

# V I K I N G

**N**o one has ever developed an airfoil that would turn 13 seconds on an FAI speed run and then fly in 20' diameter circles at 10 mph, climbing out from 50'. In other words, sailplanes which are best in light air thermals are not best in speed events. Well then — how about one sailplane with **two wings** — one wing designed to be best in light air thermal events and one wing designed to be best at the combined FAI tasks.

Now you can go to **any** contest prepared for **any** task under **any** wind conditions and not have to decide until 2 minutes before your 1st flight which wing to fly. It's like having two entirely

different sailplanes yet only having to invest in one radio, one fuselage and tail feathers; also, there is a growing pressure to revise the rules to allow changing wings, etc., between rounds.

The flat bottom airfoil I designed in 1974 for the Windrifter is known to be the best for light air thermalling. That takes care of one wing. Now I have a **semi-symmetrical** airfoil which (those who have flown it believe) is the best yet compromise for the combined FAI tasks.

The history of the design of the airfoil is in itself interesting. It all started about 3 years ago when Bill Watson, then working for Hi Johnson, was developing an aerobatic slope ship (Rubber Ducky). Bill asked Hi's advice on the selection of an airfoil. Hi suggested the NACA 2R, 12. So it was. Later Bill used this airfoil on his Goose, a big machine. It is **very** fast, but is marginal in thermals and really suffers on the launch.

Blaine Rawdon decided to try a compromise between the 2R, 12 and a Paragon airfoil (similar to the Windrifter). He split the difference in camber between the two. The result was an excellent airfoil. His Mirage, built light (5 oz./ft<sup>2</sup>) launches well, thermals well and is fast but, in my opinion, is not forgiving enough to make consistently good landings so necessary in today's contests.

I modified the Rawdon airfoil by dramatically increasing its sharp leading edge radius. The Viking Mark II airfoil is much thicker at 5%, 10% and 15%, but is the same from 30% back. The result — excellent launches (as good as a Windrifter), competitive in thermals and fast, yet easy, to fly and make consistently

good landings.

To win in FAI events, the sailplane needs to be (1) Large but not too large — I selected 3 meter span. (2) The aspect ratio should be moderate so as to keep the Reynolds Number about 12:1. (3) The tail surfaces should be designed to just achieve stability — not like a free-flight. (4) The weight must be kept down to keep the wing loading below 7 oz./ft.<sup>2</sup>. (5) Large, effective rudder. (6) Effective spoilers. (7) Flaps are not needed with 12% high lift airfoil. (8) It should be attractive — pretty sailplanes fly better.

I proudly present to you the Viking. I hope you enjoy building it — I know you will enjoy flying it. Use the Mark I wing in light air thermal contests and for sport flying. It will go up when nothing else will. When the wind is up and you want to penetrate or go fast, fly the Mark II wing. You will be pleasantly surprised at its performance.

cut out your pattern.

(2) Cut the aft sides from 1/8" x 2" sheet. Use the scrap to splice the piece between F4 and F5. Type C or A.

(3) Cut the forward sides and the batten from 1/8" Italian poplar plywood. Grain direction is not critical on the batten, but fore to aft is preferable.

(4) Bond the battens in place to form the sides. Be careful to make one right side and one left side. Type E.

(5) Taper the four pieces of 3/8" triangular stock. The top pieces stop at F4. Notch out for the batten on the bottom pieces. Butt join the bottom pieces just forward of the batten. Saw slot as shown, and attach. Type C or A.

(6) Position the left side over the plans and cement on F3, F4, and F5. Type A. Notch the bottom of all three to fit the triangular stock and also the top of F5. Allow to dry.

(7) Position the right side and check that the nose and tail ends are square, etc. When you are happy, bond F3, F4 and F5, to the right side with cyanoacrylate — then add a fillet of aliphatic resin.

## CONSTRUCTION

### Adhesives:

Use of the proper adhesive is just as important as using any other proper building material. I feel that this is so important that I have specified the proper adhesive for each joint in the step-by-step building procedure. Where more than one cement type is acceptable, the preferred adhesive is listed first.

