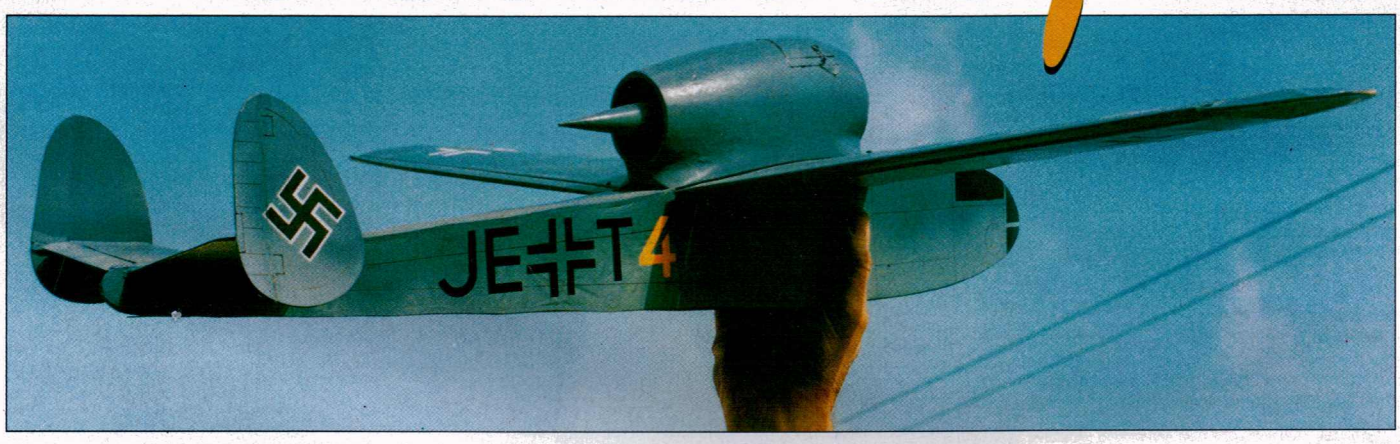
build from our full-size **PLANS**

Tecspecs

Name of model:	Jet 4
Type of model:	Semi-scale mini D/F
Designer:	Chris Golds
Wing span:	36"
All-up weight:	10.5 oz. wet
Wing loading:	7.5 oz. sq. ft.
Engine:	Cox TD .020
Fan:	2.1/4" dia. five blade home-made
No. of channels:	Two - ail, rud. (mini Rx and servos)
Construction:	Built-up balsa/ply with blue foam engine duct parts
Covering:	Tissue and dope

Here's another little gem from the drawing board of Chris Golds - try his Cox TD .020 ducted fan powered sports jet

small is beautiful



The birth of 'Jet 4' came about because of my desire to fly single Cox TD .020 (of which I have got quite a lot!) with my own design of ducted fan, with sufficient performance to allow some aerobatics. Furthermore, the design had to be simple and quick to build and use ordinary materials to produce a light airframe strong enough to withstand grass field flying.

I first tried to fly single Cox TD .020/DF in 1991 and produced a 'sort of' Heinkel He 162, with the duct on top of the fuselage. At launch the model weighed 14 ounces, with a wing loading of 15 ounces per square foot and was just capable of flying around at shoulder height in calm conditions - in other words it was a failure! From there I progressed to the twin Cox Javelin (RM May 1992) and so on through the four Cox Victor to the eight Cox B52 and YB49. But I still had not achieved my aim of flying single Cox ducted fan.

Recently, whilst waiting for dry weather to enable me to re-paint the outside of our home, I picked up a pencil and got trapped into doodling yet another try at single Cox DF. I based the shape on our very successful Henschel Hs 132 which flew throughout 1994 powered by David James' splendid Cobra gas turbine engine. I decided that the wing loading had to come down to - at most - a half of that of the first Cox model but that it should weigh less overall. In fact 'Jet 4' weighs just 10.5 ounces (including fuel!) and has a wing loading of 7.5 ounces per square foot and it flies with sufficient performance to be looped and rolled!

