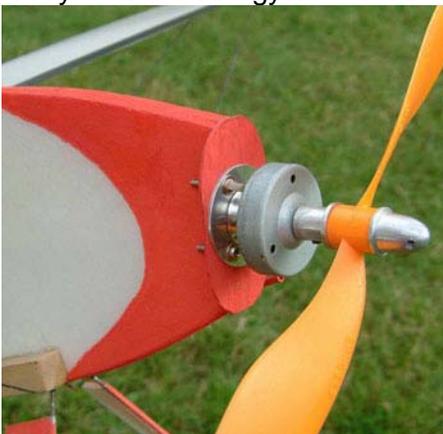




The fruits of 'cereal packet doodling' – Twirl's design owes much to the DB autogyro, a ,70s child.

I first became interested in model autogyros after reading a very interesting article in Peter Russell's 'Straight & Level' column here in RCM&E way back in the '70s. The models featured had a stub wing with two, 4-blade rotors made of balsa mounted at the ends of the wing, and the fuselage was of conventional design with a T-tail. If I recall correctly, control was single channel 'bang-bang' on rudder only. Shortly after the article appeared, David Boddington produced his DB autogyro kit (which was designed for 3-channel radio operating rudder, elevator and throttle) with the same rotor configuration, and I was very fortunate to obtain an early example in 1973. I've had endless hours of pleasure from this model, which is still flying today. The DB autogyro kit



Designed for outrunners up to about 50W, Al powered the prototype using the motor from a PC's CD ROM drive.

WANT TO TRY SOMETHING DIFFERENT? GIVE AL FOOT'S ELECTRIC AUTOGYRO A WHIRL - YOU'LL HAVE IT BUILT IN A JIFFY



Straight forward to build, flexible and quite rugged, Twirl is definitely a break from the norm' and good fun to boot!

incidentally, still available from DB Sport & scale on tel. 01348 811293.

Compared to other autogyro models that emulate the full-size practice of using a single rotor for lift, the twin rotor offers a number of rather significant advantages:

- The rotors are very easy to construct, with no special hinging required at the hub.
- There are no complicated linkages to the rotor head.
- They're easy to repair or replace using readily available material, and without breaking the bank.

The configuration is very tolerant of failures - the loss of a rotor blade for example, doesn't result in disaster, although the model certainly wobbles a lot due to the out-of-balance forces!

With the advent of lightweight and relatively cheap airborne

radio equipment and equally cheap electric motors, I desired to build a small-ish autogyro using Depron as the main material, with a target weight close to the 7oz (200g) mark. The propulsion system was to be home-made using the motor from a CD-ROM drive, with a 3s1p 700mAh Li-Po battery as the power source.

CEREAL DOODLING

After a few hours of doodling on the back of cereal packets, Twirl was born. Just like its bigger brother it has a stub wing with the rotors mounted at the tips. I decided to leave the fuselage as a flat plate profile both to save weight and to give the machine a rounded look. The secret of success in model autogyros is to get the key angles right, these being the pitch of the rotor blades, the tilt angle of the rotors relative to the wing, the wing and tailplane incidence, dihedral and down-thrust... you'll be pleased to know

that these have been built into the design. So without further ado, lei's get on and build one!

FUSELAGE

Cut out the fuselage and rudder from 3mm Depron and sand a 45° chamfer on the leading edge of the rudder. If, like me, your Depron sheets are shorter than the fuselage length, make a butt joint at the front end, bearing in mind that the fuselage has 3mm doublers on each side of the nose area. At the rear of the fuselage cut out the slot for the tailplane and the triangular area to allow the elevator to deflect. Next, fashion the right-hand front fuselage doubler and glue this to the right side of the main fuselage using UHU Por glue, ensuring that the assembly remains flat whilst the glue dries. The 3mm x 3mm right tailplane seat can also be added at this stage. When dry, turn the fuselage over and glue the left front fuselage doubler in place. To keep the fuselage flat when this doubler is glued, lay the right-hand side of the fuselage on a flat surface, with some scrap pieces of 3mm Depron placed beneath and along the length of the fuselage aft of the doubler. The 3mm fuselage strengthening dowel can also be glued in place at this stage, along with the left 3mm x 3mm tailplane seat.

TAILPLANE AND ELEVATOR

This is simply made from 3mm Depron. Cut off the tailplane tips and the elevator, then sand the tips to a

45° chamfer, but don't glue them back yet. Also, while you're in sanding mode, put a 45° chamfer on the leading edge of the elevator, then top-hinge it to the tailplane using adhesive tape. By the way, I used 'proper' modelling hinge tape here, applied as follows:

Lay the tailplane on a flat surface (workbench), top side up,

with the trailing edge hanging over the edge of the bench. Lay the elevator upside-down on top of the tailplane so that the 45° chamfer line is directly over the trailing edge. Cut two pieces of tape and apply them close to each tip of the elevator, at 90° to the hinge line and around the bottom of the tailplane. You should now be able to pivot the elevator on these two hinges to the fully down position, and then apply adhesive tape along the length of the joint to form the top hinge. What's needed is a free moving pivot that has no resistance or binding. Okay then, glue the tips to the ends and the tail's done.

to make the joint. Allow to dry thoroughly.

ROTOR AND PYLON

Having made the rotor blades from 3mm Depron, cut some printer / photocopy paper into eight 20mm widths that span the length of the blades. The paper, once glued to the leading edge of each blade, forms the spar. To apply, moisten and glue symmetrically around one edge of each Depron piece. PVA white glue is ideal for this. Allow to dry thoroughly overnight, ensuring that the blades remain flat in the process. Next, cutout the 50mm diameter rotor discs and a 16mm



There's a choice to be made during finals – a normal 'fixed-wing' landing or a slow, steep approach and arrive vertically!

WINGS

These are also cut from Depron, with 3mm x 1mm carbon leading and trailing edges glued (using UHU Por) from the root to where the rotor pylon fits. When the glue's dry, sand the roots to the correct angle, lay one wing on a flat surface and raise the tip of the other panel to achieve the desired dihedral angle. Glue the wings together with your favourite epoxy, using as little as possible

square of 8mm thick balsa to form the centre of the rotor, Drill a central hole in the discs and rotor center to take the brass bearing tube, ensuring that it's square.

To make a rotor, add the square of balsa to the centre of a Depron circle and allow to dry. Blade pitch is achieved by simply overlapping each Depron strip, before butting it against each face of the balsa. Incidentally, you'll need to 'feed' the last blade in, though this will become strikingly obvious when you eventually get

to that point. The leading edge of the blade (with the paper reinforcement) should be closest to the building board. Once happy, glue the blades and the top Depron circle and weigh down, checking that the central hole is vertical. Make the other rotor in exactly the same way, but note that the overlap of the blades must be in the opposite direction to the first rotor (one rotor will rotate clockwise, the other anti-clockwise).



