Guardian MK VIII and IX

By BILL MELTON. . .The author has been designing models for Profile Carrier competition since the inception of this CL event; the Guardian designs reflect the evolution and refinements that have taken place.

• The Grumman Guardian needs no introduction as a design for Navy Carrier competition. My Guardian designs for Profile Carrier have been around since the beginning of the event. These have continually changed as a reflection of my personal interests and to fit changes in the rules. The MK I version was almost a super plane as I look back. It had flaps, two ailerons, line sweep, kick-over rudder, but had a flat-bottom airfoil. The flaps produced a definite nose-down pitching moment and the line sweep was inefficient when coupled to the flat-bottom airfoil. My thoughts at the time were that I needed the flat-bottom airfoil to increase low speed lift. It should be remembered that, at that time, we were flying low speed in basically a level attitude.

The MK II eliminated the flaps and inboard aileron and MK III eliminated the line sweep. The MK IV, as published in *Model Builder,* was a very slightly modified version of MK III. MK V had a very low aspect ratio wing and was the first to show prop-hanging capabilities. In fact, a very small loop on the upwind side of the circle eliminated this version. The MK VI was a compromise on aspect ratio with MK V and retained the flat-bottom airfoil with a very large outboard aileron. This version was flown at the 1981 Seguin Nationals and placed third with a 271 score. My emphasis up until this time had been on light weight and high speed. I was turning 85-89 mph with ST35C engines and had 100 mph with a Tune 36 at the 1981 Nats in 26 to 28-ounce airplanes. Low speeds had improved from 89 seconds with the early versions to about 110 seconds with the MK VI.

It was at the 1981 Nats that I became a true believer in the possibilities of super low speed flight. I had read about 6-8 mph low speeds being turned by Wallick, George Cox and a few other had a hard time believing them. Ge demonstrated how nice the super low speeds could be and showed me the features that he considered necessary for this type of flying. He even gave me a set of plans for his MO-1! Well, I had to give this new challenge a try. The MK VI, flown at the Nats, was fitted with a line sweep and more tip weight but it did not help as the flat-bottom wing would level out in the slightest breeze. The MK VII had a semi-symmetrical airfoil, flaps and a line sweep. It was ridiculous and flew low speeds like a ship in a hurricane. After a couple of weeks of running it into the ground, it was stuffed in the trash.

The MK VIII retained the same planform as the MK VI and had a fully symmetrical airfoil, an outboard aileron, kick-over rudder and a line sweep. With some added tip weight and a little weight in the tail, the MK VIII was a success. I could now fly three minute low speeds with an occasional 3:20. The plane was stable in both wind and calm conditions. In 1982, I flew in three contests and had three scores over 300 points with three different planes and engines. However, about the time I thought I had caught up, Dave Wallick, Herb Patrick and some others started turning four to five-minute lows. Progress was going on! Examination of pictures of their planes showed flaps! The MK IX again had flaps! It was a joy to fly in calm weather with 4:00 to 4:30 low speeds but was a terror in a breeze. It was capable of 330-340 scores, but only in a calm. The version presented here has the leading edge of the flaps angled to conform to the taper of the trailing edge of the wing. The original had a straight leading edge on the flaps. The angled flaps really helped low speed stability, especially in the wind. The other changes made in the design over time have been primarily cosmetic to increase the scale-like appearance.

In summary, the things that I consider necessary for low speed flight are as follows: 1) the wing leading edge should be as blunt as possible, 2) the wing should have a symmetrical airfoil with a minimum thickness of 12% at the root and 14% at the tip, 3) the wing planform should have as low an aspect ratio as you think the rules will allow (this seems to increase low speed stability and allows more line sweep movement), 4) use a minimum of 2-1/2 ounces of tip weight (this may go up to 4 ounces), 5) I like a large outboard aileron, 6) line sweeps are necessary, 7) use about 1/8 inch washout in each wing panel, 8) for low speeds in the 4-5 minute range, flaps will be necessary, 9) use at least 3 degrees of engine offset, 10) fly with one hand to better coordinate elevator and throttle movement, and 11) C. G. must be as far back as possible without causing instability. I already have some more ideas and MK X will soon be on the drawing board.