(A) Aliphatic Resin (Titebond, Wilhold Aliphatic Resin, etc.)

(B) Butyrate Cement (Ambroid Aero Gloss 40% Stronger, etc.)

(C) Cyanoacrylate (Hot Stuff, Zap, Jet, etc.) Use micro-balloons or soda ash fillers. If structures are fabricated with type C, each butt joint must have a fillet of type A added before covering.

(D) Contact Cement — volatile solvent latex — the type used to bond plastic counter tops — has strong odor (toluene). Water base contact cement is not to be used on the Viking.

(E) Epoxy — Any brand of 5-minute or 15-minute epoxy is acceptable.

### Fuselage:

(1) Trace the fuselage side view and

Type C and A.

(8) Space the tail end of the sides 1/4" apart and clothespin in position. Mark the F6 and F7 locations. Squeeze together the sides while installing the Type C and A.

(9) In a like manner, bond in F2 and F1. Type C and A. Now is a good time to cut a hole at the bottom of F2 large enough to pass the battery pack connector.

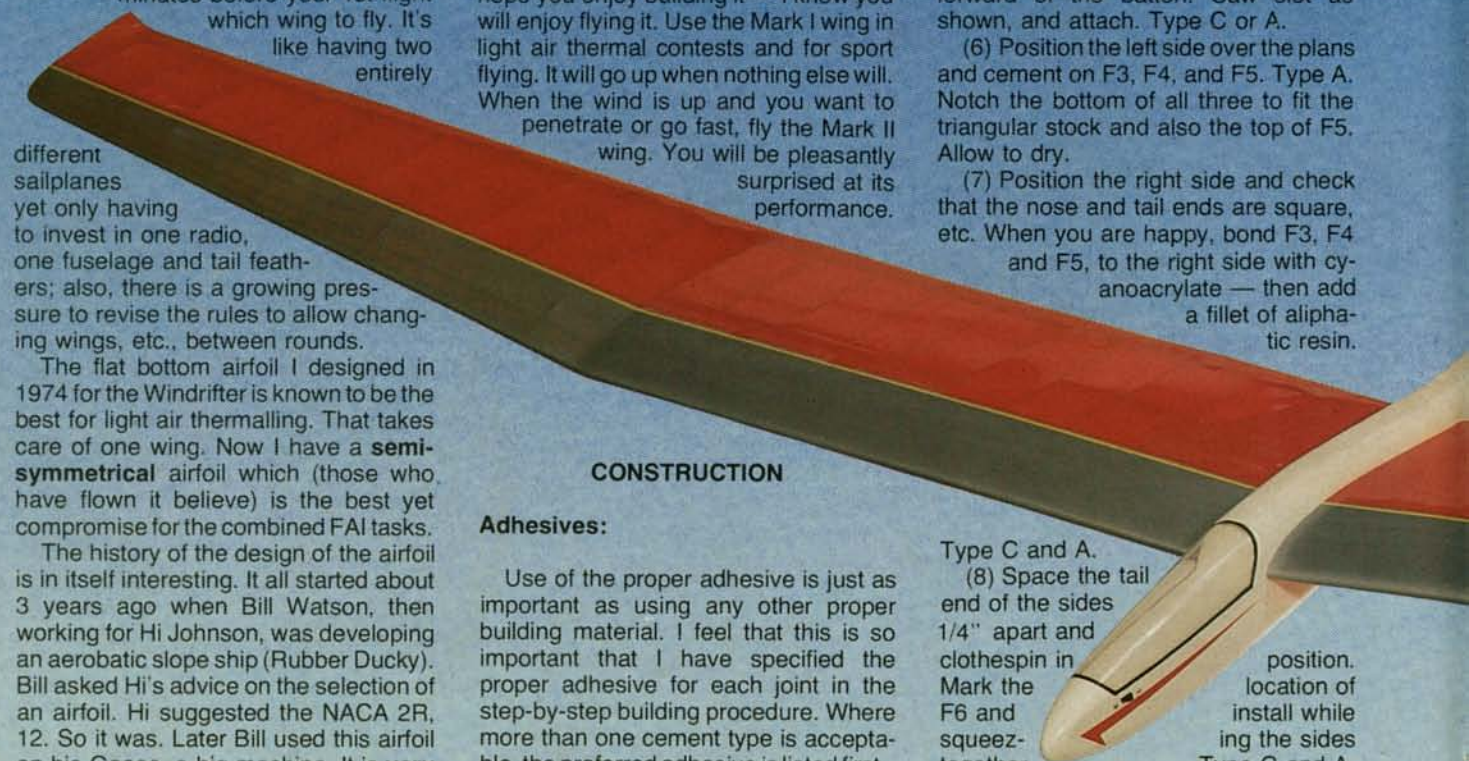
(10) Add the forward ply bottom. Type C & A, or A, or E.