So let's get building

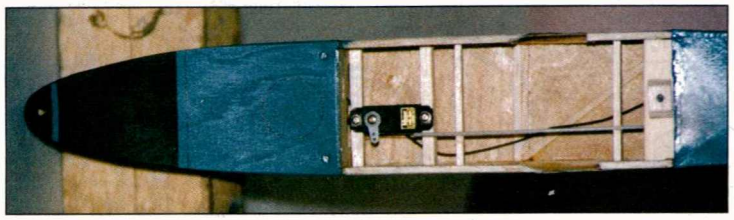
Start by protecting the plan with either candle wax rubbed in or cover it with cling film. Build the two fuselage sides in 1/8 square balsa directly over the plan using cyano as the adhesive. Separate the two halves and assemble them with bulkheads F3 and F4, ensuring that all is square. Add the other cross member and bulkheads fore and aft, ending up at the tail end. Add the .4mm ply doublers and the fuselage bottom. Next, add the built-up nose block, sensibly hollowed out. Sand the block to conform with the fuselage curvature and there is your fuselage!

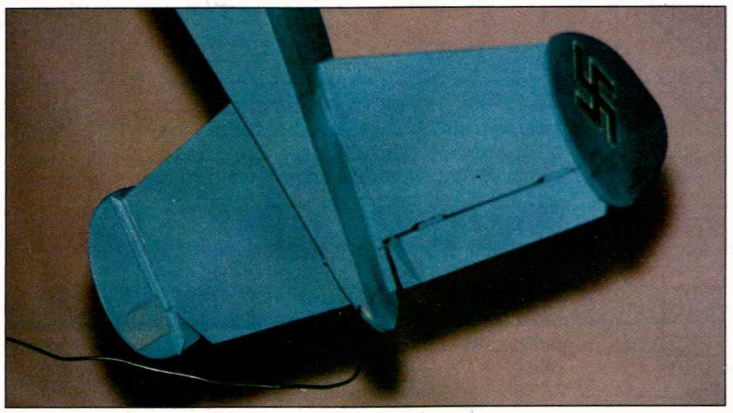
Cut and sand smooth the tailplane blanks from soft 3/32 sheet and the twin fins from *soft* 1/16 sheet. Cut off the elevator (left hand tailplane *only*) and sand round its leading edge. Fit the tailplane at the dihedral angle shown and add the very light fairing to continue the fuselage top line to the rear end. Fit the fins as shown.

The fuselage can now be papered (using lightweight tissue and tissue paste) leaving the bottom open at this stage. Water shrink the tissue then three coats of 50/50 clear dope and thinners will give you a smooth, tight, wrinkle-free finish.