Since I have presented two different versions of the Guardian, I should explain my reasoning. I would recommend the MK VIII version for the newcomer to the event or to the person wanting to increase scores into the 280-300 bracket with minimum practice. The MK VIII is definitely easier to fly and is more consistent across contest environments. The MK IX has greater scoring capabilities but is more difficult to fly and requres gentle throttle manipulations, especially in the wind. I would suggest building both versions in order to take advantage of weather conditions.

Regardless of which version you select, the construction is basically the same and similar to what would be encountered with any profile kit.

FUSELAGE

Select a medium weight 4x36-inch balsa plank. *Note* that a scrap piece about 6-8 inches long will have to be added over the canopy area in order to give the proper fuselage depth. Start construction by drawing a *straight reference line* the entire length of the fuselage through the thrust line. This will serve as a reference mark to insure a straight engine thrust line and 0° incidence in the wing and stabilizer. The engine mounts and hook mount are epoxied in with a slow drying epoxy. *Make sure the motor mounts are flat!* The 3/32 plywood doublers are also epoxied on after tapering the trailing edges to flair into the fuselage. The edges of the fuselage are then rounded and shaped to an elliptical cross-section behind the doublers. Leave the cut-out area for the stab as wide as possible. The landing gears should be made from 3/32 dural and mounting holes drilled in the fuselage at this time.

STABILIZER and RUDDER

These require a minimum of comment. All parts except the sub-rudders are cut from C-grain balsa. The sub-rudders are 1/16 plywood. The horn joining the halves of the elevator 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. 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 and applying a drop of "Hot Stuff."

WING

I obviously consider the wing to be the most important part of the airplane. My construction sequence is as follows: Cut the 1/4×1/4 inch leading edges to length

and epoxy together *with the 1/2 inch leading edge taper built in. Note* that this assembly should be made on a straight, flat surface with the leading edge pieces on edge. Cut out the ribs and trailing edge planking. On either version, shape the trailing edge pieces to the outside wing dimensions. Cut-outs for flaps or aileron will be made later. As I do not own a wing jig, I block up the leading and trailing edges approximately a 1/2 inch all around the exterior dimensions. Add a 1/8 inch block under the trailing edges at the tips to get the desired washout. Mark all rib locations.

Start assembly by putting in the center and tip ribs. I use "Zap" or "Hot Stuff." Stop and check to make sure everything is still blocked up as desired. Put in the rest of the ribs. The assembly at this stage should include leading edge, ribs, and lower trailing edge planking.

Mark the location of the 3/8×3/8 balsa portion which serves as the hinge point of the aileron. Remove a portion of the ribs and install this piece and shape it to conform to the rib outline. The next step is to install the torque rod to actuate the aileron. Remember that the aileron is going to move upward, so the hinge line and torque rod should be mounted above the center line of the aileron. The bearing surfaces (2) should be cut from 1/8 O.D. brass tubing, placed on the 3/32 music wire torque rod, and then the ends of the torque rod bent to shape. Holes or slots must be cut into the ribs and spacers fitted under the torque rod to get the desired height. The bearings and spacers should then be epoxied in place.

The top trailing edge planking can now be installed followed by the top spar. The wing is then removed from the blocks, flipped over, reblocked, and then the bottom spar installed. Now turn the wing back to the upright position and install the bellcrank platform and leading edge reinforcement with *epoxy.*

Now comes one of the critical steps. The bellcrank is prepared by deburring the holes for the leadouts *and redrilling the hole for the elevator pushrod as far in toward the pivot point as possible to slow down the elevator movement* (GS bellcrank). I usually end up with the hole just outside the offset bend. The flexible leadouts are tied up. soldered, and then washed with baking soda or a good degreaser to prevent rusting. *Make sure the bends through the bellcrank are well rounded.* The *bellcrank is installed with the moving slot in line with the leadout location at low speed.* The first one I built, I automatically lined this slot up with the leadouts in the high speed position. I could throttle down but could not get back up to high speed. Needless to say, this does not work very well!

Cut out the slots in the ribs to allow for maximum line sweep movement. Install bellcrank and make sure it works absolutely free. *The vertical webbing between the spars and between the trailing edge sections should be installed now.* I then plank the leading edge and center section on the bottom part of the wing. The throttle pushrod is then installed. *Note that it emerges from the bottom surface of the wing with an offset to clear the fuel tank.* The elevator pushrod is then installed and the top planking added. *Make sure the slot for the elevator pushrod is wide enough to allow for the bellcrank movement.* The wing is than placed back on the blocks and capstrips added. The aileron is then spot-glued in place and carved to shape.