(11) Add the forward and top nose blocks. Type E.

(12) Plank the bottom of the fuselage, all the while checking for centerline symmetry. Type A.

(13) Install the radio, antenna tube and control rods. Keep the tube and the control rods to the side in bay F3-F4 to allow for ballast installation.

(14) Build the ballast compartment hatch. Type C, A, or E. Wax paper is handy to keep the hatch from being glued in. **Caution:** At this point, make



sure the control rod housings are rigidly affixed to each frame and in the tail. Use Cyanoacrylate and micro-balloons (or soda). It requires major surgery to do this later. Type C.

(15) Cover the top of the fuselage from F4 aft. Type A. **Do not glue on the aft top piece.** This piece will be attached to the fin and installed with the fin.

(16) Fabricate the canopy tray from 1/8" poplar plywood. Type A.

(17) Attach the canopy.

(18) Notch the top block & F-2 to allow 500 ma battery pack into the forward fuselage. Set the aside at this until the fin has completed.

Type B. nose a square to fit compartment fuselage point been

(9) Remove from building board. If type C was used, go back and reinforce all right angle joints with a small fillet of Type A.

(10) Install the forward aluminum tube. Type E or C with filler. Crimp one of the tube ends closed and dent the tube in the center to hold the wire, but not too firmly.

(11) Use the bellcrank to mark the aft holes and drill for, and install, the rear tubes. Install the 3/32" x 1/2" sub spars. Check alignment and parallels before gluing in the tubes. Type E or C with filler.

(12) Use a large sanding block to sand the approximate airfoil shape shown on the plans. The exact shape of airfoil surfaces on the empenage is not paramount to good performance on R/C sailplanes. A symmetrical shape has slightly less drag in turns. Make it look pretty. Aesthetics plays a part in performance - it must be psychological, but pretty sailplanes do fly better.

(9) Cut and pin down the 3/8" x 1/4" rudder post. Slot the rudder base for the T.E. and pin down.

(10) Shim up the L.E. and rudder top 1/16". Slot the 1/4" sq. top for the T.E.

(11) Glue together the rudder spar, bottom, L.E., top, T.E., and corner brace. Type C or A.

(12) Slot the ribs as required for the T.E. and glue in all ribs. Type C or A.

(13) Use a large sanding block to shape the rudder to a symmetrical airfoil shape. Relieve the rudder post to clear the fin post in turns. Fit the hinges and control horn.

(14) Drill 1/8" diameter through for the bellcrank axle (1/8" aluminum tube). Make sure the hole is exactly perpendicular to the fin. Install the bellcrank. Slot for the rear wire. When everything is working to your satisfaction, bond in the tube. Type C.

(15) Note the grain of the aft fuselage top piece. Make this piece and attach to the fin. Type A.

(16) If Type C was used on the fin and rudder, go back now and add a small fillet of Type A to each joint.

#### Fin and Rudder:

(1) Cut all fin parts.

