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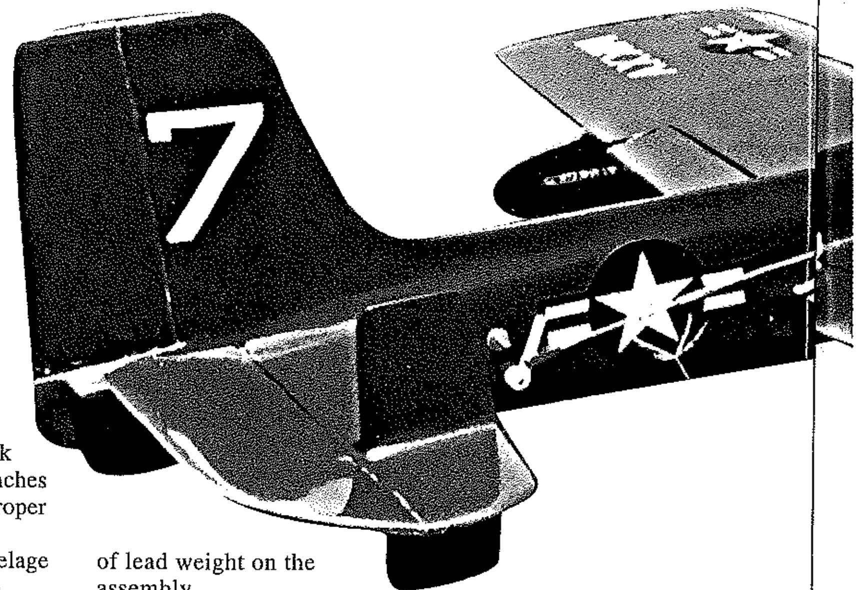
G•U•A•R

■ **Bill Melton**



MY PROFILE Guardians have been around since the Profile Carrier event was started. The Mk XV version presented in this article was first flown in 1994 and has won the Nats for five consecutive years. With a Nelson .36C, an APC 9 x 6 prop, and 65% Red Max fuel, the Mk XV usually is in the 18s (18 seconds) for high speed, and low-speed times are in excess of 300 seconds.

CONSTRUCTION

Cyanoacrylate (CyA) glues are used throughout, except in high-stress areas. Slow-cure epoxy is used for engine mounts, doublers, bellcrank mount, joining wing panels, dihedral braces, hook mount, and final assembly of wing and tail to fuselage.

Fuselage: Select a four-to-six-pound-density soft balsa plank 4 x 36 inches. Note that a scrap piece approximately eight inches long will have to be added over the canopy area to get the proper fuselage depth.

Draw a straight reference line the entire length of the fuselage through the thrustline. This will serve as a reference mark to ensure 0° incidence in the wing and stabilizer. The engine mounts and hook mount are attached with a slow-cure epoxy. Wipe off the excess with a paper towel.

Be sure that the engine mounts are flat. I generally do this by placing the fuselage on a piece of glass covered with waxed paper, and then place a flat piece of wood on the other side (also covered with waxed paper), then put roughly 10 pounds of lead weight on the assembly.

Low-speed time consistently exceeds five minutes. Note small amount of flap deflection and aileron movement. Womack photo.

After the epoxy is dry, sand away the excess with a flat sanding block to make sure the engine-mounting surface is flat. Mark the area on the engine mounts where the engine will be mounted. Cut the 1/8 x 1/2 aluminum 3/4 inch longer than the mounting lugs on the engine and epoxy to the engine mounts. Attach the aluminum pads to the mounts with small sheet-metal screws.

The doublers are cut from five-ply plywood and are epoxied on after tapering the trailing edge to flare into the fuselage. Make sure the reference line is maintained by marking the line in the wing cutout area and then transferring it to the doublers. The edges of the fuselage are then rounded and the fuselage is sanded to an elliptical cross-section behind the doublers. Leave the cutout area for the stab as wide as possible, but tapered behind the hinge line.

The landing gear should be made from 3/32 dural and the mounting holes should be drilled in the fuselage at this time. Drill a hole in the hook mount for the 3/32 wire hook. The groove for the tail skid is cut in the fuselage and the 1/16 wire tail skid is epoxied into the fuselage.

