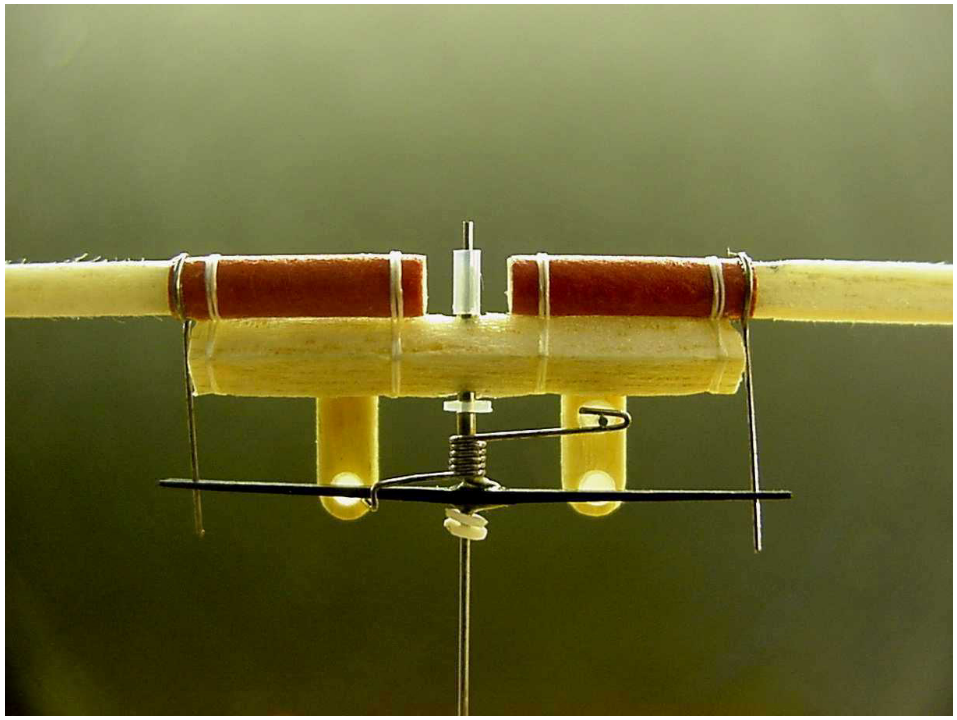
NOTE: FINISH THE HUB ADDOPTING ONE OF THE 3 OPTIONS: A-B-C ACCORDINGLY

ADJUSTABLE PITCH PROPELLER WITH MOLDED BLADES
by Ulises Alvarez URUGUAY-93

VP Hub Update

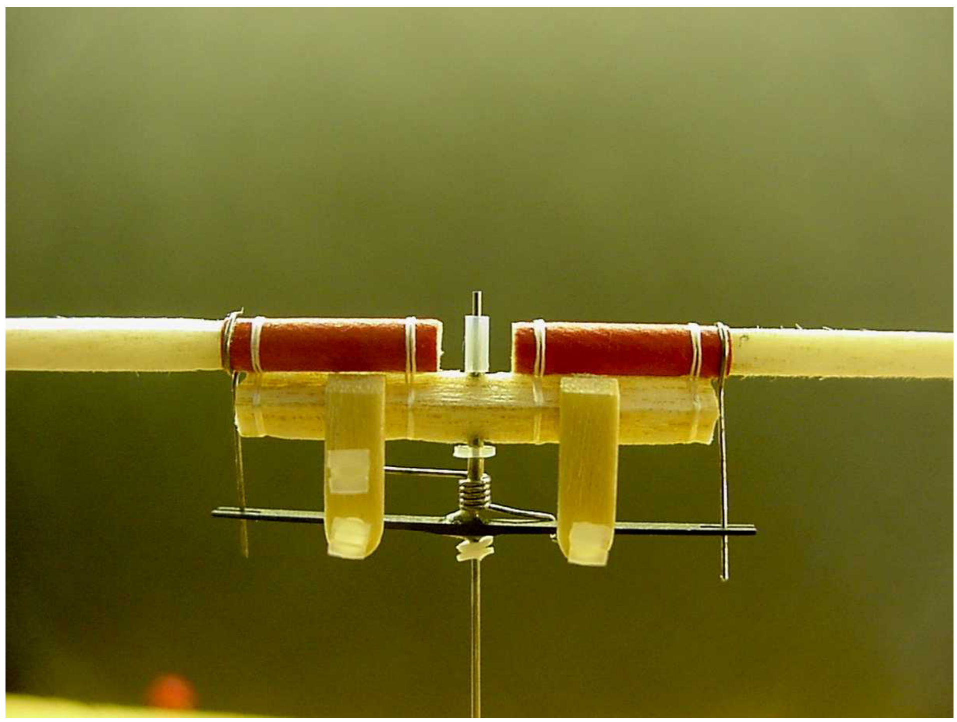
Nick Aikman

Here are 2 pics of a new VP hub completed this Spring.



The general constructional details are very similar to those described in the article in INAV 115 but the following have been altered:

- Hub bearing is now a piece of 0.013" i.d. hypo tubing. Easier to make than F1Ddling around with bits of tin can and seems equally smooth running.
- Yoke length shortened to 18.00 mm.
- Carbon drive arm extended to 22.00 mm. This is made from high modulus carbon.
- 0.008" actuator arms are at the outer ends of the tissue tubes. Each has a loop at one end, which is glued to the end of the tube, allowing blades to be removed/ replaced.
- A much stiffer spring.
- 3 screws to give bottom and top pitch adjustment as well as spring pre-load.



The changes have been engineered to give much slower rate of pitch change, more in tune with the torque reduction as the motor unwinds.

