CHALLENGER

By Peter Neuer

Introduction

This high performance two meter sailplane has both the eye appeal and flying ability to make it a definite addition to your collection of models.

Challenger! The name implies something new and exciting, and that is just what this new 2 meter sailplane design is. I have always admired the soaring hawks of California. They possess great ability to ride light lift and still have the speed to sail right through sink areas in search of updrafts.

Now you can fly a sailplane that does just that. This high performance sailplane designed for multi-task competition or just plain fun flying is great at both. Soaring slowly in light air or speeding through sink areas.

This is possible because Challenger uses a proven airfoil (which has a very wide speed range) --- the Eppler '205.'

Challenger has the ability to turn into a light flat circle while riding a thermal upwards. You can tell easily when you have entered a lift area with this design.

High starts are an absolute breeze, straight up, no rudder control is needed. Pitch control is very good because of the full flying stabilizer.

The T-tail design was chosen because it lets the flying stab ride in turbulent free air — besides I think they look great.

If you're into slope soaring you will just love flying this machine. The speed it can obtain in even a moderate wind is breathtaking. When some of the other designs are just barely able to penetrate into the wind, you'll be flying patterns with your Challenger.

Construction is pretty easy and straightforward. The use of poplar ply ensures ease of construction as well as strength.

Some Building Recommendations:

A flat building board that you can stick pins into is recommended.

I prefer using cyanoacrylate glues for construction, both the instant bonding type as well as the gap filling variety.

Let's start with the fuselage first. Some

At left, Julie Stephens showing off the Challenger

fitting of the wings and stabilizer will be done later as you progress.

Start by cutting out all the formers and fuselage sides and bottom out of 1/8" poplar plywood or "lite ply" as it is sometimes referred to.

After cutting out the fuselage sides, mark them with a pencil wherever you're going to glue a former. Lay the right and left sides across from each other, then lay a ruler across so that the lines are at a right angle to the wing mount area.

With the fuselage sides laid flat on your workbench, cut and splice the 3/32" x 1/4" spruce reinforcements and glue in place in the servo area of the fuselage. Next, glue the 1/4" triangle stock along the bottom front area. Cut reliefs into the 1/4" triangle stock in the front 1½" portion so it will be easier to bend into place. I do this as I glue; it's easy with a cyanoacrylate glue.

Now glue the two F6 doublers in place.

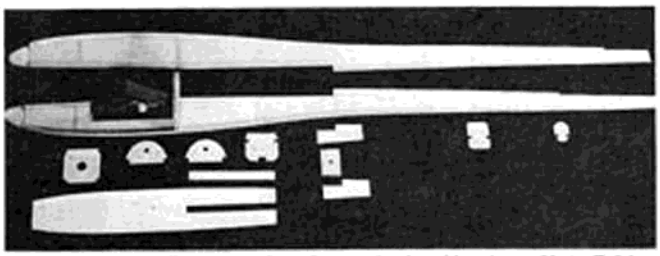
Next glue the two wing mount formers F-2 to each other. Be sure that the edges are square. Now, using a triangle to line them up squarely, glue to one side of the fuselage. After the glue sets, attach the other fuselage side. Be sure that both sides are parallel to each other. It is best that you do this while both fuselage sides are upside down on top of your workbench. You will have to let the nose extend past your work bench as the F-2 formers protrude above the top. While still in this position, pull the sides together and glue in F-4.

Be sure to check the alignment at this stage. If everything looks good and square, proceed with F-3 and F-5 using the same method.

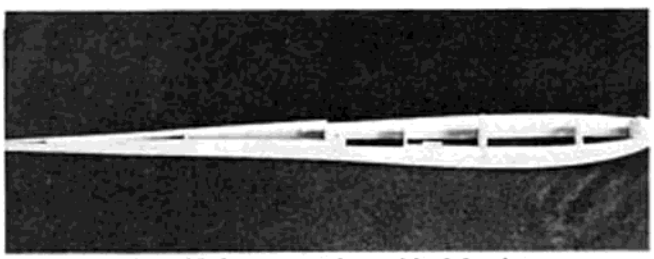
Now trim the triangle stock at the rear of the fuselage per the plans, using a straight-edge as a guide. Before gluing F-7 at the rear of the fuselage, be sure you leave a 5/16" gap so the vertical fin may be slipped into place. Tack glue, then check the fuselage with a straight-edge to be sure that the sides are at a right angle to the fuselage wing mount area. This is very **important**!