Stabilizer and Rudder: The stabilizer is cut from hard C-grain balsa; the elevators and rudder are cut from relatively soft C-grain. The subrudders are cut from 1/16 plywood.

The horn joining the elevators is bent from 3/32 music wire and a large nylon control horn is used. The hinge line should be straight and in line with the centerline of the horn. Hinges and wire horn are installed with Sig Epoxylite. The torque rod in the rudder should be bent to give the desired amount of kick-over, and installed by sticking it into each half of the rudder and applying a drop of CyA. The torque rod and the hinges should be installed at the same time.

Wing: The wing is built in halves in a fixture made from one-inch blocks for the leading edge and trailing edge pieces cut

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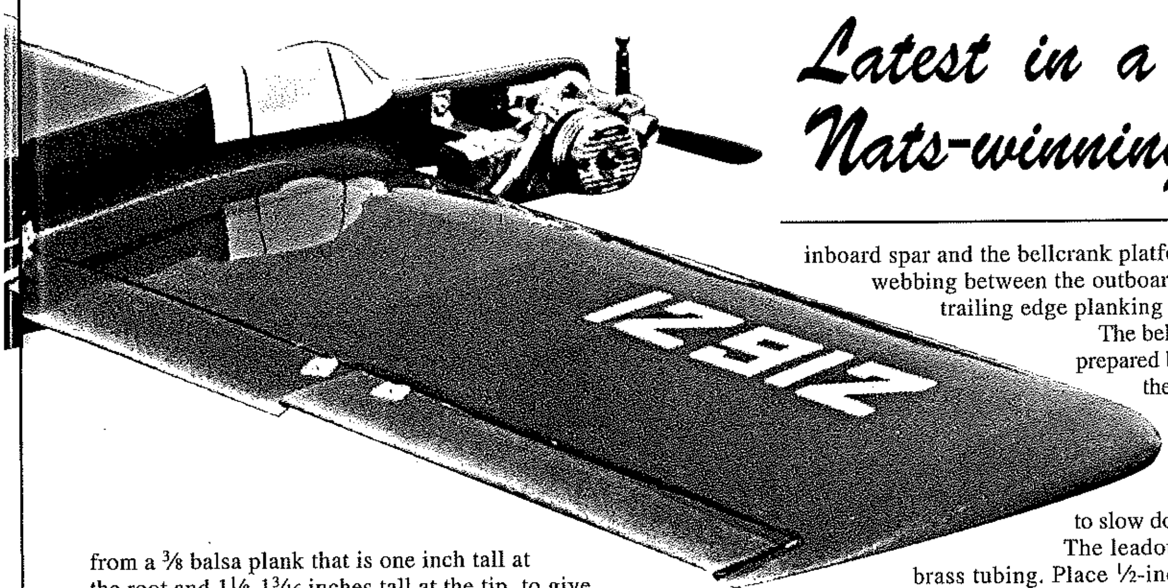
Latest in a series of Nats-winning models



from a $\frac{3}{8}$ balsa plank that is one inch tall at the root and $1\frac{1}{8}$-$1\frac{3}{16}$ inches tall at the tip, to give the correct amount of washout. The blocks are then pinned over the plans.

The leading edges are pinned to the blocks on edge and the bottom trailing edge planking pinned to the trailing edge job. Note: The cutouts in the trailing edge planking for the flaps are not made until later. The ribs are then glued in. The location of the spars is marked, notches are cut, and the top spars are glued in.

The top planking on the trailing edge is now added. I usually use normal glue, such as Testors B, to do this; it is very hard to get the CyA to go where you want it with everything pinned down.

The wing panels are then flipped upside down to put in the bottom spar. Note: The trailing edge fixture must be reversed so that the one-inch-tall part is now at the tip and the wide part is at the root. Install the bottom spars.

The next step to join the wing halves. Pin scrap-balsa blocks to the plans to get the $\frac{5}{8}$-$\frac{3}{4}$-inch dihedral under each panel. Sand the leading edges, spars, and trailing edge planking so that they fit properly.

Epoxy these parts together after making sure that the leading edge and the trailing edge are equal distance from the building board, and that the appropriate washout remains at the tips.