In GBR, Bob Bailey in particular has been playing with similar configurations for a while and tests seem to indicate an improvement in performance.

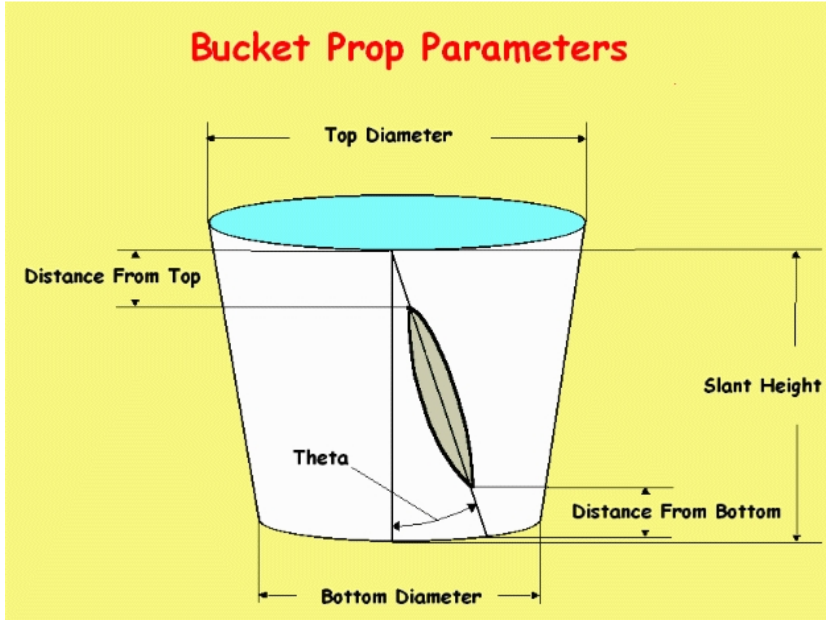
This is the first hub in a series and with so much wire/carbon etc, it's heavy at 0.116 mg. With care, it should be possible to reduce this considerably.

Nick Aikman. 21.05.07.

Bucket Props

Fred Rash - June 2007

A well-known, simple, yet surprisingly effective method for making propellers for rubber models is the can or cylindrical prop. Cylindrical or can props are made by soaking thin sheets of balsa in hot water and molding or forming the blades on a cylinder or can with the prop blade tip pointed up and 15 to 20 degrees left of vertical. The wet blades can be dried at room temperature, dried in a conventional oven, or if the form permits, carefully dried in a microwave oven. The dried blades are then attached to spars or to the hub using a pitch gauge. The blade angles are usually chosen to match a helical pitch distribution as closely as possible for the entire length of the prop blade.



A bucket prop is molded on a bucket or tapered cylinder (or cut from a tapered cup) just as a cylindrical or can prop is molded on a cylinder or can. While there are many published plans showing prop blades cut from foam cups or yogurt or cottage cheese cups, I have seen few articles that describe how to design these propellers. Some references are listed below for anyone who is interested.

An Excel spreadsheet called Bucket72.xls is provided to help design bucket props. In the light blue cells, fill in your desired prop diameter, prop pitch, and the inner tip or distance from the prop shaft to where the prop blade begins. The inner tip is typically 10-20% of the prop radius. Use any consistent units for measuring length. (I think in inches, but wish that I thought in millimeters, a better choice.)

Next fill in the size of your cup or bucket form in the next column of light blue cells. The average diameter and height of the cup or bucket should be about the same as the prop radius or prop blade length. For indoor duration, frequently the best form will be fat, but more sharply tapered than a typical bucket. Enter the top diameter, bottom diameter, and the slant height (the almost vertical distance measured on the surface of the cup or bucket).

The spreadsheet will calculate the blade angle of the prop at 10 points along the prop radius. The blade angle measurement assumes that the prop blade is being attached to hub and/or spars on a horizontal work board with a temporary vertical prop shaft and the blade angle is measured between the work board and the underside of the prop blade. The prop if rotated in the intended direction would advance up and away from the work board.

The spreadsheet will also adjust the left tilt angle on the bucket (theta) and slide the prop blade up and down between the top and bottom of the bucket form to the achieve the best fit of prop blade angles.

Now click with your mouse on the button labeled “Optimize”. If the Excel Tool called “Solver” is active on your machine, all is well and the numbers in cells F9, F10, and F11 will all be adjusted to give the best fit of your desired prop blade to your available cup or bucket. This minimizes the error between the helical blade angle and the angle given by the form. The errors are squared and summed into cell F15. When nothing changes on pressing “Optimize”, the prop blade is fitted as well as possible to the bucket form that you used.

If Excel Solver has never been installed and used on your computer, go to Tools>Add-Ins>Solver Add-In, check the box, and find the Excel or Office CD if necessary.

If you can’t get Solver working, change the numbers in cells F9, F10, and F11 to minimize the error in cell F15. Watch the plot just to the right of these cells. You can optimize manually, but it requires more effort. You can find or make other conical forms, cups or buckets, if your first selection did not give a good fit. A good fit will be obvious when looking at the plot.

Solver will be very useful for other applications and you may want to work to hard have it active.

Fit can or cylinder props by entering identical diameters for top and bottom of the bucket. A quick calculation shows that the prop tip always should be pointed toward the top (larger end) of the bucket; poorer prop designs result from the reverse. While this program assumes a helical prop as target, it will also optimize the fit to a non-helical pitch distribution if the target angles are known and are stuffed into the spreadsheet. Since this program assumes that the prop blade has the same width fore and aft of the spar, a flaring prop with more area ahead of the spar also can alter the fit of blade angles, but that calculation requires a more complex analysis than this one.

So far as I can tell, all bucket or cone props differ slightly from helical props, but the error can be made small enough to ignore.