The wheels are nothing more exotic than a pair of plastic milk bottle caps – light weight and effective!

The rotor bearings are cut from 2mm internal diameter brass tube (slightly longer than the completed hub thickness so that they protrude either side), and are glued into the holes previously drilled in the centre of the rotor disk. As for the pylons, these are cut from Depron (surprise, surprise) with the rotor axles from 2mm carbon rod, sufficiently long to allow for a bush above and below the hub. Glue and tape said axles securely to the front of the rotor pylons.



Take-off from short grass is easy, though Twirl is just as happy getting away from a hand-launch.



A slave to 3mm Depron, Twirl's flat plate profile goes a long way in providing a light all-up weight of around 7oz (200g).

UNDERCARRIAGE

Bend the 1mm dia. (16swg) wire to the undercarriage shape shown on the small exploded drawing (see plan). Cut and drill the undercarriage blocks from balsa and glue the wire into them. Whilst I used plastic milk bottle tops for wheels, you can, of course, choose your own.

FINAL ASSEMBLY

Glue the wings to the fuselage, ensuring that the fit is nice and square. Add the tailplane - again ensuring that everything's true - then the small 3mm Depron 'filler piece' behind. Hinge the rudder to the fin using adhesive tape, as before. Glue the undercarriage and wing strut balsa blocks to the fuselage sides (with foam-friendly cyano'), after which you can attach the rotor pylons to the wings and brace with triangular section balsa on the inner face.

Nearly there now. Continue the assembly by drilling the wing strut blocks and rotor pylons / triangular balsa, then cyano' the 1mm struts position, ensuring that

the wings remain correctly aligned. Tie a double strand of thread to the top of each wire undercarriage leg and through the leading edge at the bottom of each rotor pylon. The thread should be taut, but not stretched. Tip: you can strengthen the thread by soaking with cyano'

Okay, glue the engine mount to front of the fuselage and strap on motor using your favourite method. Slide the rotors onto the rotor pylon axles, noting that if they squeak when rotated (as mine did), you'll need to rub the carbon axle with a pencil, taking care to avoid the uppermost part where the retaining bush will be glued. This will lubricate the axle and stop the squeaking. I prefer the left rotor to be the one that rotates clockwise and the right one to rotate anti-clockwise as seen from above, but I've flown Twirl with the rotors the other way around as well, with no problems whatsoever. When happy, fix the rotor retaining bushes above the hub.

Plan the radio installation and battery retainer to obtain the correct C of G (without ballast, then fashion some control horns



Rudder and elevator leading edges are chamfered at 45° prior to being top-hinged.

from 1mm ply, and glue them into slots cut in the elevator and rudder. To finish, make up the control rods and connect the servos to the horns.

DEPRON

Not sure where to get Depron? Fear not, Norfolk-based manufacturer SLEC can provide sheets of up to a meter long and in various thicknesses. Visit SLEC's website at www.slecuk.com or call 01953 885279.

GIVE US A TWIRL

If you can fly a 3-channel trainer, then you should have no problems with Twirl. Take-off from

short grass is no problem, but she can also be hand-launched if need be. I've flown mine in winds up to 15mph but it's most enjoyable to fly in a light breeze, where its full potential can be realized. Although I haven't yet done so, I reckon Twirl could also be flown indoors in a suitably large hall. Of course, one of the great things about autogyros is that they're impossible to stall in the conventional sense, so you can have fun pulling the nose up higher and higher, which causes the rotors to rotate faster and faster. Play with the throttle and elevator and you can have Twirl in a nose-high hover into wind, or do

very tight turns. With sufficient power it's possible to climb Twirl vertically at a very slow speed so that the rotors actually stop, before pulling over the top of a loop whereupon the rotors spin up again.

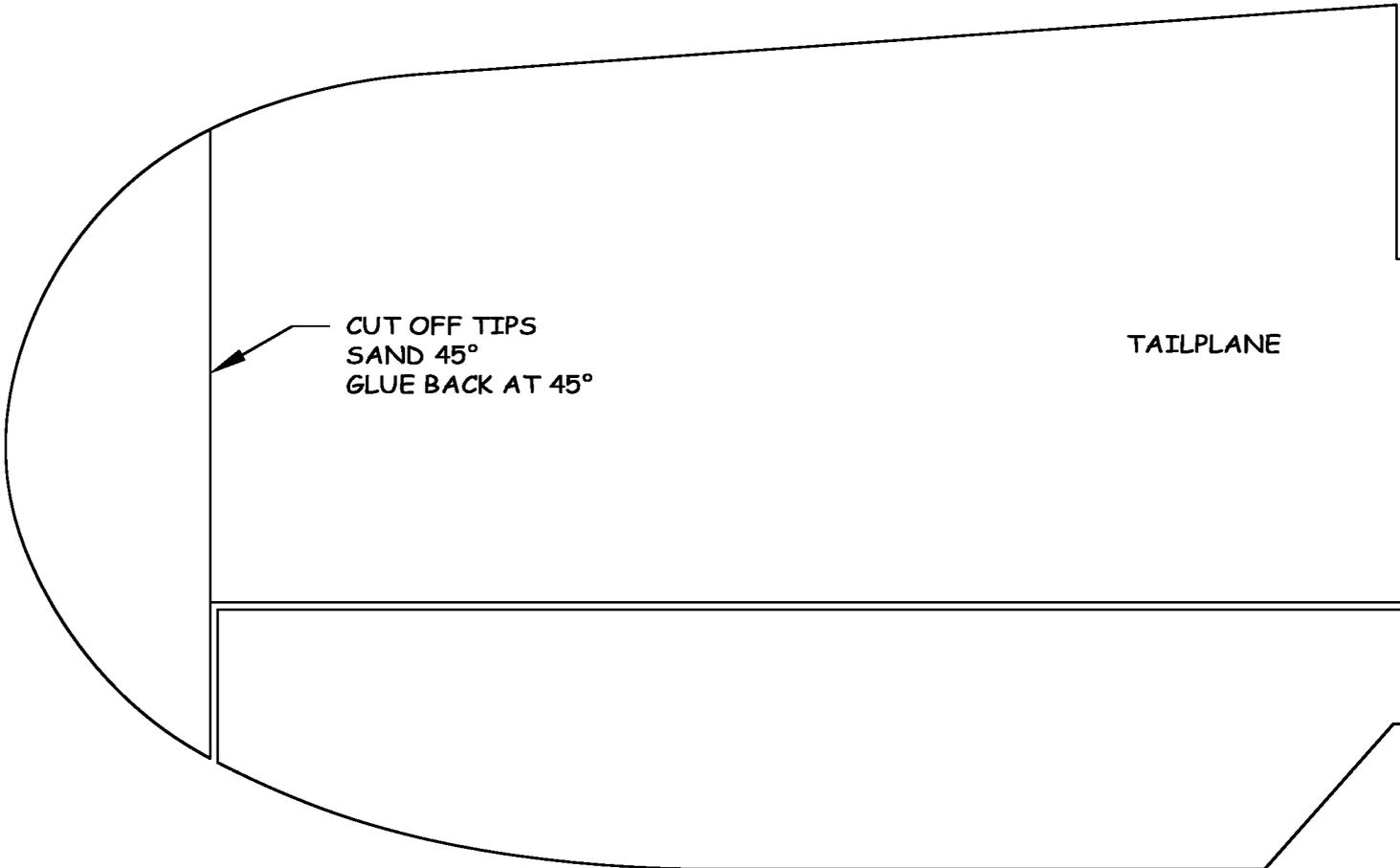
In flight the model is quite Flexible, and has proved to be adequately rugged. Mind you, be aware that it's no aerobatic ship, is best enjoyed doing the things that ordinary aircraft can't. Of course, 'normal' landings can be made or, with appropriate use of power and elevator, you can do slow, steep approaches to arrive almost vertically. However you fly your Twirl, have fun!