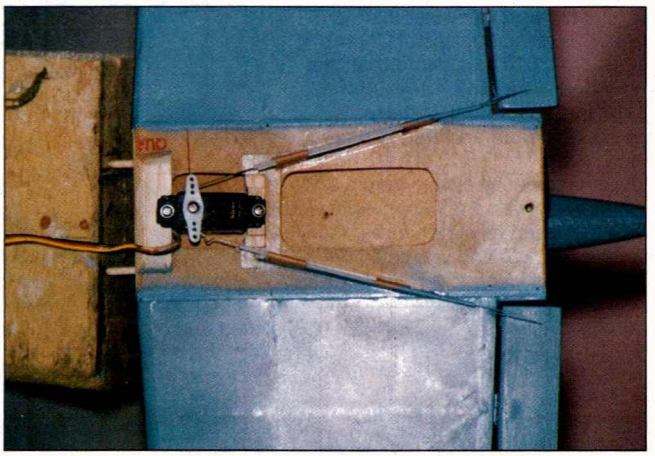
Now for the wings

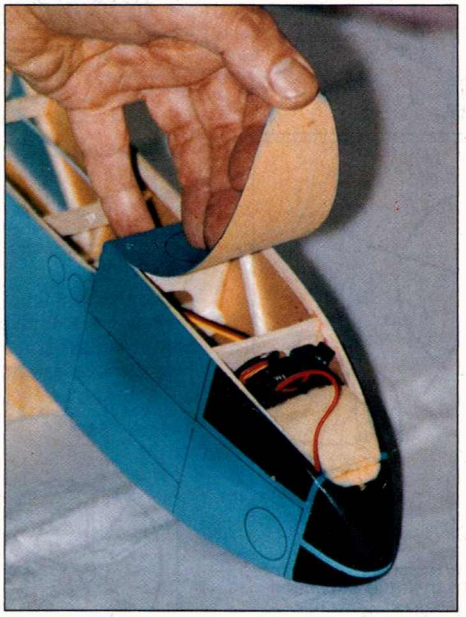
Now the most important part of any flying machine - the wings. Mark and cut the ribs and tips in soft 1/16 sheet. Assemble the tips. Lay on the wing half plan the 1/8





Below: Elevator servo on its soft 1/4" square balsa crossbars is located here at the front of the underwing compartment.





Above: And this is where Chris keeps the aileron servo inside the wing centre section. Note 1/8" wing location dowels in leading edge.

Left: The front hatch is simply thin ply held in position with small self-tap screws. There is no switch on this model, Chris just opens the hatch and plugs the battery into the Rx.

Above far left: The elevator on 'Jet 4' is confined to just one side of the 'V'-tail trailing edge.

square bottom spar and add the ribs. Pack up (as shown) the leading and trailing edges then cyano all together. Add the top spar and the tips (packed up) and cyano all. Repeat for the other half wing. Cut the dihedral brace from .4mm ply and, using a razor saw, cut down through ribs R1 & R2 in front of the spar and slide the dihedral brace in place. Set up the wing halves with the dihedral blocks in place, check that all is square and correct, then cyano the halves to the brace.

Next add the centre leading and trailing edges as per plan and triangle brace the whole of the centre section. Cover the centre section top and bottom with .4mm ply, the bottom 'hollowed' as per plan. Fit the two 1/8 dowels by drilling through the top ply as shown. Offer up the wing to the fuselage and mark bulkhead F3 to drill the dowel holes. Tissue cover the wing and shrink and dope as for fuselage.

The duct and engine mounting

Cut the engine mount keel and discs and the engine fairings as shown step-by-step on the plan. Assemble them ensuring that the discs are square to the keel, then sand until the fairing is shaped as shown. Next, wire-cut the duct halves from blue foam and lightly sand the inside. Assemble as per plan duct halves to keel, engine plates and fairing. Sand lips and rest of duct (see photos) and seal with p.v.a. paste. Sand again and repeat. NB: it is essential to have the inside of the duct as *smooth* as possible to reduce skin friction.

Make hatch as per plan, aiming for as airtight a fit as possible when closed. Paint and proof as per plan.

By now you should have the entire airframe covered and doped *(except rear bottom of fuselage)* and the duct finished and painted. Now p.v.a. the entire duct to the top .4mm ply of the wing centre section, ensuring the centre-line of the duct is parallel to plan fuselage centre-line - i.e. NO up or down thrust.

All that remains is to fit the engine and fan (I use 3/8 x 2mm self-taps) and locate and fit the battery, receiver and servos so that you arrive at the C of G position shown on the plan. This position is slightly nose heavy and gives nice stable but aerobatic flying - you can go back a maximum of 1/2" but beware!

Servos and pushrods

Using micro servos, mount the aileron servo screwing into scrap 1/4" soft inside the wing centre section and the elevator servo in the fuselage screwed to two soft 1/4" crossbars. The elevator snake outer (actually a hollow lightweight snake inner) can be supported at intervals down the fuselage and lead out through the left hand tailplane support sheet. The pushrod is 22 swg bent and hooked through the servo arm and elevator horn - simple! Same idea for the ailerons - cut short lengths of snake 'outer' and slip over suitable lengths of 22 swg bent and hooked into the servo arm and aileron horns. Then support the snake outers with scraps of soft 1/8" balsa *cyanoed* into place.