Install the leading and trailing edge reinforcements and the spar doublers. Install the bellcrank platform with epoxy. Add the reinforcement between the bottom inboard spar and the bellcrank platform and the vertical webbing between the outboard spars and between the trailing edge planking pieces.

The bellcrank (Brodak C-24) is prepared by deburring the holes for the .027 flexible leadout cables and redrilling the hole for the elevator pushrod as far in toward the pivot point as possible, to slow down the elevator movement.

The leadouts are bushed with $\frac{1}{32}$ brass tubing. Place $\frac{1}{2}$-inch-long pieces of the brass tubing over the leadout wire, then bend in a U shape around round-nose pliers. Insert this into the hole in the bellcrank and finish bending to close the bushing. The ends of the cable are then wrapped with copper wire, soldered, and washed with baking soda or a good degreaser to prevent rusting.

Mark the location of the bellcrank on the bellcrank mount so that the angle of the sliding slot is approximately halfway

Low-speed flight is flown at full 60° attitude. Model is a five-time Nats winner. Womack photo.

between the position of the leadouts at high and low speed.

My experience has been that if the slot is angled too much, there is friction in the bellcrank when going to low speed, and there is a tendency for the airplane to dive as the bellcrank is moved. If the angle of the slot is too shallow, the bellcrank binds at low speed and it is difficult to get small throttle movement. Lubricate all areas of the bellcrank with a dry lubricant.

Mark and cut out the area in the bellcrank platform to clear the sliding portion. Cut holes or slots in the ribs to clear the leadouts. I use ⅜-inch squares of hard 1/32 aluminum as spacers between the bellcrank and the plywood platform, and ½-inch squares of the same material on the other side of the platform as washers to prevent the mounting bolts from pulling through the platform.

Mount the bellcrank and make sure everything works freely. If it does not, fix it! Do not allow any binding or friction in the bellcrank operation. Put in the ½ thick partial rib in the center section. Solder nuts on bellcrank mounting bolts. Plank the leading edges of the wing and the bottom portion of the center section.

Install the throttle pushrod stub through a ⅛ wide slot in the lower planking. The pushrod is shaped to allow total bellcrank movement and to emerge through the slot in the bottom planking.

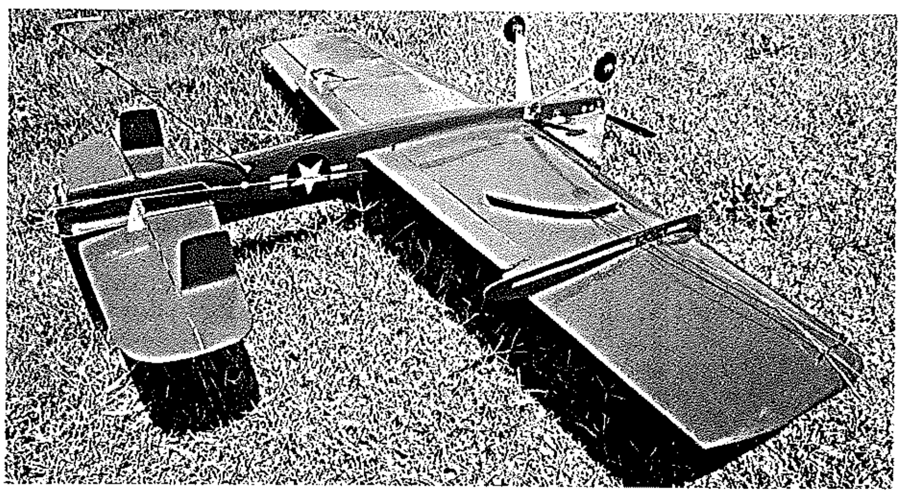
The elevator pushrod is prepared by making a Z bend in the 1/16 wire and soldering a washer on the pushrod to raise it above the leadouts. It should also be noted that there is planking between the #3 and #4 ribs on the lower surface of the outboard panel, for the passage of the pushrods from the changeover bellcrank between the flap and the aileron.

Install the rest of the capstrips.