The twin rotor design offers a number of advantages compared to a single rotor. Easy to build, easy to repair, with no complicated linkages to the rotor head.

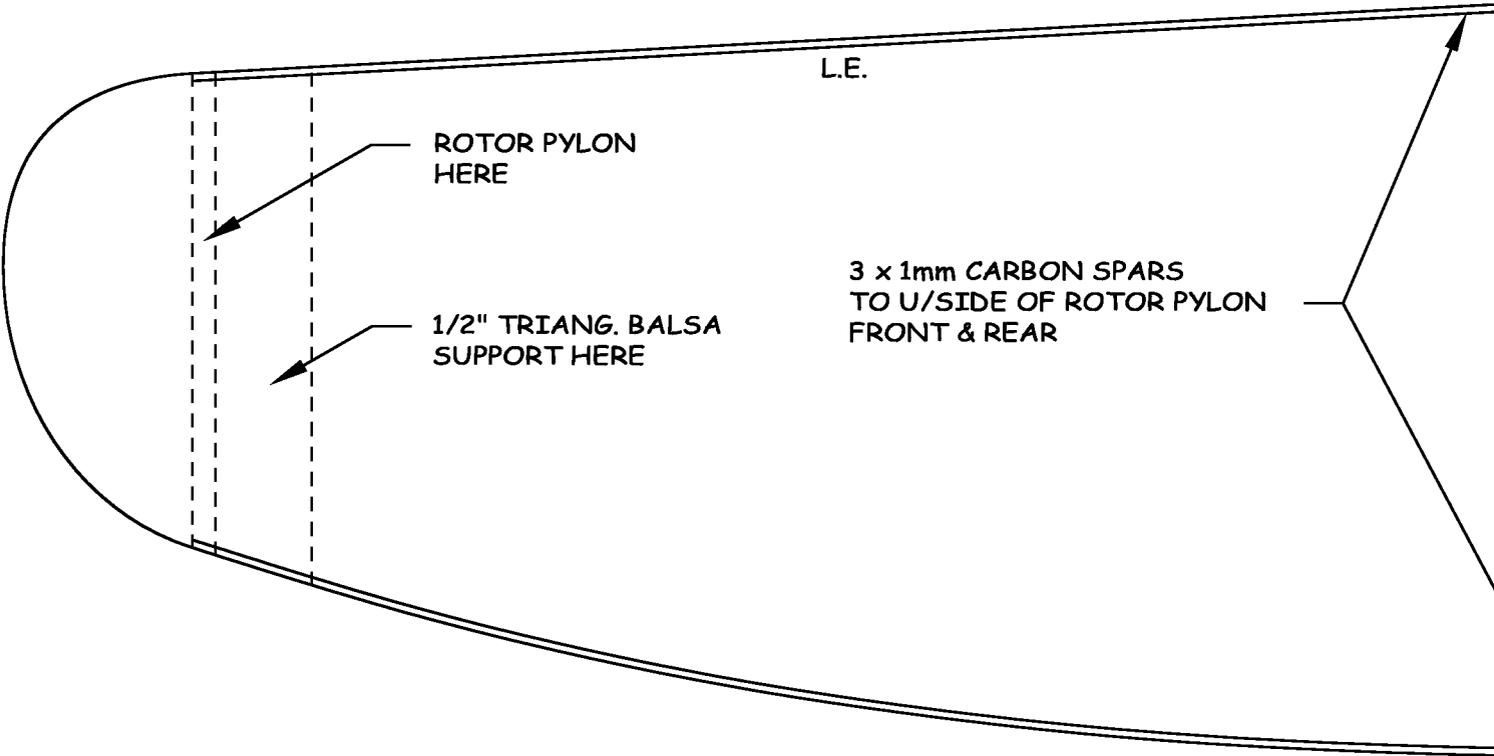
DATA FILE

Name:	Twirl	Tailplane incidence:	0°
Model type:	Twin rotor electric autogyro	Rotor blade angle:	Approximately -8° [self-jigging]
Wingspan:	19" (483mm)	Rotor tilt angle:	5° aft
Overall span:	30" (762mm) rotor tip to rotor tip	Weight:	7 - 9oz (200 - 255g)
Rotor diameter:	14 1/2" (368mm)	Wing loading:	3 - 4oz / sq. ft. (0.91 - 1.22kg/sq. m.)
Fuselage length:	26" (660mm)	Rudder movement:	1" (25mm) each way
Stub wing area:	64sq. in. (0.04sq. m.)	Elevator movement:	1" (25mm) each way
Swept rotor area:	353sq. in. (0.23sq. m.)	C of G:	50% chord at rotor posts
Wing section:	Flat plate	Motor:	Outrunner up to about 50 Watts
Rotor blade section:	Flat plate	Down- / side-thrust:	5° (built in) / 0°
Tail and fin section:	Flat plate	Propeller:	GWS 8 x 4.3"
Wing incidence:	2.5°	Battery:	3s1p 700mAh Li-Po