HISTORY and REFERENCES

The first publication on cylindrical props known to me was Jim Baguley's LAST RESORT design in 1960 (Ref. 1). There are many other instructions for can props such as Chernoff (Ref. 2, 3), Meuser (Ref. 4), Williams (Ref. 5), Tenny (Ref. 6), Garber (Ref. 7), and Linstrum (Ref. 8). A cork form with a cylindrical surface for molding indoor prop blades was sold by Jim Jones (Ref. 9).

The most definitive article that I have found on bucket or cone props appears in the National Free Flight Society Symposium Report for 1996 by Antii Jolma and Kai K. Halsas of Finland (Ref. 10).

Before I saw this, I provided a program to the NFFS Symposium Report for 1995 (Ref. 11). My BASIC program had some math errors. While my math was erroneous, the practical effect of the errors may or may not be significant, depending on the prop needed. Later I used the equation from Jolma and Halsas. Bucket or cone props are always compromises and approximations but fit the blade angles to a helical pitch distribution better than a can prop does. The goal is usually a quick, but not very dirty, prop design.

After all the above, I began to try to find out the origin of the cup prop concept since clearly I was a latecomer to the method. Email information from Don DeLoach, Dean McGinnes, and others helped in learning more about the history of the concept.

Don DeLoach's "Celtic" Bostonian article (Ref. 12) first made me aware of cup props. He emailed that the concept was originated by the late Jim Clem and first appeared in Al Backstrom's Maboussin Hemiptere Peanut, Model Aviation, April, 1987 (Ref. 13). The article by Al Backstrom first made this prop concept widely known and credits Jim Clem with originating the yogurt cup prop for Bostonian and Indoor Scale models.

This drawing of the cup prop appears to place the tip of the prop blade at the wrong end of the cup or bucket, but I should be reluctant to say that Jim Clem, who helped and encouraged me a lot, did it wrong. There may be subtleties in prop camber or blade shape or something else that I have missed. In any case, Dean McGinnes emailed that he found several years ago that the props with the blade tip at the larger end of the cup or bucket performed better.

Jolma and Antti found that a cone with a 30 degree angle was a useful "best" form for many props. I found that an average diameter of the bucket equal to the prop blade length was useful and helped eliminate props which gave an angular "fit" but had either excessive blade camber or hook. The two "answers" are similar.

(1) Baguley, Jim: "LAST RESORT" design in Model Aircraft, 1960, pp. 154. This design began in 1956.
(2) Chernoff, Max: Form for Bent Propellers, 1964-65 Model Aeronautic Year Book, Edited by Frank Zaic, Model Aeronautic Publications, 1965, pp. 198-200.
(3) Chernoff, Max: A proposed method for designing low advance ratio propellers, NFFS Twenty-Fifth Annual Report 1992, pp. 15-22.
(4) Meuser, Bob: Can-Formed Prop Blades, NFFS Symposium, 1973, pp. 28-33 and Indoor News and Views, January 1993, pp. 18-20.
(5) Williams, Ron: Building & Flying Indoor Model Airplanes, Peregrine Smith Books, Salt Lake City, 1984, p. 258.
(6) Tenny, Bud: Indoor Column in Model Aviation, August 1988, p. 157 and October 1988, pp. 62, 168. Bill Henderson's version appeared in Bud Tenny's column for December 1989, pp. 76, 187.
(7) Garber, Lester W.: Designing & Building Indoor Propellers, April 1991, 2324 East 5th Street, Duluth, MN 55812, pp. 11-16.
(8) Linstrum, Dave: Free Flight News Column in Model Airplane News, July, 1980, pp. 61-62.
(9) A cork prop form with cylindrical surface and 3.1-inch radius was sold by Jim Jones, 36631 Ledgestone Dr., Clinton TWP, MI 48035. (Mine worked well until charred in the microwave.)
(10) Jolma, Antti and Halsas, Kai K.: "A Universal Forming Block For Propeller Blades," in the National Free Flight Society Symposium Report 1996, pp. B1-B6.
(11) Rash, Fred H.: "Bucket Prop Design Program", 1995 NFFS Symposium Report, pp. M1-M8.

DESIGNING AND BUILDING A CONE FOR FRED RASH'S PROGRAM

Bill Gowen

Fred's program can be used to custom design a cone to form blades for most any kind of prop. The Solver program doesn't seem to want to run for me, but I don't find this a big drawback. You can input information into the program and make trial and error changes to come up with a cone that suits your purposes. The screenshot shown is a cone design for a 12x20 prop for Limited Penny Plane. The numbers were manipulated to give a blade with washout in the tips. You can see that the actual pitch of the blade will be 20.1 at the root and 18.4 at the tip.

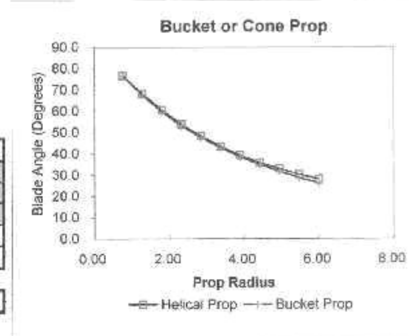
BUCKET PROPS 07/05/2007 15:40

Optimizes Fit of Prop Blade to Existing Bucket or Conical Form
Specify prop and available bucket or cone in blue cells.
Vary settings in green cells to minimize error in yellow.

Bucket70.xls 29-Jan-07 Copyright (c) 1993-1994, 1999-2007 by Fred H. Rash
Resale rights retained. Otherwise share freely.