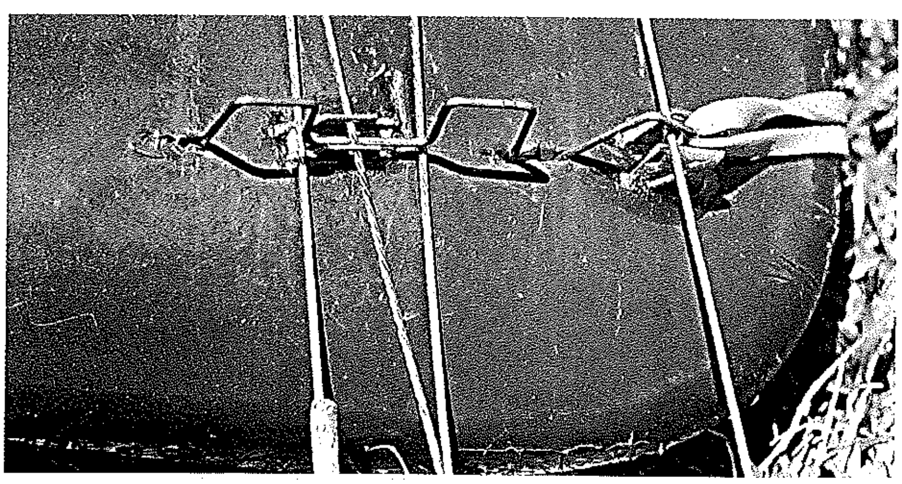
The line slide is cut from 1/16 plywood. The moving part is cut from tin-can stock, with Perfect eyelets as leadout guides. When soldering the eyelets to the tin, make sure the eyelets are angled as will be present in the low-speed position. I usually use pieces of 1/32 plywood as spacers between the tin and the plywood slide holder.

A 1/16 wide slot is then cut in planking next to the #4 rib between the spar and the trailing edge planking, and the line slide mechanism is installed—first with CyA, then epoxy.

Make the cutout in the bottom planking to clear the leadouts at the high- to low-speed positions. Note that the bottom spar will be cut and tapered to clear the leadouts in the high-speed position and that rib #3 may also be cut through. Make



Dihedral enables leadouts to exit lower wing surface, which allows line slide to be mounted inboard of wingtip to increase yaw at low speed. Womack photo.



Line slide release is placed on wingtip to reduce yaw at high speed. Release is triggered by pin attached to throttle leadout. Womack photo.

Scoring in Navy Carrier is heavily dependent on low-speed performance. The things I consider important for good low-speed flight are:

- Blunt leading edge of wing, to soften stall tendencies
- Symmetrical airfoil, with a minimum thickness of 12% at the root and 14% at the tip
- ⅛-3/16 washout in each wing panel to minimize tip stall
- Low aspect ratio, to maximize allowable line sweep
- Large outboard aileron, to induce "banking"
- Two to four ounces of tip weight
- ⅝-¾ dihedral in wing, for low-speed stability and to allow leadouts to emerge from bottom surface (not tip) to maximize line sweep
- Line slide mounted inboard of wingtip and beneath wing to maximize line sweep and yaw at low speed
- Flaps, if trying for low-speed times in excess of 4½ minutes
- Mount bellcrank behind center of gravity (CG) to ensure positive line sweep without rubber bands or springs
- Use Brodak "backward" inverted bellcrank (C-24) mounted upright to get "jump-up" instead of "crash-down" when line slide is activated
- Fly with one hand, to better coordinate elevator and throttle movement
- Trim your airplane to fly to suit your method of flying
- Practice.

If you are new to the event, try for 150-second low speeds and then increase your goals by roughly 30 seconds. Six-minute low-speed times are possible!

—Bill Melton

sure the leadouts are free to slide from the high speed to the low speed positions without binding.

Put in the stub spar between ribs 3 and 4 in the leading edge planking and the heavy webbing between the spars where the cutout is removed. The bottom planking is reinforced with a 1/16 x 1/4 balsa strip where the #3 rib is cut out and the webbing is placed between the trailing edge planking pieces.

Make the cutouts in the trailing edge planking for the flaps and the outboard aileron. (Note that there is no inboard aileron.) Mark locations of 1/4 trailing edges on trailing edge planking and the 1/4 leading edge pieces for the flaps and aileron on the top and bottom of the wing.