CUT OFF TIPS
SAND 45°
GLUE BACK AT 45°

TAILPLANE

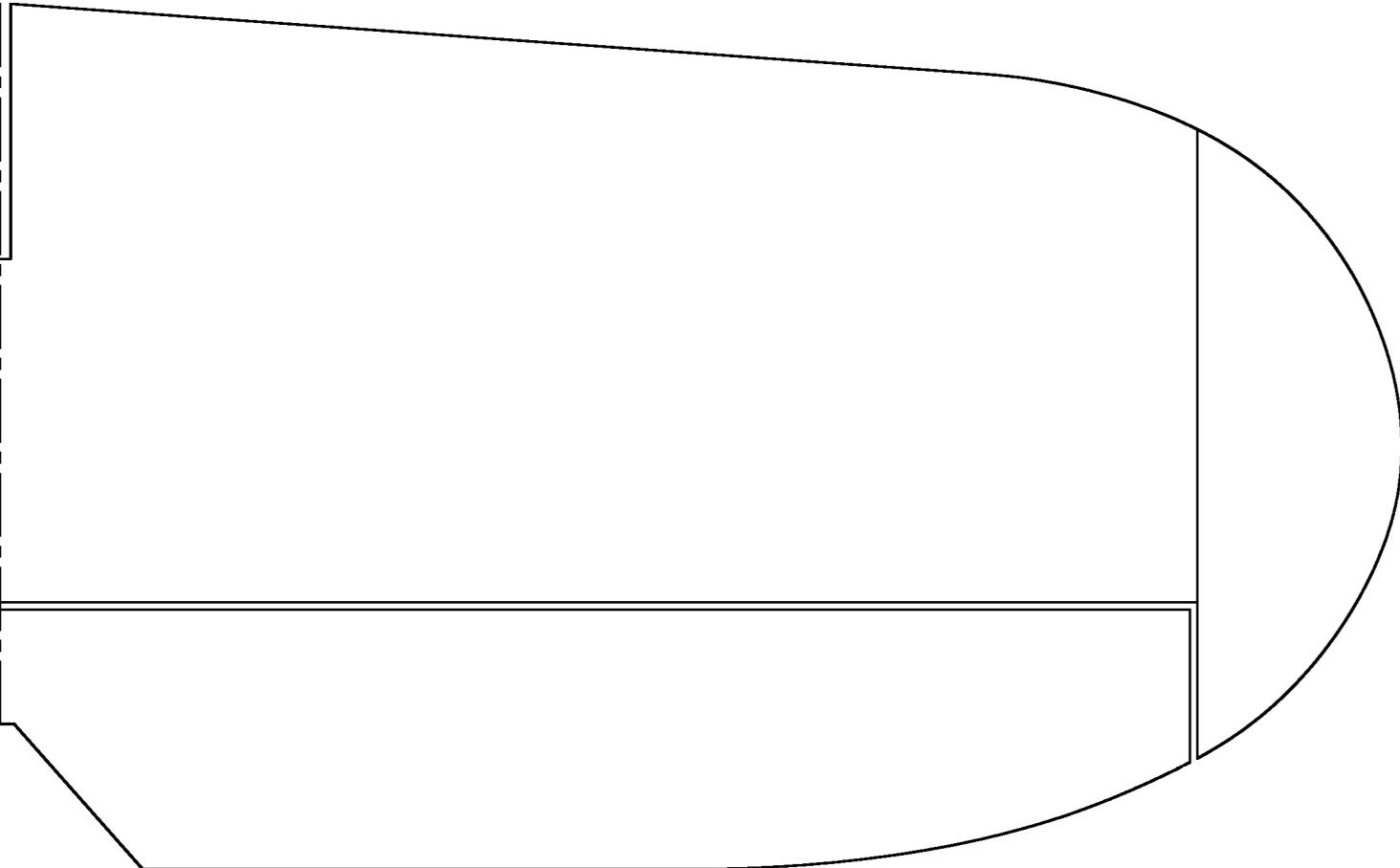


L.E.