DESIRED PROPELLER		AVAILABLE BUCKET		VARY TO OPTIMIZE SET UP	
PropDia	12.00	TopDiameter	9.20	Theta (Angle on Bucket)	22.00
PropPitch	20.00	BottomDiameter	3.00	Top of Bucket to Blade	0.13
InnerTip	0.75	SlantHt	6.50	Actual Tip Angle	26.00
PropTip	6.00	Top Radius	4.60	Target Tip Angle	27.95
Blade Length	5.25	Bottom Radius	1.50	Bucket Bottom to Blade	1.51
				(keep positive or zero)	
				Error Sum To Minimize	12.11

Optimize



Prop Radius	Target Angle(deg)	Target Pitch	Bucket Radius	Actual Angle (deg)	Actual Pitch	delta Angle	dAngle Squared
0.75	76.7	20.0	2.22	76.8	20.1	0.04	0.00
1.28	68.2	20.0	2.45	67.4	19.2	-0.79	0.63
1.80	60.5	20.0	2.68	59.6	19.3	-0.92	0.84
2.33	53.9	20.0	2.92	53.1	19.4	-0.80	0.64
2.85	48.2	20.0	3.15	47.5	19.5	-0.68	0.46
3.38	43.3	20.0	3.38	42.7	19.5	-0.65	0.43
3.90	39.2	20.0	3.61	38.5	19.5	-0.74	0.55
4.43	35.7	20.0	3.84	34.8	19.3	-0.93	0.87
4.95	32.7	20.0	4.08	31.5	19.1	-1.21	1.47
5.48	30.2	20.0	4.31	28.6	18.8	-1.56	2.43
6.00	27.9	20.0	4.54	26.0	18.4	-1.95	3.79

Try to minimize the sum of squares of errors in blade angle.

Be sure to look at graph via tab below.

To move plots closer vertically, change blade tip angle.
To make plots more parallel, change angle on form.
If these give poor results, find or make another cup or bucket.

You can also unprotect the spreadsheet and use Tools>Solver to minimize error (cell D15) while changing values in green cells repeatedly.

"Optimize" Push Button has been provided to run Solver macro to optimize more quickly.

Instead of making a complete cone I've found it more convenient to make a half or quarter cone. Making a half cone from this info involves first doing a few simple drawings. The first part to draw is the vertical back wall of the half cone. The widths of the top and bottom of this piece must be reduced by two times the thickness of the planking to be used for the skin. If the skin is to be .030" thick then the top width will be 9.2 – (2)(.030) = 9.14 and the bottom width will be 3 – (2)(.030) = 2.94.

Here are the steps to make the drawing:

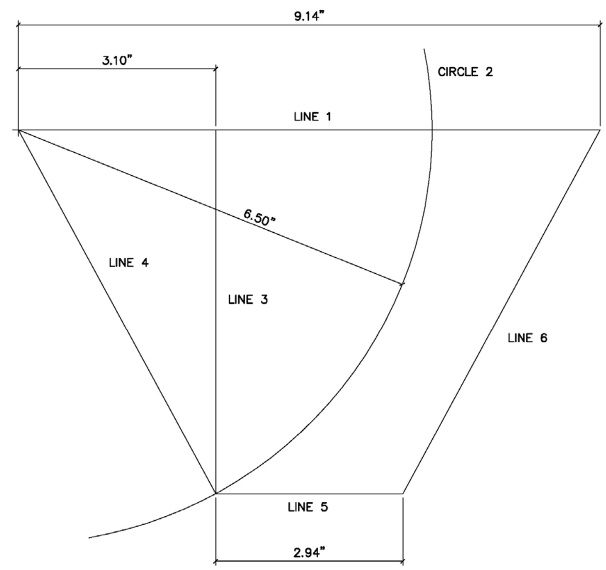
Draw a horizontal line 9.14” long

Using the left end of that line as a center point draw a circle of radius 6.5” (the slant height of the cone).

Measure from the end of the first line the following distance: (9.14 / 2) – (2.94 / 2) = 3.1”

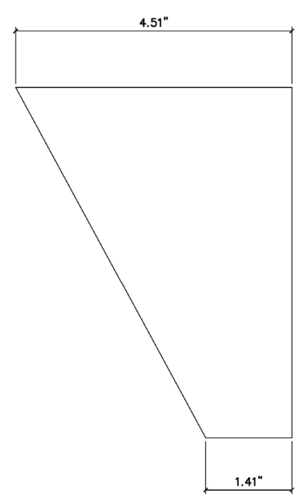
Draw a vertical line from that point down to intersect the circle.

A line drawn from the previous intersection to the left end of the first line will be one side of the back form.



BACK FORM

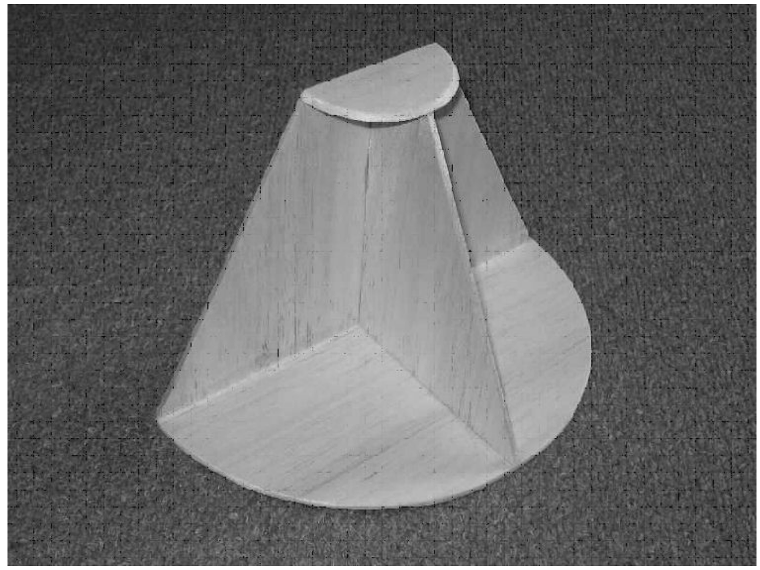
The middle form is made by cutting the back form in half. You also must reduce the width of this part by one half of the thickness of the back form. So if the back form is 1/8” sheet then the top of the middle form will be (9.14 / 2) - .0625 = 4.5075 and the bottom of the middle form will be (2.94 / 2) - .0625 = 1.4075.