(2) Construct a sandwich of the fin base. The 1/4" sq. forward fin base must be tapered on both sides to 1/8" thick so that the total thickness of the base sandwich (1/16" ply — 1/4" balsa — 1/16" ply) at the L.E. will equal 1/4". Type C or A.

(3) Space up the L.E. and fin post 1/16". Glue the L.E., base, fin post and top rib together — add the corner

#### Wing:

If you're serious about R/C soaring, you will probably build more than one or two polyhedral wings, and a little time and a couple of bucks invested in a wing building board now will save you many hours in the future. The material required is:

2 pcs — 12" x 3' particle board shelving.

2 pcs — 15" x 3' composition ceiling board (Celotex).

#### Stabilizer:

(1) Cut the tapered spar webs.  
(2) Fabricate both I-beam spars. Type C.

(3) Cut the balance of the parts. Slot and notch the ribs.

(4) Pin down the 1/8" x 1/2" root rib. Block up the 1/4" sq. tip block 1/8".

(5) Pin and block as required to center the L.E., and the assembled spar.

(6) Set the T.E. in the rib and tip slots. Type C or A.

(7) Bond in the forward and aft ribs. Type C or A.

(8) Add the corner braces. Type A or C.

braces. Type C or A.

(4) Shape the L.E. spacer for the stabilizer base sandwich. Glue in the 1/4" sq. spacer and the L.E. spacer. Type A or C.

(5) Position the sub assembly just made, and attach. Type E.

(6) Add the 1/16" x 1/4" fin post fillers. Type A or C.

(7) Shape the L.E. and check that the fin is not warped.

(8) Carve the 1/2" x 3/8" stab root blocks to fit onto the fin and attach. Type A or C. Fit the stabilizer to the fin and carve the stab roots for a neat fit.

1 pr. — 1 1/2" loose pin hinges with screws.

1 pc — 2" x 4" x 1".

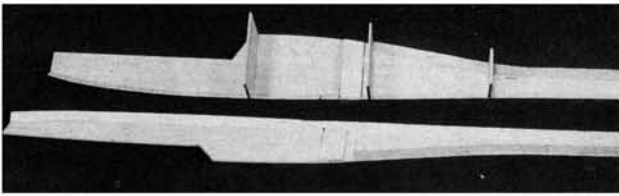
6 — 1" #8 F.hd. wood screws.

Hinge the shelving together (endwise) to form a 6' board. Block up one end to conform to the 7 1/2° tip dihedral requirement with the 2 x 4 and put in a couple of the wood screws to secure it. (This may be relocated later as required to conform to different dihedrals.) Cut away for hinge clearance and cover the shelving with the ceiling panels **upside down**.

Pins will hold beautifully in this material to page 67

By  
Tom  
Williams

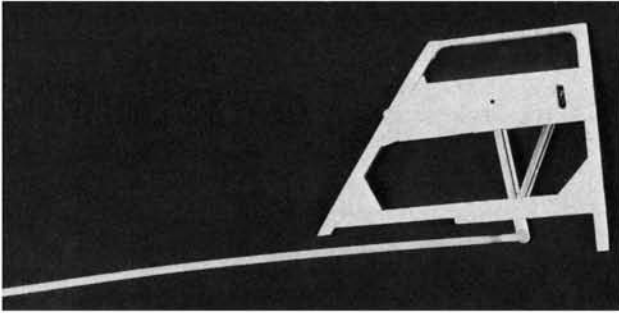
**A New Concept — One Sailplane designed to be the best at all tasks!**



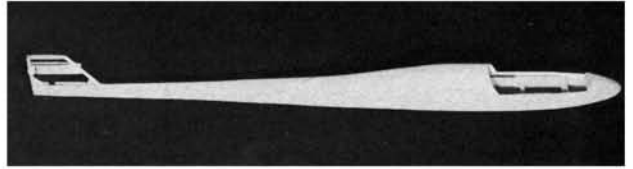
*Fuselage sides ready to join. Photo shows splice batten to top of fuselage. Was later shortened for ballast hatch clearance.*