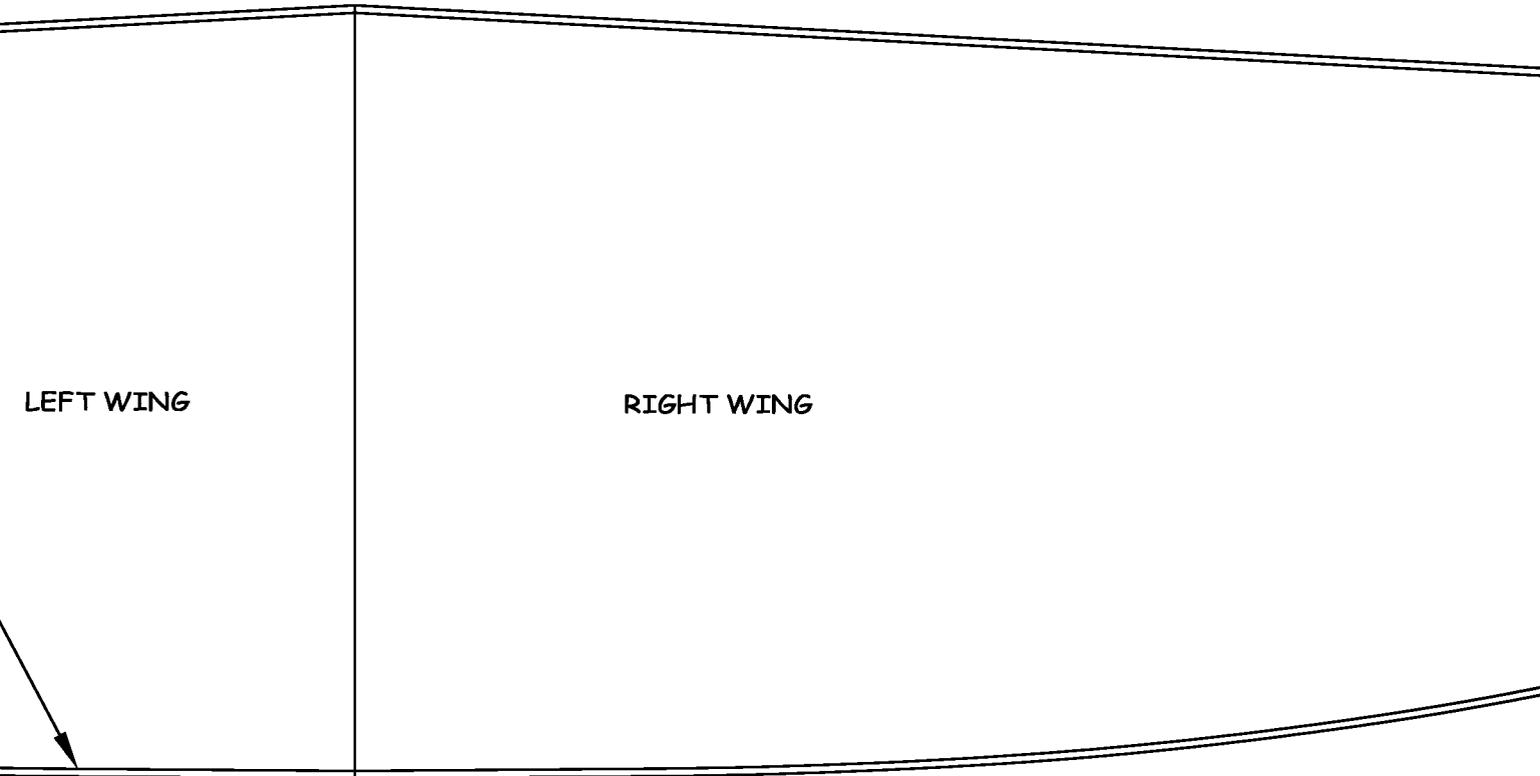
ROTOR PYLON
HERE

1/2" TRIANG. Balsa
SUPPORT HERE

3 x 1mm CARBON SPARS
TO U/SIDE OF ROTOR PYLON
FRONT & REAR



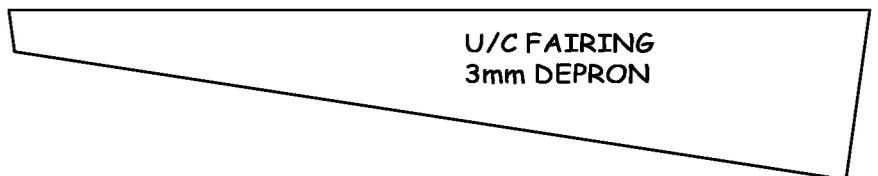
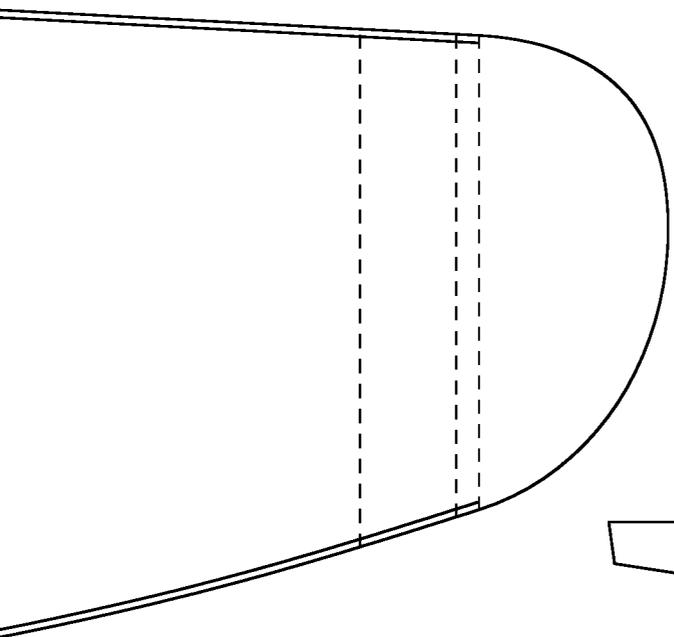
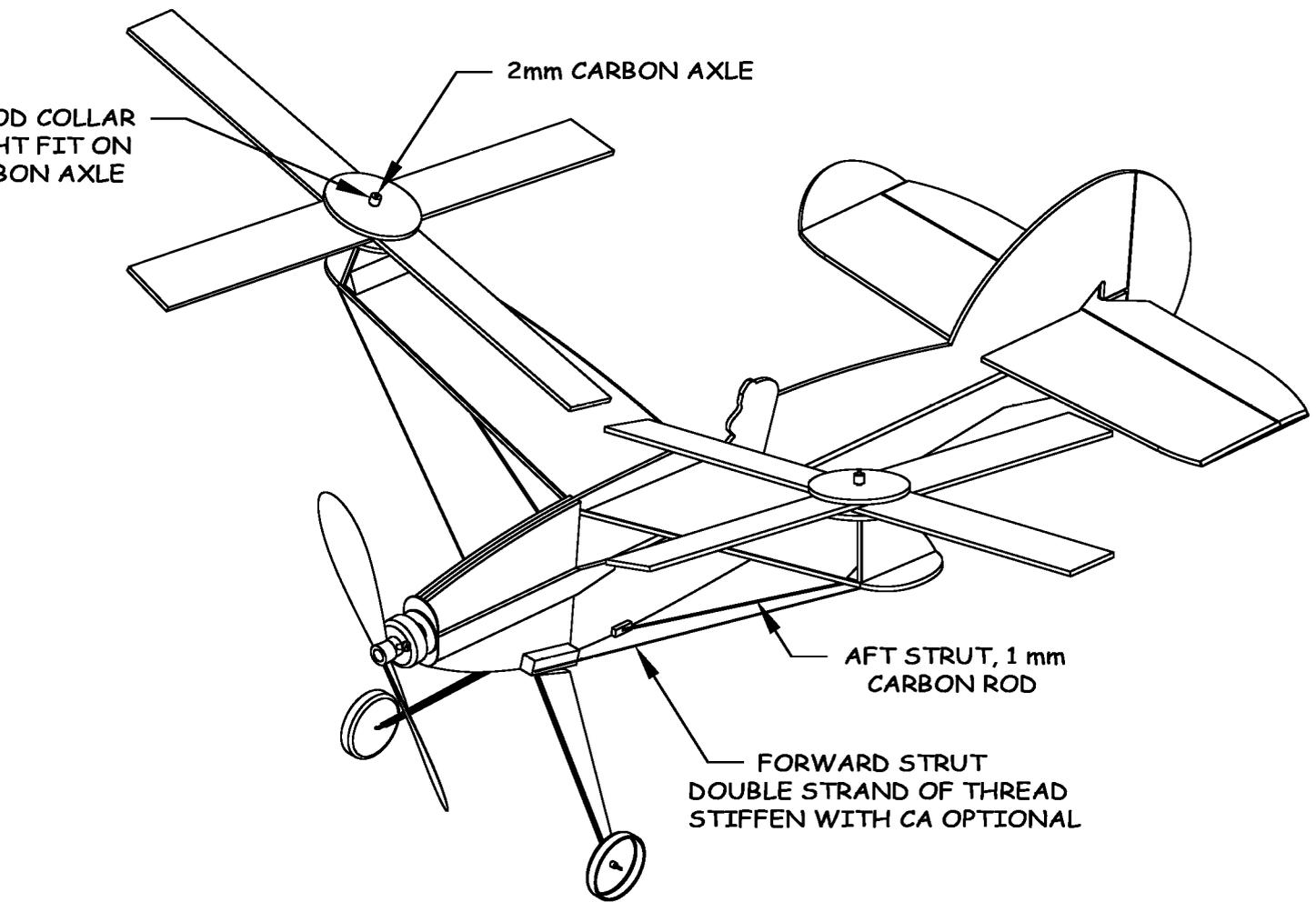
WOOD
TIGHT
CARE