Glue the pine nose block in place. I pull the nose together and hold in position with duct tape across the front. While doing this, place F-1 in-between the sides, line up and then glue. Now you may glue the 1/8" poplar ply bottom into place but **leave the top and bottom planking until later**. This is so that you can slip the vertical fin complete with the flying stab pushrod into place later on.

Cut the two pieces of 3/8" square spruce

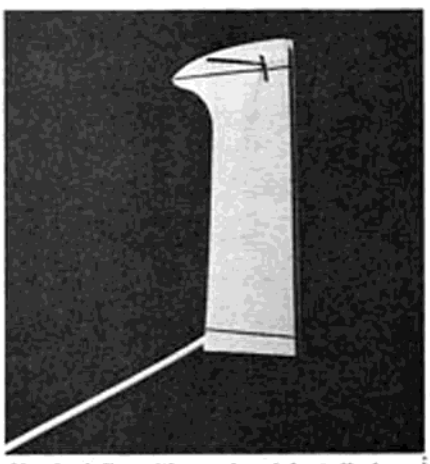


Fuselage sides showing triangle stock glued in place. Note F-2 is at a right angle to fuselage side.

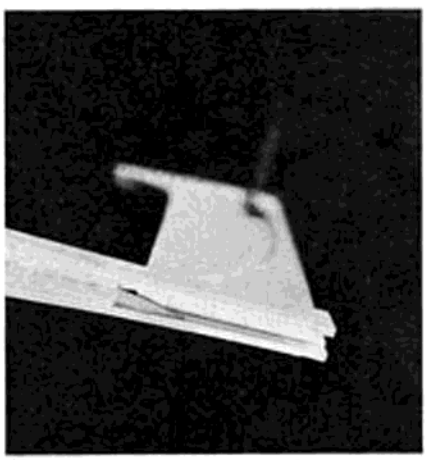


Fuselage sides with formers and noseblock in place.

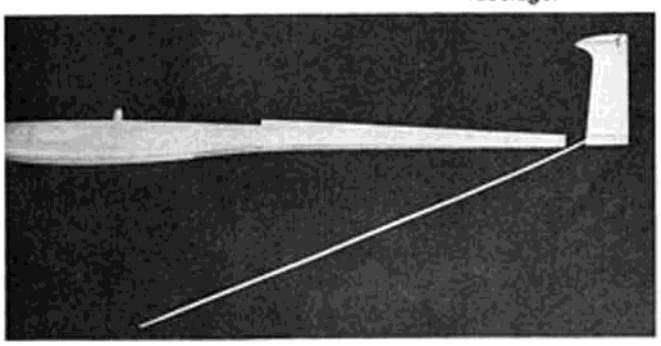
Su-Pr-Line pushrod with Rocket City ball end link. Trial fit into fuselage before covering sides.



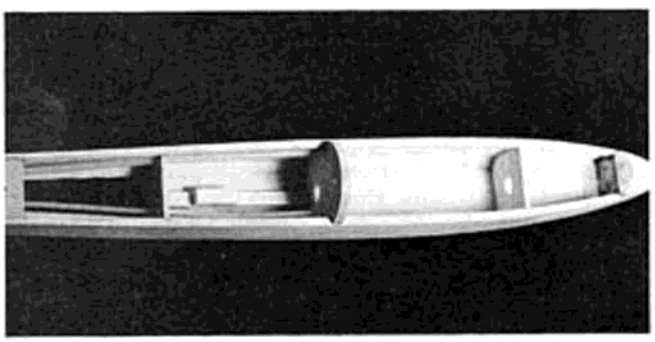
Vertical fin with pushrod installed and side sheeting attached. Notice reference lines used for alignment when gluing to fuselage.



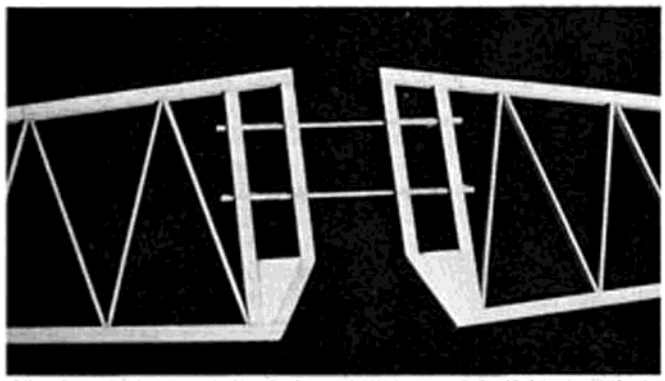
Bottom view showing rudder pushrod location, exit on right side of fuselage.