Make the cutouts and retain the portion marked for the flaps and aileron as the basis for a built-up flap and aileron. Mark locations for the hinges and glue in blocks to attach the hinges. Sand cut-out area of trailing edge planking flat and glue on the 1/4 trailing edge "spar." Note that the hinge line on the flaps is on the bottom; for the aileron it's on top.

The sections of the cut-off portion designated as flaps and aileron are then cut out. Solid blocks are glued in on the end sections for horns and hinge locations and the 1/4 leading edge installed and sanded to shape.

Hinges are then installed in the flap and aileron sections, followed by the 1/16 music wire horn connecting the flaps. The horn connecting the flaps is bent to correspond to dihedral and the swept angle of the flaps. Carve a block to fill in the area between the flaps.

Install the 1/16 plywood bellcrank platform in the outboard wing panel to actuate the aileron. Note the differential in the bellcrank so that a little flap movement gives a lot of aileron movement.

Add the wingtips and sand everything to shape. Remember: A very blunt leading edge. Add approximately 2 1/2 ounces of weight to the outboard tip.

Assembly: Be sure the original centerline is still present on the fuselage to serve as a reference to set 0° incidence in the wing and stab. Push the throttle pushrod into the wing through the exit slot. Fit the wing into the cutout in the fuselage, making sure that the centerline of the wing corresponds with the reference line on the fuselage.

Epoxy the wing into the fuselage. I align the wing-to-fuselage angle by making a template from the plans. The wing is then propped up over the building surface so that the wingtips are equidistant from the surface, and the fuselage is set so that it is at 90° to the building surface (use a large triangle). An epoxy fillet is formed between the wing-to-fuselage joint.

After this assembly is dry, the stabilizer is epoxied in. The stabilizer is carefully aligned with the wing in both axes.

The rudder and dorsal fin are then epoxied onto the fuselage. The cutout for the elevator pushrod in the wing is faired in with a piece of 1/4 scrap balsa, hollowed to clear the pushrod.

Finish: All fillets and fairings are Sig Epoxolite applied to the raw wood and shaped with a wet finger. After drying, the fillets are wet-sanded. When all moisture is gone from the wood, all surfaces are sanded smooth.

The fuselage, rudder, stabilizer, flaps, and aileron are painted and the wing is covered with MonoKote®. Mask off 1/2 inch of wing center planking to leave a place to attach the MonoKote®.