You will now have to notch the wing support plates to allow the wing to sit down and the snakes to emerge from the fuselage without crushing. Last of all is the radio access hatch which covers the top of the fuselage nose from F3 forward to just over the nose. It is attached by two 2mm self-taps into the F3 triangles and held down by a simple turnbuckle over the nose.

Spray paint and decorate as required (original is in Luftwaffe two tone grey for 1944/45 - with simple cross corners, see photos, and swastika). Panel lines are by judicious use of fine felt pen - black - and the canopy is just sprayed on for simplicity and lightness.

Radio

1. Use mini equipment.
2. There is no switch - simply plug the battery into the receiver (with the Tx on, of course) and close the hatch.
3. The aerial runs down the fuselage and exits at the rearmost point. Smooth it out to lie as straight as possible during flight.

Flying

For starting you will need a good mini starter (see my article on the Javelin in RM May 1992). The chap who made mine, David Brock, is willing to supply plans or made-up starters for 6 volts operation. You can contact him by s.a.e. to: Brookfield, Rakeham Hill, Torrington, North Devon. EX38 8JE.

Using standard 25% nitro Cox fuel, starting is easy once you are practised at the art! Once running, close the hatch and adjust the needle valve to best running. The standard tank fitted to the Cox TD .020 gives about 100 seconds if run with the fan (because of the higher r.p.m. than with a prop) so you do not have to hurry to get airborne. A gentle hand-launch, very slightly nose-up, will get you away and climbing.

The original flew perfectly from the drawing board (an event which is RARE with my models!) and needed NO trim changes. The model will loop, provided you dive sufficiently first, and will roll quickly with aileron throws of 1/4" inch up and down, but remember - she has very little energy and with continuous loops she will descend in each one.

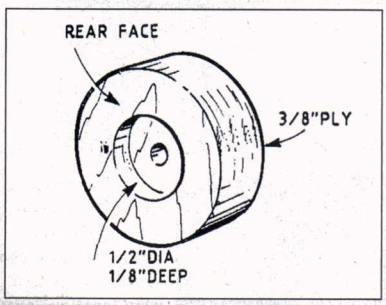
Clean up thoroughly after flying as tissue is difficult to fuel proof adequately. 'Jet 4' is such fun to fly that everybody will want a go! So make sure that you get in the queue first! Remember - FLY SAFE.

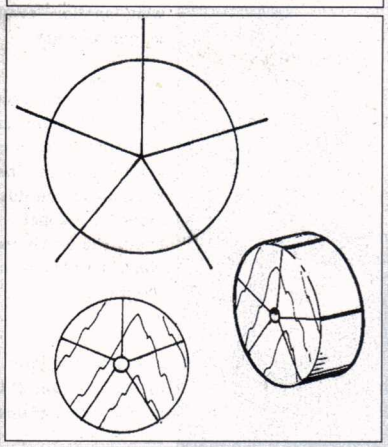
RM

The fan

For readers whose collections of RM may not go back as far as 1992, here are the originally published details of Chris' home-made Cox .020 fans. **Note that this refers to a five blade unit - development since 1992 has resulted in a more efficient six blade fan and this is used in 'Jet 4'.**

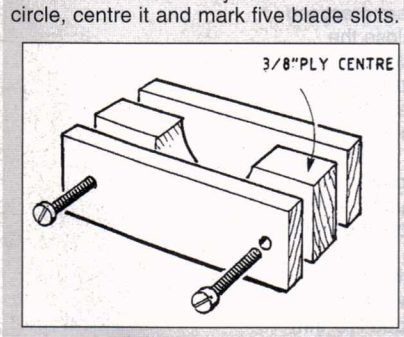
"The fan is made quite simply from a 3/8" thick multi-ply disc with a 2.1/2mm centre hole and a 1/8" deep relief at the rear face. The diameter is 1.1/8" and you could get a model engineering friend to turn you one -