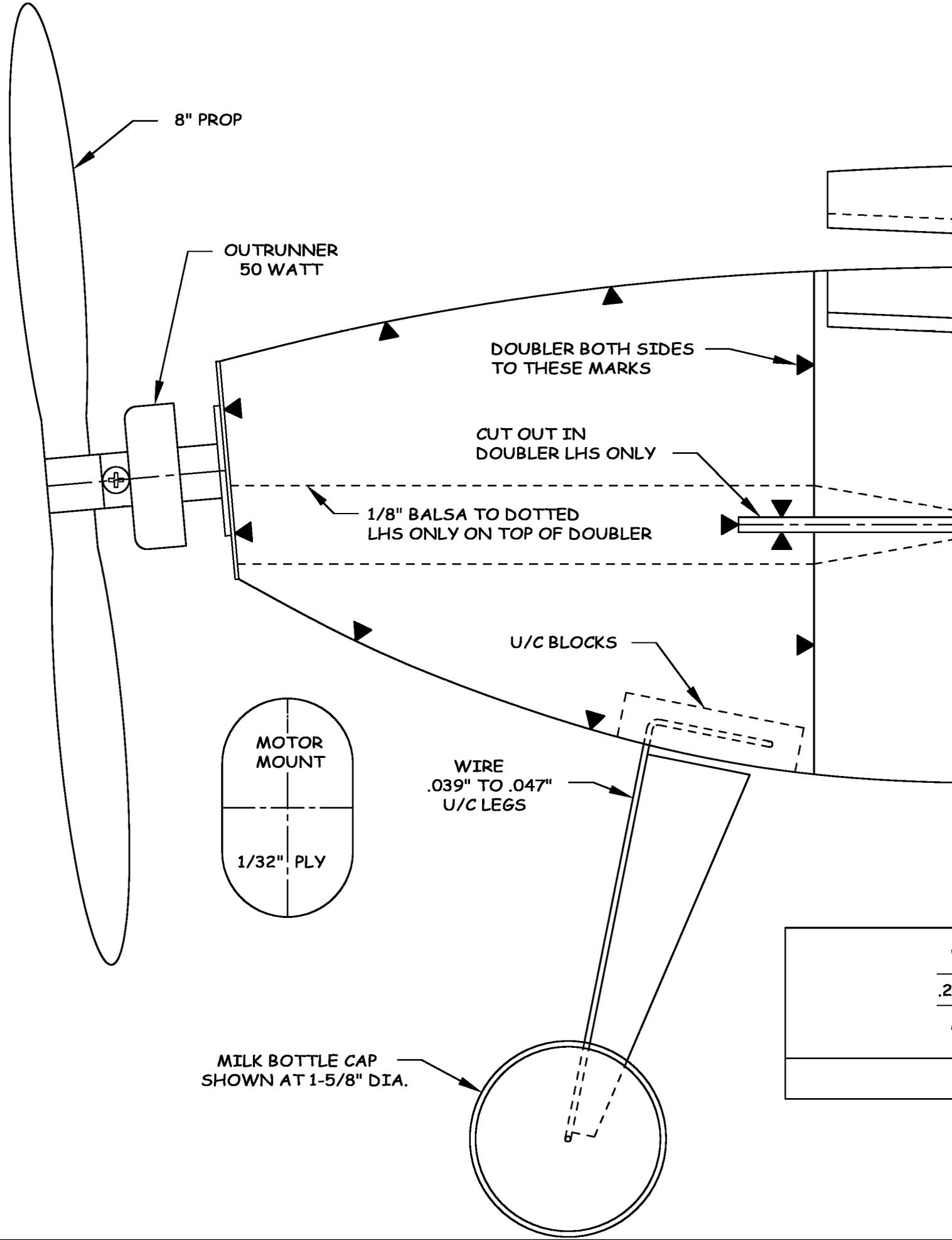


LEFT WING

RIGHT WING

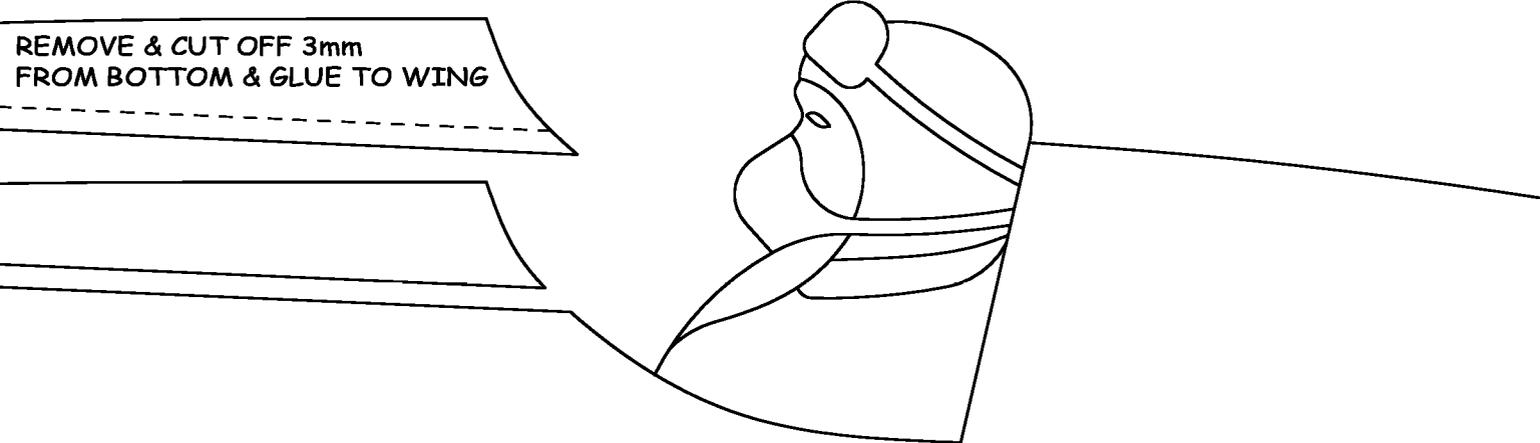




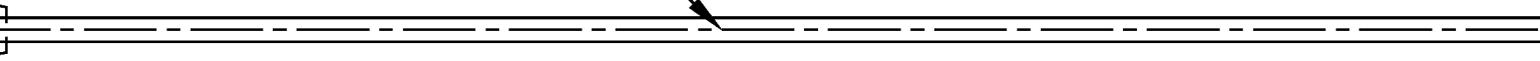


.2

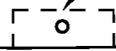
REMOVE & CUT OFF 3mm
FROM BOTTOM & GLUE TO WING