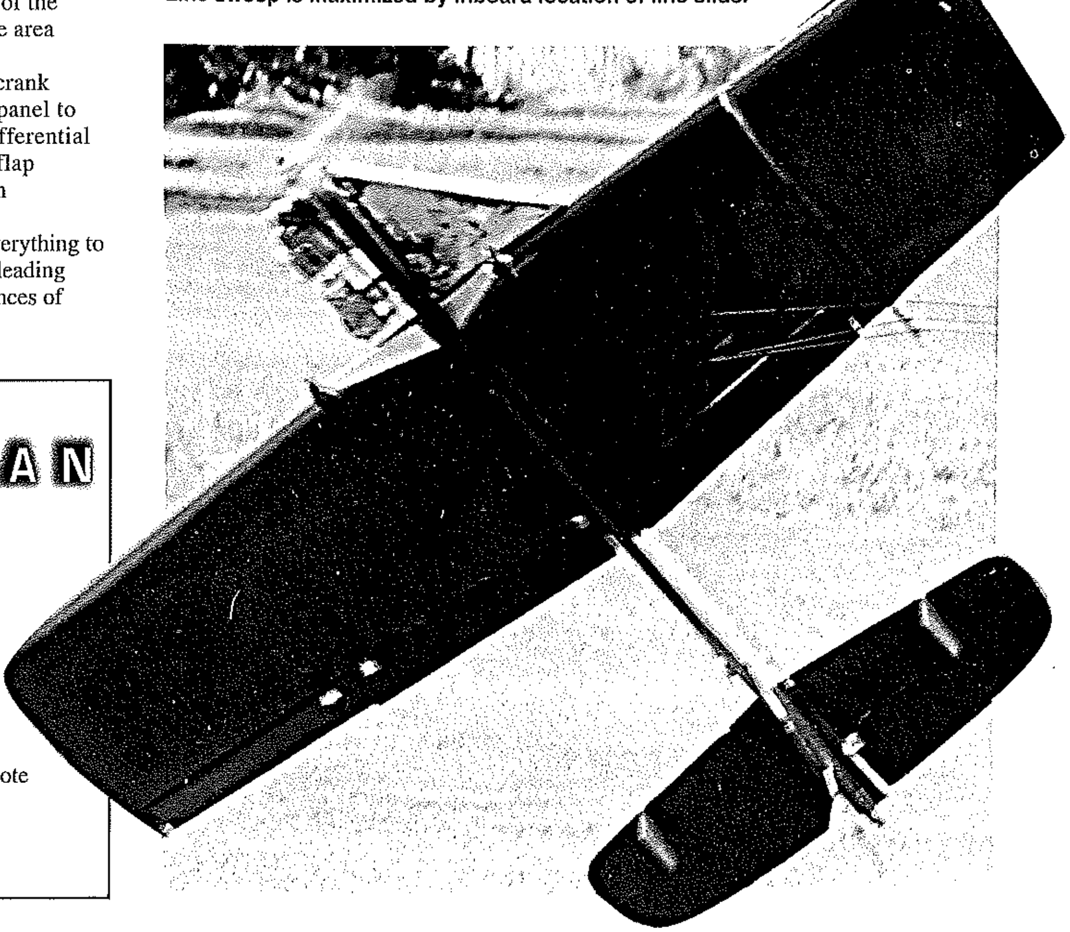
The finishing process is simple: mix enough clear Hobbypoxy to apply two coats. Allow this mix to set 30-45 minutes before using. Talcum powder is mixed with thinner. Use lots of talcum. The clear is thinned roughly 30% with the talcum-thinner mix. Brush two coats on the surfaces to be painted. Allow to cure for 24 hours and then sand until smooth.

The primer/filler is Pactra prep primer. Brush on three coats, then sand with 220 and finish with 400-grit sandpaper. The Hobbypoxy color is mixed and allowed to set 30-45 minutes before spraying. Thin roughly 30% with Hobbypoxy thinner.

Make pushrods connecting flaps and aileron to the bellcrank in the outer wing panel from kwik-links and solder links. Cover the bottom surface of the outer wing panel with MonoKote® and then install the pushrods. The rest of the wing is then covered with MonoKote®.

Mount landing gear and wheels. Hook up all control surface pushrods. Install engine with 6-32 bolts with a 3° offset, provided by nylon wedges from Brodak. A little downthrust is desirable! The stub throttle pushrod is "fished" out of the wing and connected to the engine throttle with a kwik-link. Make a hook from 3/32

Line sweep is maximized by inboard location of line slide.