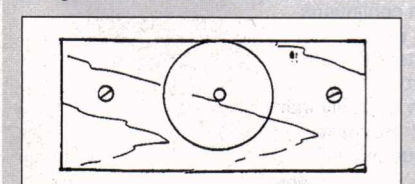


it's much better than trying to saw cut it out. Blades are from nylon sheet the thickness of postcard. Cut out and clamp together to sand in one go as when making multiple ribs. You'll need five (now six).

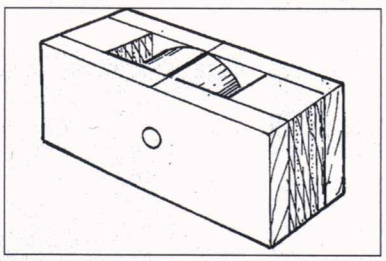
"Draw on paper a 2.1/4" diameter circle and plot it for five radials at 72 degrees spacing (60 degrees for a six blade). Extend these lines. Lay the disk on the circle, centre it and mark five blade slots.



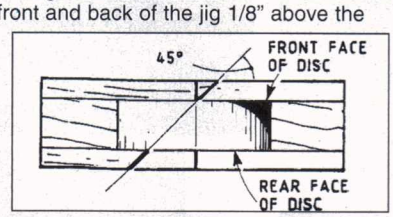
Draw right angles at the rim. Make a slot-cutting jig using scrap 1/4" multi-ply for the outer panels. Clamp together and bolt through. Plot and drill a 2.1/2mm hole

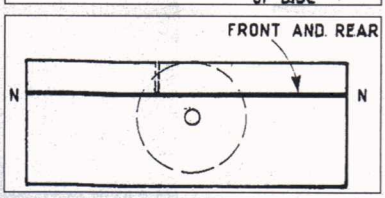


through the jig so that the disc just shows flush with the top. Mark a line across the top of the jig to align with the disc edge



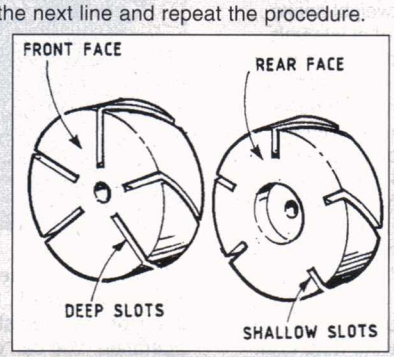
marks. Now mark a 45 degrees line across the top of the jig. Fit the disc into the jig and secure with 2.1/2mm rod or drill through the centre. Draw a line across the front and back of the jig 1/8" above the



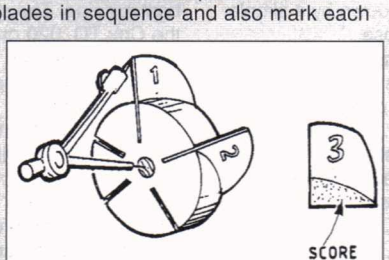


centre hole.

"Now mount the jig in the vice and saw cut along the 45 degrees line down to line N-N in the sketch to cut the first blade slot. Now remove saw, ease vice, rotate disc to the next line and repeat the procedure.



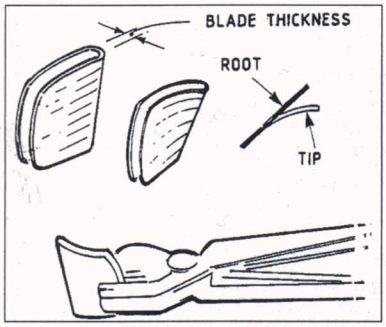
You should end up with a five cut 45 degrees root disc. Tight push-fit the blades into the slots and use a compass to check equal blade tip diameters all round - fill the centre hole with a small dowel to enable you to centre the compass. Mark the blades in sequence and also mark each



blade where it meets the disk.