C/L OF 1/8" DOWEL
LHS ONLY

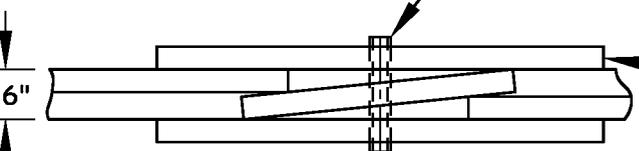


SMALL BLOCK Balsa
FOR WING STRUT

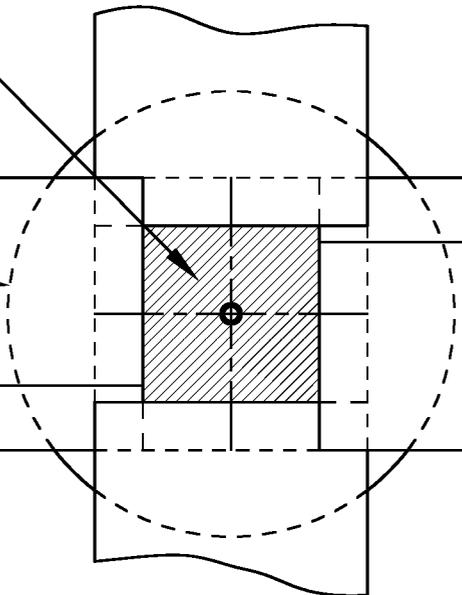


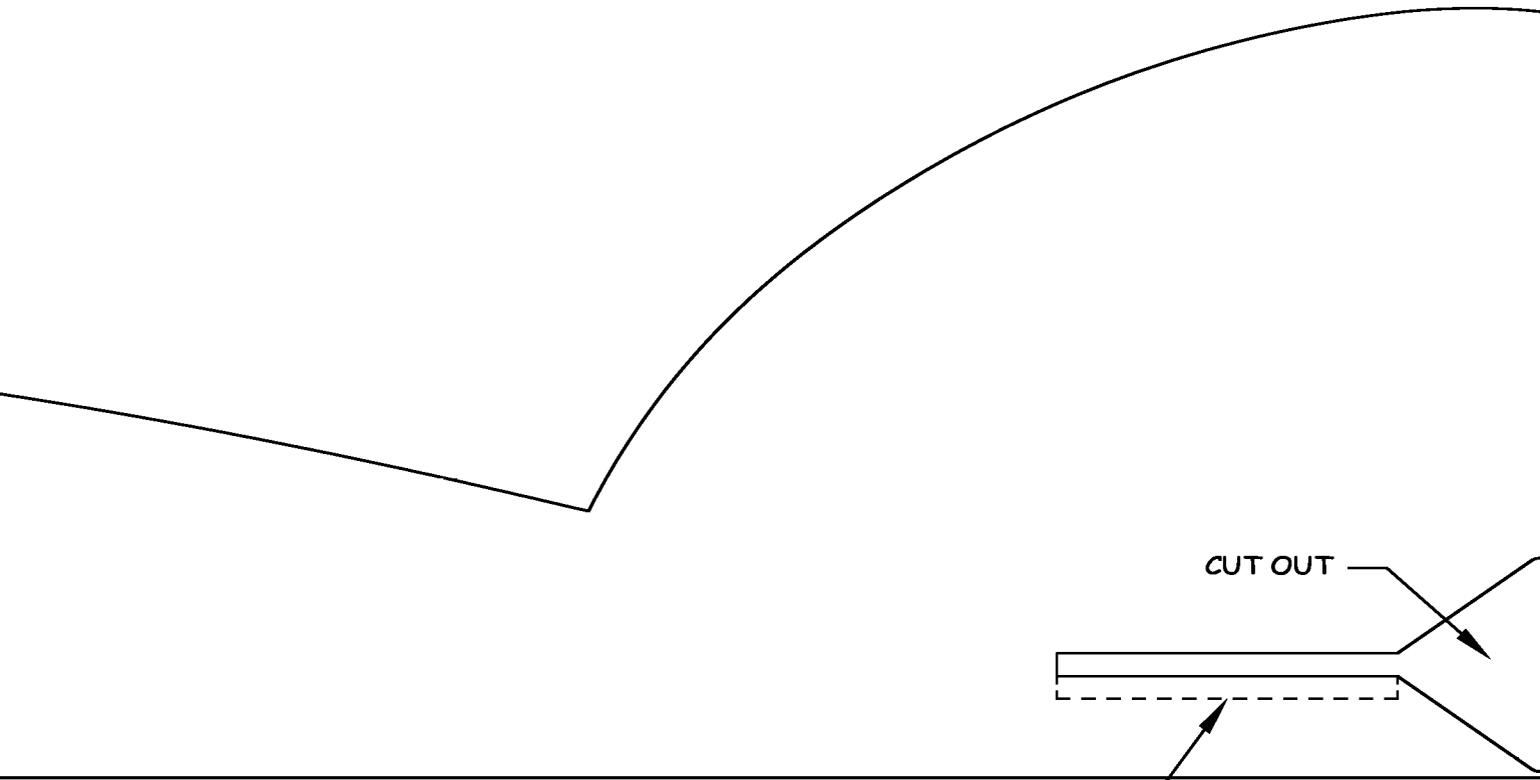
SUGGEST A .26" x .92" SQ. BLOCK
OF Balsa TO SUPPORT BRASS
TUBE & CONTROL BLADE INSERTION