GUARDIAN

Type: CL Profile Carrier

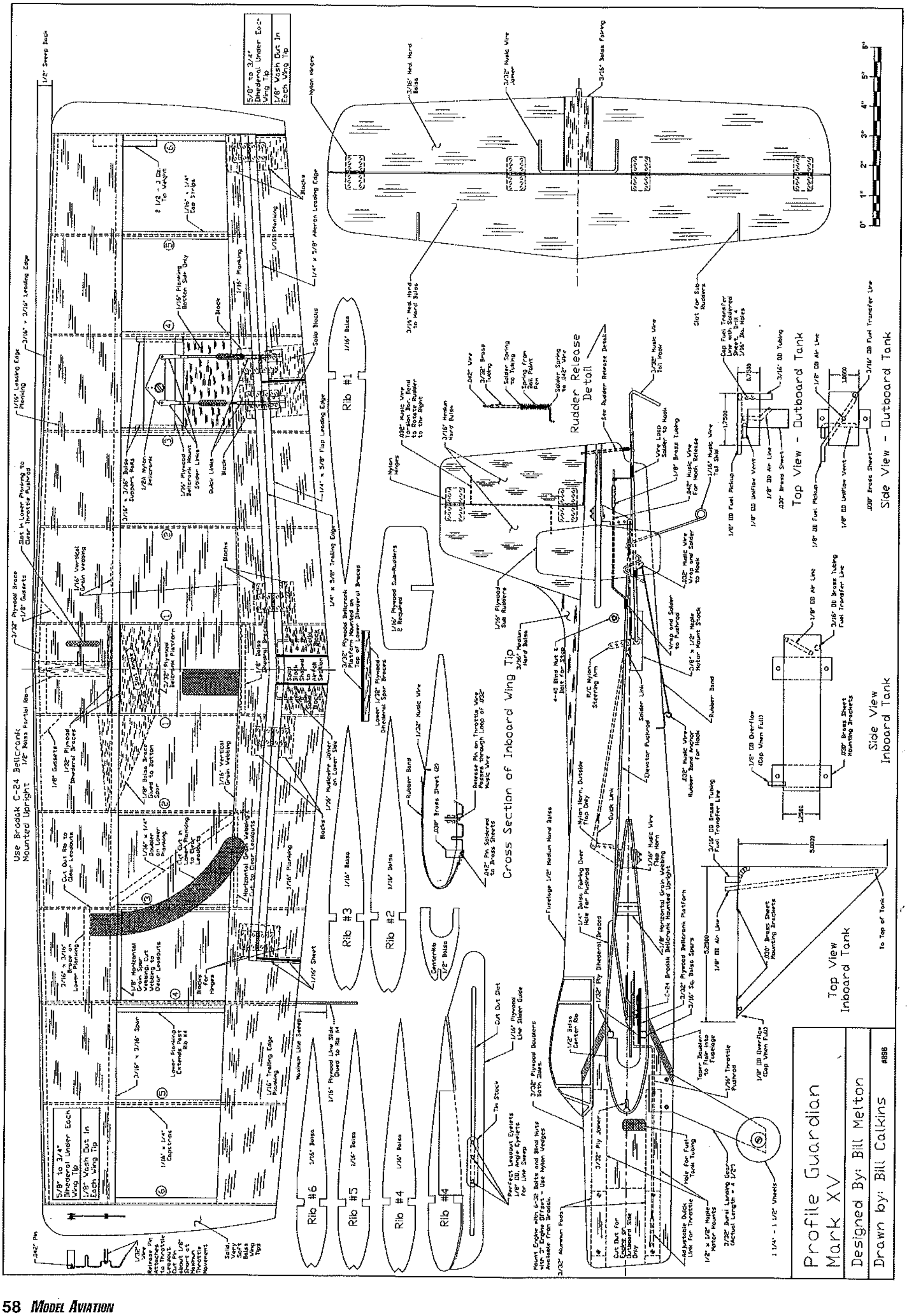
Wingspan: 38 1/4 inches

Engine: Nelson .36C

Construction: Built-up

Covering/finish: MonoKote and epoxy

Full-Size Plans Available—see page 182



music wire and install with horn for flaps on outboard side.

The horn to operate the flaps is made from an RC nose-gear steering arm with a 3/32 collar. It is necessary to drill a hole as close as possible to the centerline to attach the pushrod to the flaps. A "flat" should be filed on the hook wire to help the horn stay in place. Install the pushrod from this horn to 1/2A nylon horn on top side of the outboard flap. The pushrod is made from a long kwik-link with a solder link connector.

Epoxy 1/8 OD brass tubing to the rear of the fuselage on the inboard side to serve as a bearing surface for the pushrod for hook release. Solder .045 music wire pushrod to elevator pushrod so that it is flush with the end of the brass tubing when elevator is down approximately 30°.

Build and install the rudder release mechanism. It will be necessary to cut out a portion of the elevator to clear rudder when kicked over. Solder the other wire fittings to the hook. Tie the leadouts.

The tip-mounted line-slide release mechanism is formed from .045 wire and .026 sheet brass. It is important to note that the wire sticks into the balsa tip. The release wire is soldered to the throttle leadout cable. The throttle cable is pulled to the maximum low-speed position and the release wire cut off about 1/8-3/16 inch from the release point. Wick the end of the release wire with solder to prevent unraveling. The line-slide release mechanism is mounted to the tip to minimize yaw at high speed; the line slide is mounted inboard to maximize yaw at low speed.

