Junior F1D Notes

The weights and densities listed are approximate and densities varying by plus or minus 0.2# are acceptable. The motorstick should be kept below 5# (as low as 4.6# is acceptable). The ribs can go as low as 5# and still be strong enough. The leading edge spar of the wing was found not to be stiff enough in initial testing. Two 9" lengths of 0.003" boron fiber attached to the top and bottom of the spar is the lightest way to increase the stiffness. If one does not wish to use boron fiber, the leading edge spar can be increased in depth to 0.080" (or more). This will add 10mg of weight over using boron. Also, the original leading edge spar depth can be kept at 0.063" and the wing wash adjusted as noted below, but this may slightly decrease the flight times.

The wing and stab spare lengths in the material list are 0.2" longer than the lengths given in the plans. The extra length is so that 0.1" long notches can be cut on each end. The tip are placed in these notches and tack glued with Ambroid or Duco. After covering, the dihedral break is made by loosening the tack glue with acetone. One may use another technique for the dihedral break if desired. It is suggested that the outer ribs on both the stab and wing be attached using CA (SuperGlue) rather than Duco or Ambroid as the CA will not loosen when acetone is used to loosen the dihedral breaks. Of course, CA should be used on any joint that involves metal (like the prop bearing and tail hook)

The prop setting of 51° at 4" radius gives a prop pitch of 31" at the 4" radius. The pitch length will differ at other radii. The direction of the grain on the prop blade is significant. The blades can be cut at this grain angle from a 2" wide sheet of balsa. The blade is placed just to fit between the balsa edges. Using c-grain balsa is also necessary for the prop. Near c-grain sheet will provide the necessary stiffness for the prop blades.

The plans show a plane 72mg over the minimum weight for an F1D. Using wood in the lightest part of the ranges will allow for a plane of minimum weight. The development planes were all built from wood purchased at a Hobby Lobby craft store. This includes the sheet for the prop blades which can be thinned by sanding from 1/32" sheet. Also, as a beginner gets more build skills, rolled tubes can be used for the motor stick and tail boom. Born reinforcement will be needed for the rolled motor stick tube and probably for the tail boom.

The motor stick bracing fiber is definitely needed. For launch torques above 0.25 oz-in, an unbraced motor stick will bend enough to severely flatten the takeoff angle often resulting in a dive to the ground. Also, the Harlan prop bearing will flex at high launch torques (above 0.3 oz-in). This is increases the down thrust and also flattens the launch angle. Both of the above are needed to launch at or above 0.35 oz-in.

The original design with the 5# density motor stick was done without bracing. The bracing will allow a less stiff motor stick to be used so the balsa density of the motor stick can be decreased. Also, the motor stick length was kept as short as possible at 7" to reduce the weight. The motor stick can be increased in length to 7.5", especially if the density in decreased. The tail boom could then be decreased in length by half an inch. Even if the motor stick balsa density is kept at 5#, such changes olny increase the model weight by 8mg. And, a reduced density motor stick at 4.9# would mean to weigh increase. Another advantage of the increased motor stick length would be the ability to move the wing back a bit more. This would allow the cg to be moved forward if desired. As discussed below, some builders may have problems getting the cg in the optimum location and this might help.

The CG, with the 0.4g motor, should be located 4.2" behind the leading edge of the wing. Depending on how the plane is built, the CG will probably be located behind this point. This is not a serious problem as

the plane can fly quite well with the CG 4.7" or even more behind the wing leading edge. Of course, the decalage will need to be reduced as the CG moves toward the rear.

The plane flies well on 5.9" to 6" of good rubber (late Tan SS or good Tan II) with the prop built and set to the specifications in the plans. The initial stab setting should be 0.14" up at the trailing edge (about -2.0° inclination) and the initial wing setting should be 0.04" down at the trailing edge (about 0.5° inclination). This gives a total decalage of about 2.5°. In poor air, the decalage may need to be reduced, perhaps as much as to 1.5° to prevent stalls when the plane is upset by thermal bubbles. The stab should have no warps and a tail tilt of about 0.5", side to side, should give a 20' flight circle. The wing warp is critical. The plane is designed to have a static side to side wing warp of 0.1" right wing washin. However, if the wing leading edge is not stiffened with boron or an increased spar depth, the wing warp must be changed to 0.1" left wing wash in. This change will affect the performance but without the change, the left wing will tuck when the airspeed increases (after an upset or after launch when the nose drops from the higher initial angle. The latter will cause a dive to the ground when the plane is launched with a torque higher than 0.25 oz-in. For reference purposes, the above setting will result in an average prop rpm of 74 to 80 rpm.

With good rubber and winding, the plane should fly for more than 15 minutes in a Cat III site.

Junior F1D material and weight list

Fuselage:

motor stick:		7” x .25”x .125”, 5#	288 mg	
tail boom:		13” x.063” x .25” taper to .094”, 6#	221 mg	
posts				
	wing, 2 x .063” sq, rounded at end, 1.5”, 8#			
	stab, 2 x .062” sq., rounded at end, 1.0”, 8#:		50 mg	
bearing:		Harlan F1D, hard balsa brace:	27 mg	
tailhook:		0.013” music wire x .75” plus gusset:	17 mg	
ms brace:				
	post:	.063” sq, x .95”, 8#		
	wire:	6# UHMW line (spider wire) or		
		200 denier Kevlar:	5 mg	
				608 mg

Wing:

spars:	2 x 11.55” x .063” sq, 6#:	140 mg	
boron:	leading edge spar only, 2 x 9”, .003”:	8 mg	
ribs:	4 x 4.85” x .063” x .031”, 6#:	60 mg	
tips:	2 x 11.6” x .063” x .031”, 6#:	72 mg	
tubes:	2 x polyimide. .064” ID x .188”:	10 mg	
covering:	OS film, 90.2 si:	50 mg	
			340 mg

Stab:

spars:	2 x 10.00”/10.07”” x .063” sq, 6#:	124 mg	
ribs:	4 x 3.85”/3.40” x .063” x .031”, 6#:	45 mg	
tips:	2 x 7.3” x .063” x .031”, 6#:	45 mg	
tubes:	2 x polyimide. .064” ID x .188”:	10 mg	
covering:	OS film, 51.3 si:	26 mg	
			250 mg

Prop:

blades:	2 x 7.07 si x 0.010”, 5#	180 mg	
spars:	2 x .063” sq., double tapered to .025”,		
	rounded at end, 6#, 300K (110 SC):	52 mg	
hub:	1” x .064” ID, .003” wall polyimide tube,		
	.25” x .064” round 8#,		
	1.25” x.013” music wire:	37 mg	
			277 mg

Total: 1472 mg

If 0.080” high leading edge wing spar used instead of boron, weight increases by 10mg.