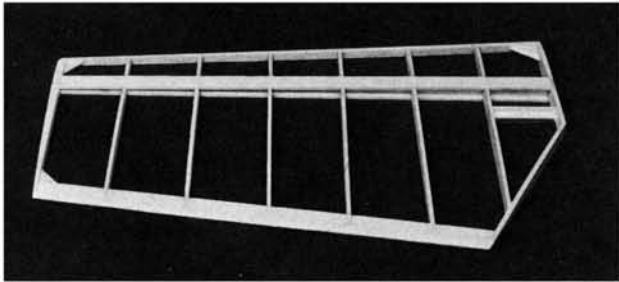
*Tail end of fuselage ready for fin to be installed. Last piece is glued to fin then on to fuselage.*



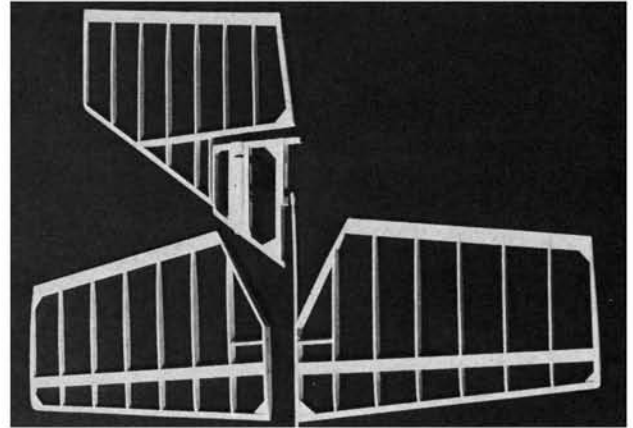
*Fin completed and ready to attach to fuselage.*



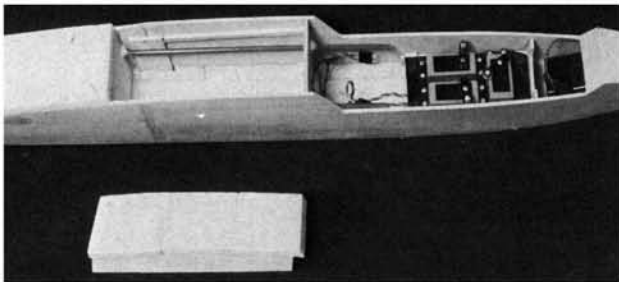
*Completed fuselage and fin.*



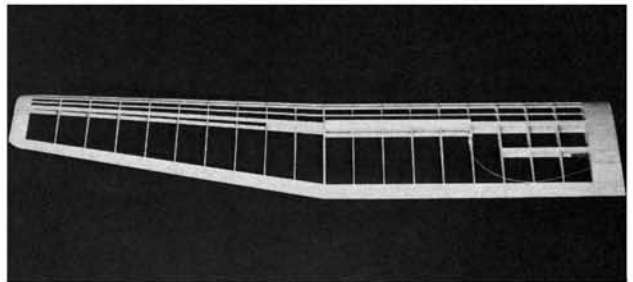
*Completed stab panel.*



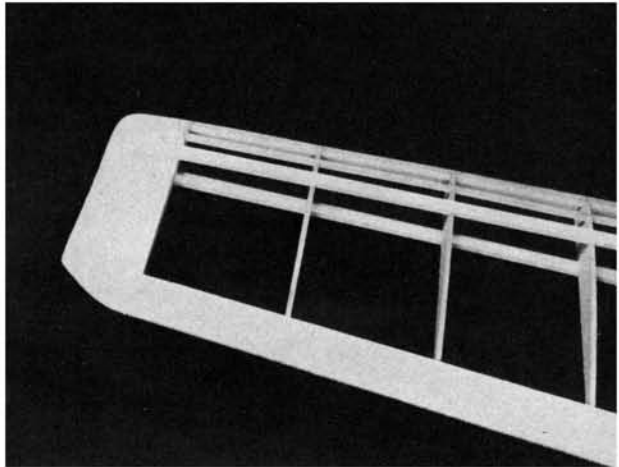
*Entire tail group completed and sanded to shape.*