Tank: Because of the very slow speeds at which these models fly, at least 6-8 ounces of fuel is required. This fuel requirement essentially eliminates conventional tanks, because there is no place to put them. This necessitates some type of a chicken-hopper tank. I am on my fourth generation of tanks, with each one bigger than the one previous.

The vent arrangement on the inboard tank consists of an air line, a fuel transfer line, and an overflow. The air line extends out of the tank (to be coupled to the air line on the outboard tank) to the innermost top side. The fuel transfer line extends only to the inside of the tank in the lower rear corner. The overflow tube extends into the top surface of the tank at the front and is capped after filling.

The outboard tank is most critical for good engine runs. It has a fuel transfer line in the bottom rear corner that just extends into the tank; an air line that is located at roughly the center of the side of the tank and extends roughly halfway into the tank; a pick-up line that exits the tank in line with the needle valve and goes to the lower outside corner; and a vent line that is centered in the top of the tank and goes to the bottom of the tank. The top portion is bent forward.

The air and fuel transfer lines of the tanks are connected through the fuselage with tubing. The outboard tank is supported by 1/2-inch-wide .030 brass sheet so that the inboard point is just inside of the needle valve centerline.

The outboard tank can be adjusted in two ways to get a good engine run: Up-and-down or in-and-out to compensate for rich or lean engine runs, and by moving the vent tube location. By moving the vent tube farther into the tank, the engine run will lean out; reducing the amount that sticks into the tank will richen the run. The vent tube can also be pinched to reduce a tendency to richen in flight.

This tank setup will not work if there are any air leaks in the system!

I usually end up cutting the hole in the fuselage to connect the tanks after painting and have to patch a little to prevent fuel soak. Pinch off fuel line to engine when filling tank. Fill through vent tube on outboard tank. Do not forget to cap overflow on inboard tank.

Engines/Props/Fuel: I have used the Nelson .36C engine for a number of years with an O.S. 4D carb, 9 x 6 APC props, and 65% Red Max fuel. To install the carb, the venturi is cut off just above the needle valve holes. The carb is filed square and held in place with JB Weld®.

Trimming and Flying: This design has two annoying habits that often need to be removed by trimming.

It may roll over on its back and loop into the ground. This apparently may be caused by three factors: the airplane is tailheavy; flaps are dropped too much; or the line slide goes back too far.

I usually start by working on the center of gravity (CG), which should be 20-30% back from the wing leading edge. If this does not work, check flap movement. Flaps should be lowered roughly ¼ inch or ⅜ inch maximum. The line slide should not go past the trailing edge of the wing root, but too much line sweep or the line slide mounted too far inboard will also cause this roll-up reaction. Downthrust is also a standard trim point that reduces roll-up and helps to prevent "stopping" at very low speeds.

The other bad habit is a tendency to change from the 60° nose-high attitude to level flight, or even into a dive, when going into the wind. This is caused by a noseheavy condition or too much flap. Too little tip weight generally reduces line tension and too much tip weight causes hinging or "flopping" at low speed. Do not be afraid to temporarily hang weight anyplace on the airplane and see what you like.

Flying is simple and straightforward. Every effort should be made to obtain a straight, level takeoff to maximum 6-8 feet altitude. The transition to low speed will be accompanied by a "jump-up" when the line slide changes to the low-speed position. A "flick" of down elevator will drop the hook (use rubber band for tension) and actuate the rudder, flaps, and aileron.

For initial flights, drop the flaps approximately ¼ inch. On the downwind side of the circle, the airplane will tend to settle. A little up-elevator and a slight increase in throttle should result in a nose-high attitude.

Get someone in the circle with you with a 60° triangle so that you can learn where 60° really is! Remember, 60° is ⅔ of the way to vertical.

Another problem with this airplane is that it may stop forward motion or even back up when going into a wind. Downthrust in the engine helps, but the pilot must anticipate this tendency.

Landings are generally made by holding the airplane in the 60° attitude until it is over the deck, then just cut the throttle and allow the airplane to back down to the deck.

Thanks should be extended to Bill Calkins for computer-drawing the plans, and to Dick Perry and John Womack for the photography. *MA*

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