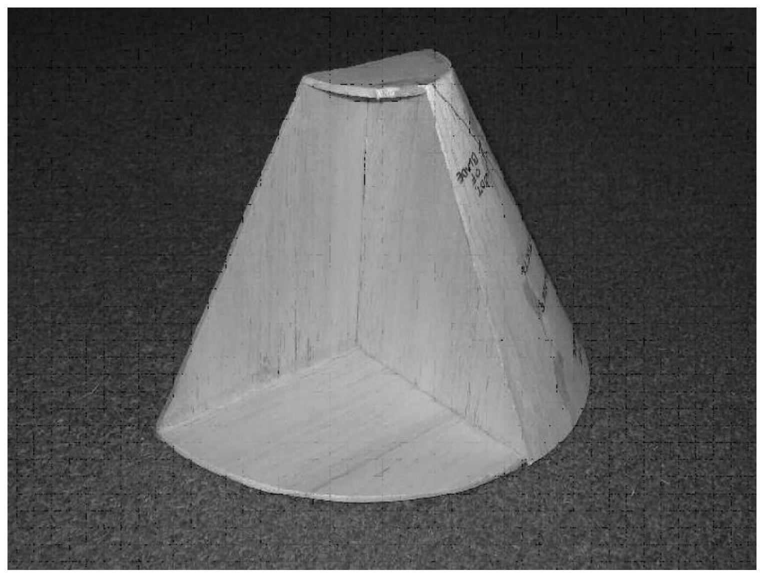
MIDDLE FORM

Next make 2 circles or semi-circles. The top form will have a diameter equal to the top width of the back form. The bottom form will have a diameter equal to the bottom width of the back form.

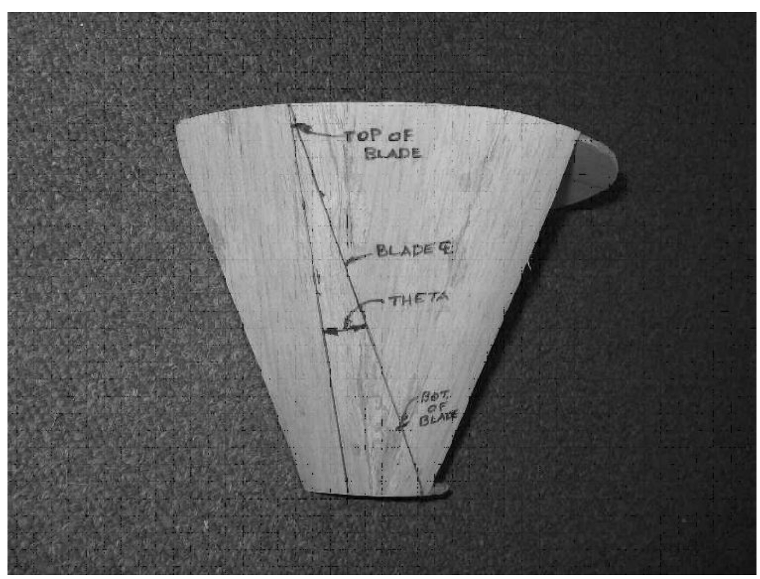
Glue the wide end of the back form to the top form exactly centered on a diameter of the circle. Glue the middle form to the middle of the back form.



Glue the bottom form to the small ends of the back form and middle form. The bottom form needs its edge sanded to match the cone slope. Plank the cone with your choice of material. To keep the skin as uniformly bent as possible it's best to glue the skin pieces together first before gluing the skin to the cone. In the large cone in the picture I only covered one quarter of a full cone to get enough surface for the prop blade.



Draw the blade centerline on the face of the cone at the angle theta shown on the spreadsheet (22 degrees in this case). Measure up to the proper point for the bottom of the blade and you're ready to form your blade.



THOUGHTS ON MAKING AND ALIGNING PIGTAIL BEARINGS

Rodney O'Neill

In 2005 I was in the USA at the indoor event in the Kibbi Dome in Moscow in Idaho. There with my partner Dorothy, we had the good fortune to meet most of the prominent American indoor flyers and a very friendly lot they were. While there I picked up a jig for making wire nose bearings (see INAV issue No.113 page 25) and what follows are a few notes on my attempts to use it.

Shortly after returning home, I followed Andrew Tagliafico's article and made a couple of bearings at a size suitable for a ministick model. After forming the bearings I found it difficult to align them correctly. I set them aside for my next ministick. I did not think of wire bearings again (as I have a plenty of Ray Harlan's bearings) until I decided to replace all my current F1L models.