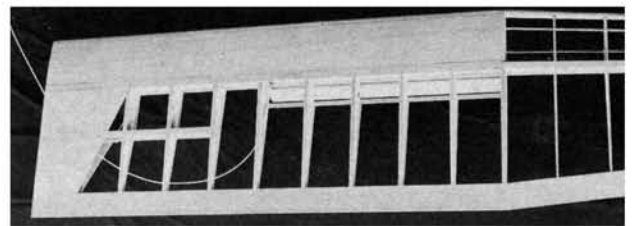
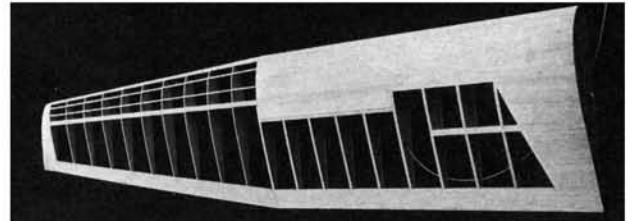
*Ballast hatch cover ready for sanding. Servos shown for location only; fuse needs final carving & sanding.*



*Completed MK.I wing panel. First bay only is sheeted.*



*Close-up of the anti-vortex wing tip.*



*TOP: Completed MK.II wing panel. Note the D-Tube sheeting as compared to the MK.I. ABOVE: Bottom view of MK.II wing panel. Note spoiler cable.*

rial, yet are easy to remove. Now your entire wing half can be built at once, saving lots of time and insuring a strong, true wing.

**Note:** The Mark I and Mark II wings require some differences in procedure. Steps which are common to both are noted with an asterisk. Since four wing halves and the fuselage must match exactly with two steel rods, before proceeding with either wing, make a set of four 1/32" ply W1 rib blanks with matched drilled 5/16" diameter holes.

### Mark I Wing:

(\*1) Taper the tip L.E. and T.E. stock. Pin down the lower half of the T.E., the lower main spars, and the lower sub spars.

(2) Pin down the L.E.

(3) Glue on W1 rib. Lean the rib 6° (top outward). Type A.

(\*4) Laminate two W5 ribs together. Type D. Cut notches for the dihedral wires.

(5) Cut out for the spoiler and the spoiler frame in four of the W5 ribs.

(6) Glue on the balance of the ribs. Type A.

(\*7) Glue in the 3/32" spacer on the center section T.E. Type A or C.

(\*8) Complete the T.E., i.e., add the top piece. Type A or C.

(\*9) Roughen the 5" pieces of 1/16" diameter steel wire (not music wire) with the edge of a flat file and bend in the center 7 1/2°. Slip one through the notch in the double W5 ribs.

(\*10) Slip in the fiberglass wing rod tubes and fit and glue in the main and sub spar webs. Type A. Remove the tubes.

(\*11) Add the spruce spar top pieces. Type A. Set the prepared wire spar splice piece in place before putting in the spruce.

(12) Put in the spruce turbulator spars from W2 to the polyhedral break and the balsa ones in the tip section. Type A or C.

(13) Install the spoiler framework. Type A.

(\*14) Install the 1/4" x 1/2" x 1/2" spruce screw eye base. Type A or C.

(\*15) Install the ASA plastic spoiler horn. Type B or C.

(\*16) Route the 25" nylon spoiler cable housing as shown through the ribs. **Do not cut off.**

(\*17) Cut a 1/4" square piece of tin from a coffee can lid, or what have you, and cement to the spoiler. Type E.

(\*18) Epoxy the magnet on to the rib. Type E. Install the dacron cable and check out the action of the spoiler. Use Scotch Magic Tape as a hinge.

(19) Remove the wing from the board and sheet the bottom of the first half of the first bay. Type A. Repeat these 19 steps on the other half of the wing.