2.1mm ID
BRASS TUBE



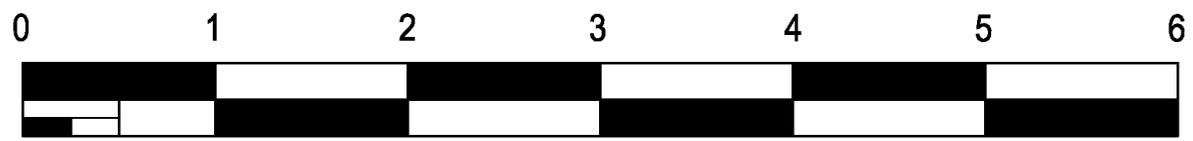
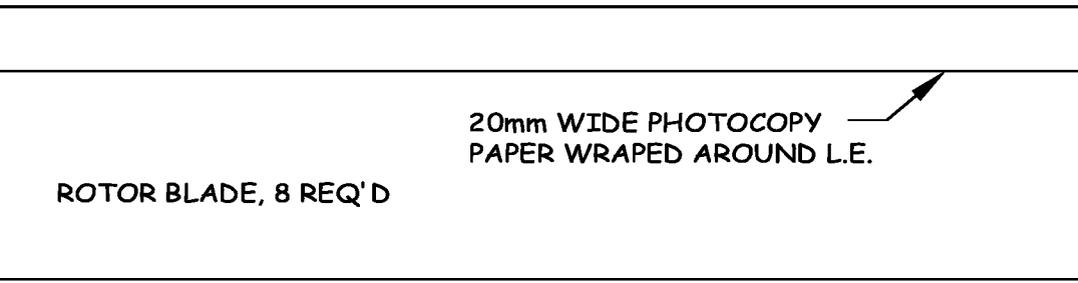
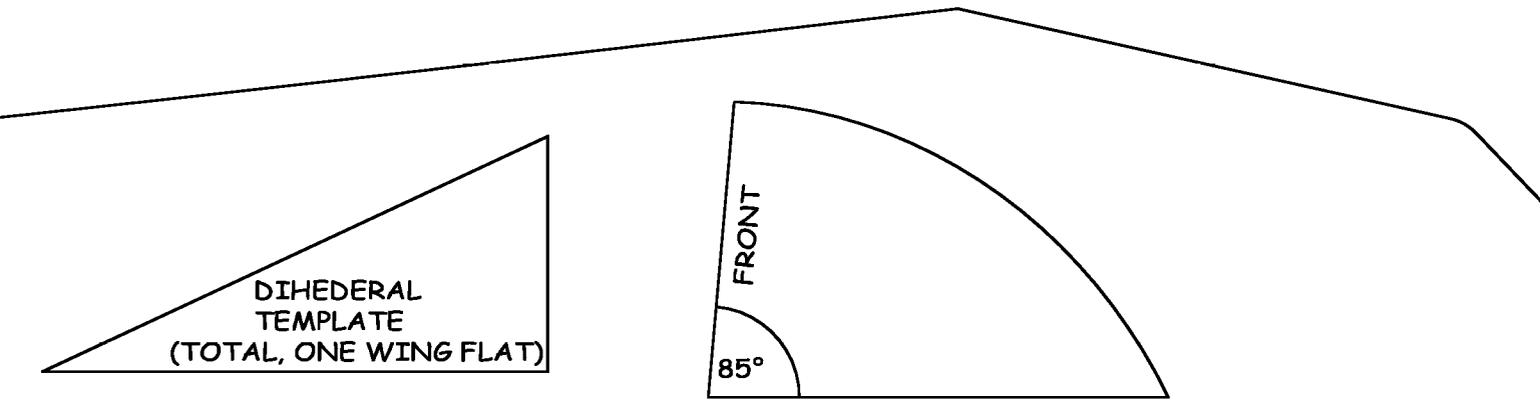
ABOUT 5.8° WITH .25" OVERLAP SHOWN



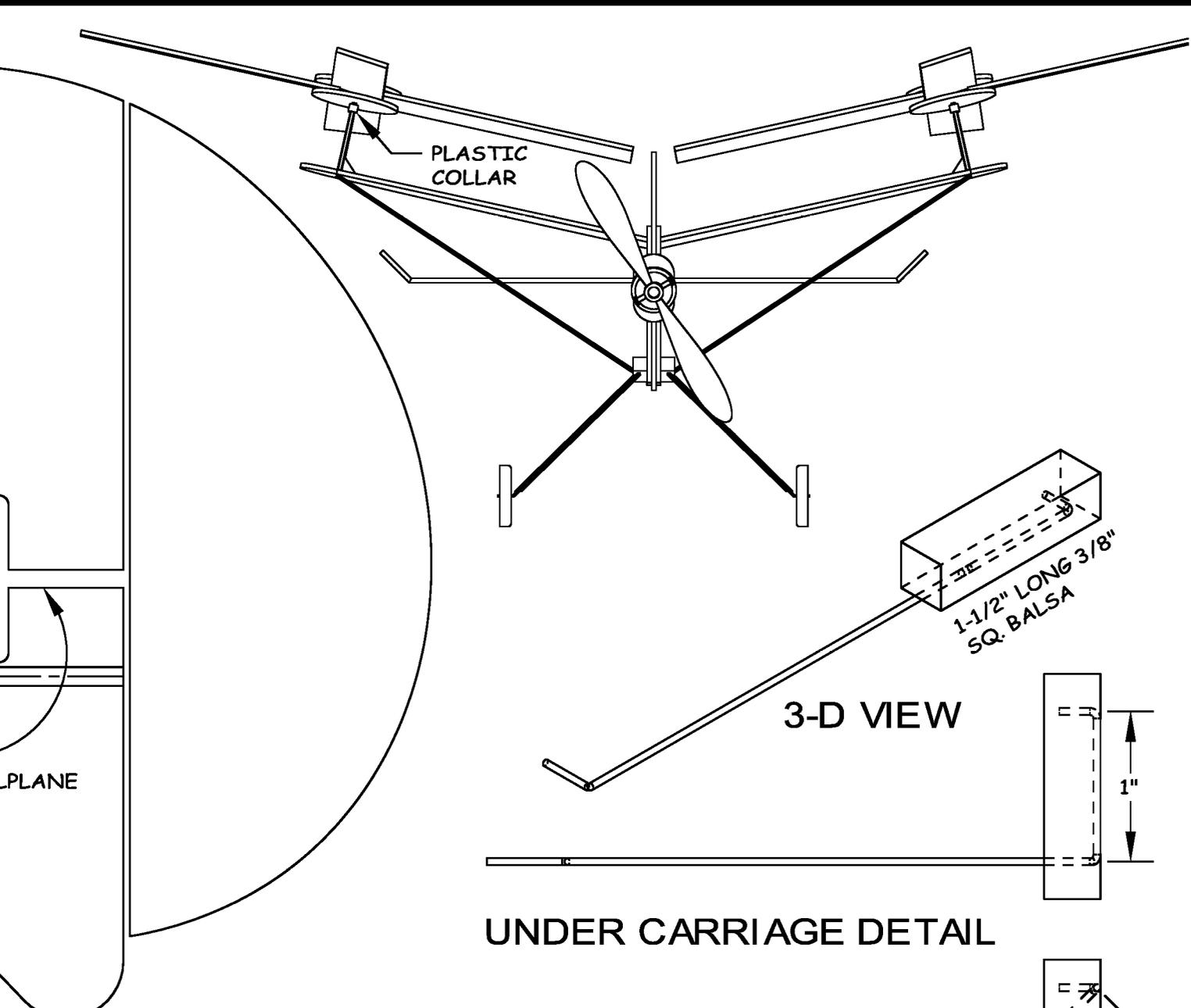


3mm SQ. DEPRON
BOTH SIDES

FILL IN WITH 3mm
AFTER INSTALLING TAIL



INCHES



IWIRL

ELECTRIC AUTOGYRO
DESIGNED BY AL FOOT

1" - DEPENDS
ON WHEELS
USED