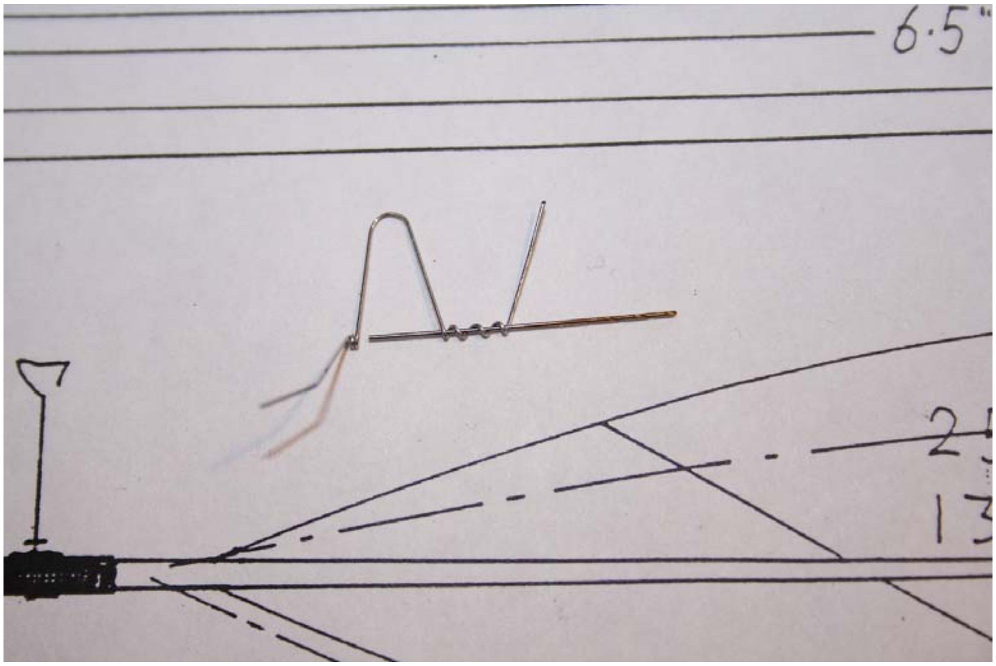
One thing that helped me to decide to try wire bearings again was a mention, of the use of a coping saw as a means of keeping the anvil wire on which the bearing is formed, taught and therefore stiffer. On reflecting back on my original attempts with wire bearings I realised that lack of stiffness in the anvil wire contributed to my problem and that the saw idea could be the answer. I unearthed a fret saw which I purchased about 50 years ago and probably only used twice before and pressed it into service, it did in deed help, During my initial attempts at forming bearings, I had found it difficult to control the wire to my satisfaction, so to have more control of the wire while winding the bearing I attached a small pin vice to the wire. This helped enormously as I could be more consistent in winding the wire.

For my second attempt I made a few bearings, but still had some difficulty in aligning them, until I realised that if I put about four turns in the pig tail the first two turns kept better alignment which made things a little easier. The last of the alignment difficulties disappeared when I delved into my small drill box and came up with a drill which was 0.0005 ins. up on the propeller shaft size. The drill is quite stiff and does not flex, when used to twist the parts of the bearing into alignment.

The process for alignment I now use is:

1. Insert the shaft of the drill into the front of the bearing and align this with the entry point of the pigtail. If the drill passes into the pigtail for more than one and a half turns, then happy days, you are there, trim the excess wire and reach for the next one.

2. If it does not pass into the pigtail, then remove the drill from the front bearing and insert the shaft into the open end of the pigtail and align the pigtail with the front bearing. This is usually just a small tweak.



On this occasion I was making bearings for a 0.014 ins. shaft and used a 0.35mm drill. In Imperial sizes, a No. 79 drill would also do. Remember to check the alignment after you have ground the front bearing flat. You should also push the drill into a small piece of balsa and put it in your field tool box as it will help with re-alignment after changing the thrust offset, at the flying site.

2007 Contest Schedule

Sept 1,2

The East Coast Indoor Modelers (ECIM) host a Sanctioned AA Labor Day Indoor Meet in Lakehurst Hangar #1. You must be a member to gain entry to the base. To join ECIM, contact Rob Romash. (cgrain1@yahoo.com)

Corrections and Errata

Issue #120

Page 14 - Second Column , Last Paragraph:

“The wing will have masses of positive incidence on the starboard wing” should read:

"The wing will have masses of positive incidence on the Port wing"

Contest Results

WILLAMETTE MODELERS TWO DAY INDOOR MEET - ALBANY, OREGON APRIL 21,22, 2007

Reported by John Lenderman, contest director

Usually, when we arrive to start the two day contest, there is a group of modelers waiting around, model boxes ready, to get into the building when it opens. This time it was strangely quiet, with nobody waiting at the door. I wondered if my clock was wrong, or did I pick the wrong day? However, shortly after entering, a few modelers began showing up, and we made the preparations necessary to run the meet. Somehow, there wasn't the usual flurry of activity that marks the start of our two day program. Tony Hula began flying his scale and semi—scale models right away, and soon the Science Olympiad competitors had their models up in the air. We usually allow the hours between 10 and 12 for set up and general flying. We have this system for regulating the flying times for the heavy models, and the light, duration models. After the set up time and general flying, we let the heavy models fly between 12 and 2:30. Then from 2:30 to 5:00 P.M., are the light weight models. We break at 5 and return around 6 P.M. for the symposium. After the symposium we give the heavy models another hour, then from 8 P.M. to the time when everybody gets tired, usually around 10 or 11, we fly the light weights. Then on Sunday, it's back to the regular schedule--gliders from 8:30 to 9:30, heavy models until noon, mass launch, and then light models until closing time of 3:30. This has worked well for us, with no problems at all.

Saturday morning was a great deal of activity with the Science Olympiad flyers. When the rules were first announced for 2007, dictating a smaller model, we thought the performance would drop off quite a bit. We were pleasantly surprised to find that these models not only flew well, but had performance well above our expectations. Our young flyers quickly mastered the qualities necessary to make these models fly well, and demonstrated that they could compete very well with the schools around the state. Rebekah Altig had her models doing very well and is going on to the Washington State Science Olympiad finals.