(\*20) Slip the fiberglass wing rod tubes in position in both wing halves.

Check their alignment. Cement the tubes to the ribs with epoxy. **Don't economize on the epoxy.** Puddle in large epoxy fillets around the tubes to insure that the stress in the tubes is transferred to the spar. Plug the tubes with 1/4" sq. balsa forced in. Leave 4 1/8"

## VIKING

Designed By: Tom Williams

### TYPE AIRCRAFT

Competition Sailplane

### WINGSPAN

3 meters (118 in.)

### WING CHORD

11 1/2" (root) 6 1/2" (tip)

### TOTAL WING AREA

1200 Square Inches

### WING LOCATION

Mid-Wing

### AIRFOIL

Mark I, 11 1/2% Flat Bottom

Mark II, 12% Semi-symmetrical

### WING PLANFORM

Constant Chord - center section

Double Taper - tip panels

### POLYHEDRAL EACH TIP

6 Degrees center

7 1/2 Degrees tips

### O.A. FUSELAGE LENGTH

48 Inches

### RADIO COMPARTMENT AREA

(L) 9 1/2" X (W) 2 1/4" X (H) 2 1/4"

### BALLAST COMPARTMENT AREA

(L) 5 1/4" x (W) 2 1/4" x (H) 3"

### STABILIZER SPAN

14 7/8 Inches

### STABILIZER CHORD (incl. elev.)

7 1/2" (Avg.)

### STABILIZER AREA

94 Square Inches

### STAB AIRFOIL SECTION

Symmetrical

### STABILIZER LOCATION

Mid-Fin

### VERTICAL FIN HEIGHT

3 1/2 Inches

### VERTICAL FIN WIDTH (incl. rudder)

8 1/2" (Avg.)

### REC. ENGINE SIZE

NA

### FUEL TANK SIZE

NA

### LANDING GEAR

NA

### REC. NO. OF CHANNELS

3

### CONTROL FUNCTIONS

Rud., Elev., & Spoilers

### BASIC MATERIALS USED IN CONSTRUCTION

Fuselage ..... Balsa, Ply

Wing ..... Balsa & Spruce

Empennage ..... Balsa

Weight Ready-To-Fly ..... Mk. I, 54 oz.

Mk. II, 56 oz.

Wing Loading ..... Mk. I, 6 1/2 oz./sq. ft.

Mk. II, 6 3/4 oz./sq. ft.

or 17 oz./sq. ft. w/ballast

unplugged for wing rods. Type E.

(\*21) Epoxy the dihedral wires to the upper and lower main spars.

(22) Sheet the top of bay one. Type A.

(\*23) Reinforce W1 with 1/32" plywood. Type D.

(\*24) Attach the tip block flush with top on W15. Type D.

(\*25) Plane the bottom flush and radius bottom surface. Trim ends to continue L.E. and T.E. lines. Carve and/or sand top surface from spar forward to continue top contour of W15. This will form the tip profile. Rough carve the top rear surface to approximate shape (no material is removed from the extreme tip from the spar back). Use a pocket knife or a paring knife — X-Acto is not long enough to cut a straight line (varying angle) from the top of W15 to the extreme tip. Wrap a piece of 60 or 80 grit sandpaper around a piece of broom handle, a dowel, a piece of pipe or what have you, about 1" to 1 1/2" diameter and sand in the convex shape. The T.E. of the tip should be square and 1/16" thick.

(\*26) Sand the top of main T.E. to continue the rib contour and to achieve a square T.E. 1/16" thick.

(\*27) Sand the L.E. to the proper contour. It's a good idea to make a template.