If the MK IX version is to be built, make the appropriate cut-outs for the flaps and install and 1/4-inch leading edge pieces. The flap blanks should be spot glued in place and carved to shape. Before removal, epoxy in the connecting horn. *Note* that this has a slight bend in it to compensate for the angle. I carve a solid block to fill in between the flaps. Hinges should be backed with scrap blocks to insure that they stay in place.

The line sweep is next and deserves some special consideration. My design may not be the best but provides maximum movement. The tip rib is 1/16 plywood. The center part of the slide is 3/32 plywood. This is shaped to provide an angled portion which fits the slot angle in the back of the rib so that the slide moves as far back as possible. The outside portions of the slide "sandwich" are shaped to provide (1) an overlap of the rib to keep things in track, (2) *provide an area for the release wire to pass through both sides of the sandwich and the rib* and still move as far back as possible. I usually glue the center piece to one of the side pieces and then screw the assembly together over the rib. The holes for the leadouts are then drilled. The release wire is from extra leadout wire and is soldered to the throttle movement is required for release. *The release wire is bent so that after release it springs out of the way and does not bind throttle movement.* The end should be "wicked" with solder to prevent raveling.

The outboard wing tip can be permanently installed and shaped. The inboard wing tip is spot glued in place, shaped on the outside, and hollowed on the inside to clear the line slide and leadout movement.

The wing is now ready for final sanding. *The leading edge should be as blunt and rounded as possible.* Since I usually MonoKote the wings and paint the aileron and flaps, strips of MonoKote are now ironed over the hinge area of the wing with at least an overlap of a quarter of inch of MonoKote on the top and bottom surfaces. The flaps and aileron are now hinged onto the wing and tip weight installed.

I usually fiberglass the wing center section around the leading edge and back to the spar with a width past the center ribs.

ASSEMBLY

To assemble the wing into the fuselage (when the GS bellcrank is used), it is necessary to remove the bottom section of the fuselage. *Make sure you have retained the original centerline mark on the fuselage to serve as a reference mark of 0° incidence of the wing.* Epoxy the wing in and then add the cut-out portion. *Fiberglass the area of the cuts!*

The rest of the assembly is straightforward. I use a slow-drying epoxy and then Epoxolite for all fillets. As I mentioned earlier, I Monokote the wings and paint the fuselage and tail. The finish is light and simple. Mask off the areas of the wing next to the fuselage where the MonoKote is to be placed and the areas around the aileron and flaps. I put on two, thinned coats of clear Superpoxy, sand, and then apply 3-4 coats of Primer, sand, and spray on the epoxy paint. Just follow directions on the MonoKote. Hook up all control surfaces, install landing gears, engine, and fuel tank and everything is about ready to go. To start with, set the flaps on the MK IX version with a maximum of 3/8 inch movement. *Don't forget the engine offset!*

ENGINES

I use the Tune 36, K&B 5.8, or TWA 36. Some people have had success with the Fox Combat MK IV and the ST S36 is also available. I think the old ST 35C and G20-35 are still competitive.

FUEL

I use 60% nitro Red Max fuel, but have had good luck with K&B Racing and other 50-60% nitro fuels.

PROPS

I use a 9×7-1/2 inch Rev-Up cut to 8-11/16-inch diameter. Zinger 9×7, Top Flite and Power Prop 9×7 and Power Prop 9×8 have been used by other competitors.

FLYING

This is a simple plane to fly. Takeoffs require only a *very* slight "up" and every effort should be made to get a straight, level take-off to a maximum six feet altitude. The transition to low speed will be accompanied *by a jump-up,* if the GS bellcrank is used, or *down,* if a SturdiBuilt bellcrank is used. Now drop the hook and activate the aileron and flaps. *Start with a very minimum amount of flap movement and see how much you like.* On the down-wind side of the circle, the plane will tend to settle. The transition into the nose high attitude is made by giving some "up" elevator and some throttle. From then, it is just a matter of practice to maintain whatever angle you desire. After you get proficient at low speed flying, get someone into the middle of the circle with you a 60-degree triangle so you can learn where 60 degrees actually is. You might as well use all the rules allow. Landings can be made from a level attitude by simply cutting the throttle as you go over the ramp at about two feet of altitude and then give slight up elevator as the plane settles or just land in the nose high attitude by just "backing down" to the deck. Remember 180 seconds for seven laps is about 10 mph. This should be your first goal. •