I believe that it had been mentioned previously about the new speakers the school had installed on the roof beams. With the necessary wires and chains to hold these speakers, we have found them to be a formidable hazard to our models, especially the light weights. Even though some modelers have fiberglass poles to reach them, some models were destroyed while attempting to get them down. As a result, we found ourselves not winding to the maximum, or flying older, inferior models in order to avoid the possibility of losing a really good flying model. Last year we introduced the 35 cm event with the hope of encouraging others to build and fly them. This year we have 5 models that were entered. Kurt Schuler having a truly magnificent model that did a really great 15:21. Kurt is a real artist when it comes to building talent. Another in this category is Ed Berray. He had a brand new 35 cm that was immaculate, and showed a great potential when he gets it adjusted properly. The rules are easy--wingspan of 35 cm, just under 14 inches, and that's it: No weight limits on rubber or model weight. Try it--you might like it.

There was steady flying until 5 P.M. when we broke for supper. After returning, we began the symposium.. Bob Stalick showed some various products that you find every day which he uses when he is building. He gets hair clips and converts them into devices that hold parts together while glue is drying, He uses 2 different containers to store wing ribs and templates, and smaller containers to keep small parts from being mixed up in the tool box. Andrew Tagliafico showed us how he makes indoor props. If you have seen his props, you know he really knows what to do. After soaking the blades, he makes a sandwich of the blades and light weight silkspan. Andrew cautions about soaking the blades too long. He says too long a soak will allow the balsa cells to absorb too much water, and they burst, thereby weakening the wood. On top of the blade sandwich, place a thin balsa shaped like the blade, and then a rubber pad also the same shape as the blade. Bind this to the prop form with a 1" strip of cotton from the bottom of a tee shirt, and bake in the oven, at 220 degrees, for 20 minutes. Then take this apart carefully. Some builders say they leave the blades on the form for several days to help the blades keep their shape. Ed Berray told us how to make curved parts, such as wing spars, rudders and stabilizers. He soaks the wood first, then has a prepared form to place the parts on, binding them with soft material, and baking in the oven. Ed stressed that the form is very important in producing an accurate structure. His forms are generally made from balsa. Ken Hark showed his devices for testing motor sticks for twist. He said it is important to keep records, so you can duplicate a model again. He also showed his testing device for spars, both wing and prop spars. His successes show he has mastered this art. Kurt Schuler demonstrated how he makes his rolled tube fuselages, and how to glue them without warps. He is really precise in his work and his models show this talent. The CD, John, talked about the various kinds of glues, and their uses. He said he had different bottles with glue of various viscosities. For thinners he uses acetone for quick drying, lacquer thinner for slower drying, and brushing lacquer for even slower drying. Some of the white glues and wood glues can also be used in modeling if you thin them out with water. The hot glues should only be used sparingly in indoor modeling, and it can be applied with insect pins after a drop is put on aluminum foil. Never used either the thick or thin hot stuff right from the bottle. We had some good discussions before resuming the flying for the evening.

The Sunday flying went along steadily, and at the noon mass launch for SO models, there were six flyers. After the launch, one model hung up and two got tangled up. Andrew was the winner with a flight of 4:02.

* New site record

RESULTS

A-6 (8)

1. Ed Berray 5:18
2. Chris Borland 4:56
3. Michael Altig 4:17

OPEN SCIENCE OLYMPIAD (7)

Andrew Tagliafico 4:31
Chris Borland 4:29
Michael Altig 4:07

JR SCIENCE OLYMPIAD (2)

Rebekah Altig 3:30
Caity Gilbert 2:24

LIMITED PENNYPLANE (6)

1. John Lenderman 3:39
2. Chris Borland 3:37
3. Michael Altig 2:45

NOON MASS LAUNCH SO (6)

Andrew Tagliafico 4:02
Rebekah Altig 3:02
Dick Trethway 1:30

MINI-STICK (5)

Andrew Tagliafico 8:43
Ed Berray 6:59
David Bufford 6:53

EZB (1/4 MOTOR) (5)

1. Ed Berray 6:21
2. Andrew Tagliafico 6:01
3. John Lenderman 5:54

CATAPULT GLIDER (3)

Ed Berray 74.89
Bob Stalick 66.29
Chris Borland 54.12

PEANUT SCALE (2)

George Gilbert :46.8

BALLOON LAUNCH (1)

Wes Altig 1:08.4

1.2 EZB 1/4 MOTOR (3)

John Lenderman 5:35
Chris Borland 4:15

HAND LAUNCHED GLIDER (2)

Ed Berray 73.41
Bob Stalick 54.2

A-ROG (1)

1. John Lenderman 4:25

35 CM (5)

Kurt Schuler 15:21 *
John Lenderman 8:50

BOSTONIAN (2)

John Lenderman 1:37

INDOOR TOWLINE (1)

1. Chris Borland :50.77

MAGNIFICENT MOUNTAIN MEN - "PIKES PEAK CEILING CLIMB"

Cat II National Cup Challenge &F1D Regional Qualifier   24-25 March, 2007

HLG

1st	Rob Romash	37.5+34.7	72.2
2nd	Bill Gowen	35.9+33.1	69.0
3rd	Don DeLoach	34.3+32.8	67.1
4th	Todd Reynolds	33.8+32.3	66.1
5th	Bob Miller	33.7+31.2	64.9
6th	Mark Covington	32.8+30.0	62.8
7th	Randy Reynolds	27.5+27.4	54.9
8th	Roland Solomon	24.7+24.2	48.9
9th	Neil Myers	22.9+20.5	43.4