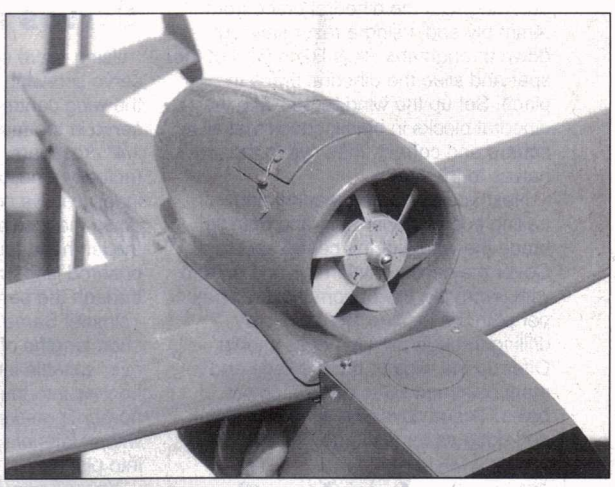
"Now remove the blades and sand/score lightly inside the marked area front and back to key for the cyano. Replace the blades in the disc and check again thoroughly with the compass for equal tip diameter then cyano each blade carefully into the disc hub.

"You can improve the performance of the finished fan by giving each blade a tip curve - use thin aluminium to make a bending jig. Place a blade in the jig and, using round

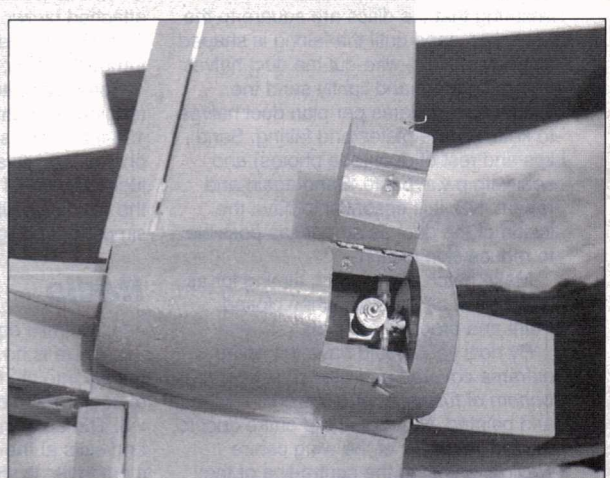


nose pliers, give the tip some aerofoil shape - slightly more than you need, in fact, as the blade 'memory' gradually loses shape. Mole clamp the bottom trailing edge of the blade and boil the whole thing in water for two minutes then plunge into cold water for about one minute. After this, remove the blade from the jig. Repeat for all blades then re-fit them to the hub following the procedure for establishing equal diameter outlined above before cyanoing them into place.

"I've made numerous fans by this method and not one has ever shed a blade. However, there's going to be a first time and you should take great care and wear safety goggles when running them - at least for the first few runs." RM



Above: Home-made six blade fan - text gives full construction details based on a five blade unit. Subsequent development has shown six blades to be more efficient, so simply divide your hub blank into 60 degree segments!



Cox TD .020 is accessed through hinged hatch in blue foam engine duct.