(\*28) Cover the wing with Top-Flite Super MonoKote. Make sure the MonoKote adheres to every rib and spar. My designs are "stressed skin" and require the superior strength of MonoKote, properly applied. Our tests have proven, to my satisfaction, that MonoKote is both the strongest and the lightest covering commercially available. Cut out the spoiler. Reseal the covering to the spoiler and all around its frame. Hinge the spoiler with Scotch Brand Magic Tape 3/4" wide. This acts as a return spring. **Don't leave the spoilers open in the sun.**

### Mark II Wing:

Because the bottom of the Mark II airfoil is not flat, a slightly different building procedure is required. Most of the steps are the same and are not repeated. Refer to the Mark I wing for these steps.

(\*1) Same as Mark I.

(2) Block up the L.E. 1/8" and pin.

(3) Glue W1 rib to the T.E. and sub spar. **Do not glue ribs to the main spar or L.E. The L.E. and main spar are in place to aid in rib alignment. Type A.**

(\*4) Same as Mark I.

(5) Cut out for the spoiler in four of the W5 ribs.

(6) Attach all the ribs to the sub spar and the T.E. Type A and C or A.

(\*7) & (8) Same as Mark I.

The trailing edge is now complete. When the glue is dry, remove the pins and block up the T.E. 1/4" at the forward edge in the root section tapered to 1/8" at W15. Block up the root ribs just ahead of the main spar 1/16" to allow for sheeting. Glue all ribs to the main spar and to the L.E.

(\*9) through (11) Same as Mark I.

(\*12) Put in the balsa turbulator spars in the tip section. Type A or C.

(13) Install the spoiler framework and the cap strips. Type A or C.

## VIKING

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(\*14) through (18) Same as Mark I.

(\*19) Remove the wing from the board and install the bottom sheeting. Type A. Repeat these 19 steps on the other wing half.

(\*20) Same as Mark I.

(\*21) Epoxy the dihedral wires to the upper and lower main spars.

(22) Install the root section sheeting. Type A.

(\*23) through (28) Same as Mark I.

### Final Assembly & Trim:

(1) Paint or cover the fuselage with the covering of your choice.

(2) Cover the fin, stabilizer, rudder and wings.

(3) Mark the location of the fiberglass wing rod tubes on the fuselage. Be careful to get the wing incidence correct. Install the tubes. Type E.

(4) Cut oval shaped holes in the fuselage sides for the screw eyes and the spoiler cable. Drill a 1/4" diameter hole in F-3 for the spoiler cable. Put a flat washer on a #2 x 5/16 sheet metal screw and install in the last hole in the spoiler servo arm. Slip the looped ends of the dacron lines over the screw and check that both spoilers start to open simultaneously.

(5) Make the tow hook and install it where shown on the plans. Type E or C with filler. Adjustable tow hooks are not needed nor desired on the Viking. A captured, releasable tow hook may be used, although the advantage gained is very small with a high C/L airfoil, and, in addition to complicating the ballast installation, it adds weight and is something else to go wrong — to each, his own.

(6) Initially — use a 7/16" servo arm on both the elevator and rudder, and a 9/16" arm on the spoiler.

(7) Balance is very important. Initially, set the C.G. under the center of the spar.

For light air thermalling move C.G. back until just before it starts to become squirrely. This will vary from plane to plane and especially from pilot to pilot. For speed, add as much weight as you wish (maybe 5 or 6 lbs.) in the ballast compartment a little ahead of the C.G. to move the C.G. to about 25% — 28%.

Check your wings for warps after covering. Make sure the covering is tight and adhered to every rib. **No wash out!**

Good Flying! And may your Viking help you to become the World's Grand Champion — but look out — you'll have me to beat!

### VIKING SPECIAL PARTS LIST AVAILABLE FROM CRAFT-AIR

Description	Price ea.
SP-712 canopy	2.50
1/4 dia. x 10 1/2 230 KPSI steel rod	1.50
Set (10 pc.) F.G. wing tubes	2.50
Set (4 pc.) plastic spoiler horn	.50
Set (4 pc.) Alnico magnet	1.00
A-1 bellcrank	.95
SP-513 .046 I.D. x 25 nylon tube	.25
SP-312 .076 I.D. x 30 antenna tube	.25