Standard Catapult

1st	Bill Gowen	38.0+38.6	76.6*
2nd	Bob Miller	35.9+34.2	70.1
3rd	Rob Romash	34.3+34.1	68.4
4th	Todd Reynolds	27.2+26.8	54.0
5th	Mark Covington	25.7+25.1	50.8
6th	Don DeLoach	25.0+24.5	49.5

Unlimited Catapult

1st	Bill Gowen	42.3+42.4	84.7*
2nd	Mark Covington	36.0+35.8	71.8
3rd	Bob Miller	35.5+35.2	70.7
4th	Rob Romash	35.1+35.2	70.3
5th	Roland Solomon	30.5+28.9	59.4
6th	Todd Reynolds	29.5+24.5	54.0
7th	Don DeLoach	26.1+25.7	51.8
8th	Randy Reynolds	15.7+0	15.7

Unlimited Catapult –Junior

1st	Demetri Collins	6.6+8.0	14.6
2nd	Jamie Collins	5.3+5.1	10.4

Limited Pennyplane

1st	Rob Romash	8:15
2nd	Jerry Murphy	7:07
3rd	Bill Gowen	6:59
4th	Tom Sova	6:57
5th	Pete Steinmeyer	6:02
6th	Frank Deis	5:48
7th	Bill Leppard	2:09
8th	Chuck Etherington	0:07

Pennyplane/F1M Combo

1st	Bill Leppard	PP	9:40
2nd	Don DeLoach	PP	8:29
3rd	Pete Steinmeyer	PP	6:13
4th	Frank DeisPP		4:25

F1L

1st	R. Romash	11:22+11:06	22:28*
2nd	Tom Sova	11:11+10.53	22:04
3rd	Bill Gowen	11:18+9:40	20:58

F1D

1st	John Kagan	21:43+21:18	43:01*
2nd	Tom Sova	19:34+18:31	38:05
3rd	Bill Leppard	17:53+16:37	34:30
4th	Steve Smith	13:32+11:41	25:13
DNF	Eric Monda		

A-6

1st	Bill Gowen	5:16
2nd	Bill Leppard	5:15
3rd	Don DeLoach	5:05
4th	Tom Sova	5:01
5th	Neil Myers	3:57
6th	Jerry Murphy	1:57

Ministick

1st	Tom Sova	8:21*
2nd	Rob Romash	8:15
3rd	Bill Leppard	6:21
4th	Don DeLoach	6:19

FAC No-Cal Scale

1st	Don DeLoach	Farman	2:28
2nd	Bill Leppard	Spitfire	2:03
3rd	Jerry Murphy	Corsair	0:21
	Don DeLoach	Judy	1:37

FAC WWII No-Cal Mass Launch

		Heat 1	Heat 2
Don DeLoach	Judy		x
Rolf Christopherson	P-51	x	
Jerry Murphy	Corsair	x (3rd)	
Bill Leppard	Spitfire		WINNER

Intermediate Stick

1st	Bill Leppard	16:52*

Easy B

1st	Rob Romash	12:21

35CM

1st	John Kagan	12:49

P-24

1st	Chuck Etheringtion	2:14
2nd	Roland Solomon	1:33

*denotes site record

East Coast Indoor Modelers Contest

Lakehurst, June 30 & July 1

When we arrived Saturday morning the door was open and not scheduled to close until 2:30PM. There are a lot of large containers scattered through out the hanger which are being removed or added on a daily basis.

Bill Gowen set up a world record sanction for his F1M and didn't waste any time on his assault on the existing record of 20:25. After a number of short motor flights, and processing his model, Bill put up his first flight and it landed at 20:27, with a lot of turns left, but had three seconds of prop stop. He made a few adjustments to his variable pitch prop to use up the turns and the model climbed almost to the ceiling and there was no doubt that the record was his, with a great flight of 21:49.

Jeff Hood, Max Zaluska, Buzz Buzzoli and Larry Coslick had their EZB's out and most of the flights were made on half motors. Jeff had a few half motor flights of around 15:00 on Saturday but wound up with 25:19 on Sunday with a full motor. Ray Harlan built his first sub four hundred mg EZB which flew right out of the box. During the Sunday session Ray had a flight which was scrubbing the ceiling and he elected to balloon the model down at 14:00 instead of possibly hanging it up in the girders. Max took his eyes off of his winning 2007 USIC EZB for a few minutes and lost it somewhere in the hanger. Larry Coslick had a nice flight of 35:01 with a .33gm EZB.

Day two was a repeat of day one and we had to wait until 1:30PM. for the door to be closed. Bill Gowen was trying to establish a new AMA F1L record but fell short by 24 seconds. Larry added some time to his existing ROG Stick record and posted a flight of 25:22 but hung it up in the ceiling on his next flight. Larry brought his Manhattan Cabin model along in hopes of beating the old record of 15:17. On the first attempt he uses an old motor that was used at the 2000 USIC and did 14:45 but blew that motor on the second wind. A blast tube saved the model and with a new motor and more torque, the model climbed near the ceiling a landed at 16:23.

Max was preparing for the F1D team selection and had two good flights of 33 and 34 minuets with his immaculate F1D. Even with the shortened days, it's a great place to fly.

F1M

Bill Gowen 21:49
(World record)

F1L

Bill Gowen 25:26, 24:57

F1D

Max Zaluska 33:01 34:00

Hand Launch Stick

Tony D'Alesandro 34:05

Autogiro

Tony D'Alesandro 17:36

LPP

Carl Von Bueren	12:04
Tony D'Alesandro	11:38
Buzz Buzzoli	8:00+

EZB

Larry Coslick	35:01
Jeff Hood	25:19
Ray Harlan	14:00
Buzz Buzzoli	7:00+

ROG Stick

Larry Coslick 25:22

Manhattan

Larry Coslick 16:23