small is beautiful

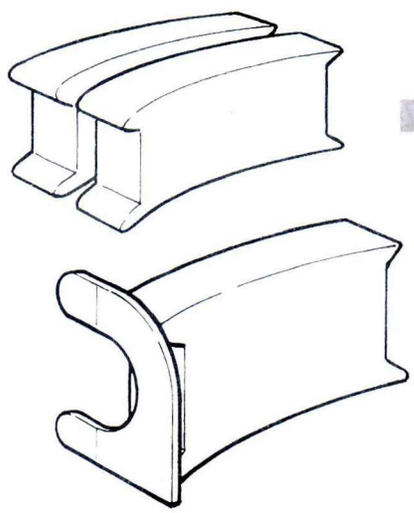
duct construction

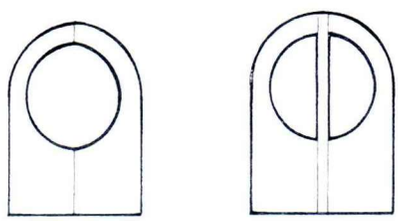
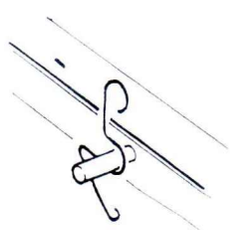
MATERIALS:

BALSA — SOFT –	1/8"SQ	SPARS, LONGERONS ETC
	1/4" x 1/2"	L.E.'s, T.E.'s
	1/4" x 7/8"	AILERONS
	1/16" SHT	FINS, RIBS, BRACES
	3/32" SHT	TAILPLANE
	1/2" SHT	ENG. FAIRINGS
	1/4" SHT	NOSE & SCRAPS
PLY	.4mm DOUBLERS, DIHEDRAL BRACE	
	1/8" LITEPLY ENGINE PLATE, KEEL, WING SCREW PLATE	
ADHESIVES	CYANO (THIN)	
	CYANO (FOAM)	
	PVA PASTE (65% PVA, 35% WATER) TO SEAL DUCT	
WIRE	22SWG PUSHRODS	
PLASTIC	INNERS OF LIGHTWEIGHT SNAKES	
DOWEL	1/8" SOFT SCRAP	

PLUS:
SCRAPS OF 1/32", 1/16" & 1/8" SOFT

MAKING DUCT:
1. CUT PATTERNS FROM .8mm PLY
2. MARK & HOT WIRE CUT (HWC) 2 DUCT HALVES FROM 2" BLUE FOAM (HOME INSULATION BY BOW CARVING)
3. ACCURATELY LOCATE FRONT & REAR PATTERNS ON ONE HALF & HWC
4. PRODUCE 2 IDENTICAL, HANDED HALVES WHICH TOGETHER ARE 1/8" SHY OF FULL CIRCULAR DUCT
5. WHICH IS CORRECTED BY ADDITION OF CENTRE VERTICAL KEEL
6. ENG. PLATE 1 IS NOTCHED INTO L.E. OF KEEL, CYANO IN. BACK UP WITH ENG. PLATE 2 EACH SIDE, CYANO IN
7. CUT 2 OFF 1/2" SOFT FAIRINGS AND HOLLOW OUT, PLUS 1/8" BALSA BETWEEN THEM FROM KEEL T.E. TO POINT 'Z'
8. JOIN HALVES & INSERT & SAND TO ROUND CONE
9. FIT TO KEEL
10. FIT DUCT HALVES (FOAM CYANO) ACCURATELY TOGETHER
11. SAND LIPS & OUTSIDE AND SEAL WITH PVA PASTE THEN SAND LIGHTLY
12. SCREW ENGINE TO PLATE 1, ALIGN FAN TO CENTRE IN DUCT WITH ABOUT 1/16" TIP CLEARANCE DRILL DUCT WALL TO FIT NEEDLE VALVE WITH FUEL TUBE EXTENSION
13. CUT OUT HATCH, FACE FORE & AFT OF HOLE WITH .4mm PLY AND BOTTOM SIDES OF HOLE IN SOFT 1/4" BALSA. TREAT HATCH SAME WAY AFTER REDUCING SIZE TO ALLOW LININGS
14. HINGE AT LEFT SIDE & MAKE & FIT CATCH ON RIGHT SIDE
15. SPRAY ALL OF DUCT IN & OUT WITH FUEL PROOFER





HATCH CATCH
20 SWG WIRE