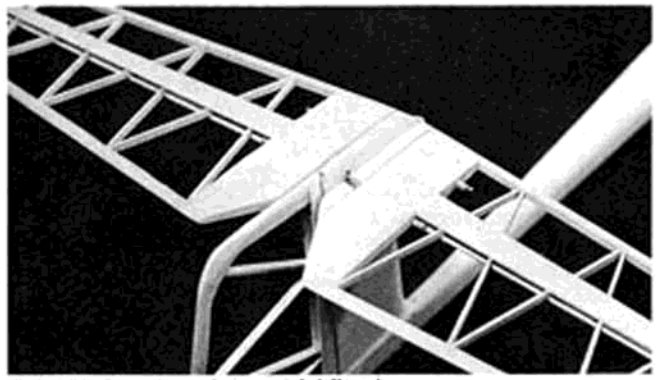
Glue vertical fin in place before sheeting top and bottom of fuselage.



Fuselage bottom installed with towhook mount in place, note pushrods.

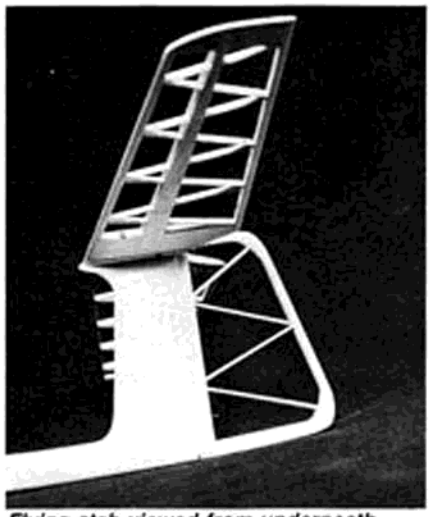


Slip the 1/8" brass tubing into each flying stab half, be sure that they are parallel and 1-7/16" apart before gluing. Use epoxy here.



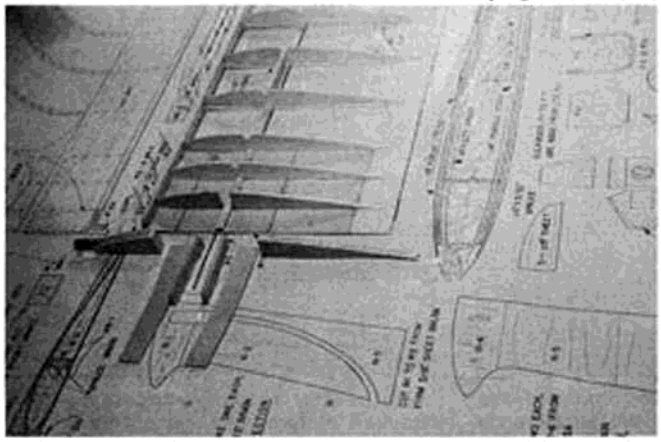
Flying stab and rudder are trial fitted.

Vertical fin with flying stab mounts in place.

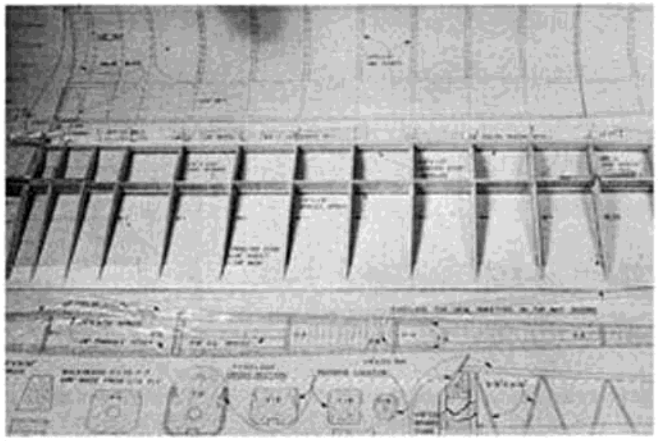


Flying stab viewed from underneath.

Top view of flying stab mount.



Right wing half, the first 3 ribs are cut to clear the 1/16" birch ply dihedral braces. Note the wing mount assembly with the 1/4" dowel in place.



Right wing pinned to assembly board. Shear webs are glued in place.

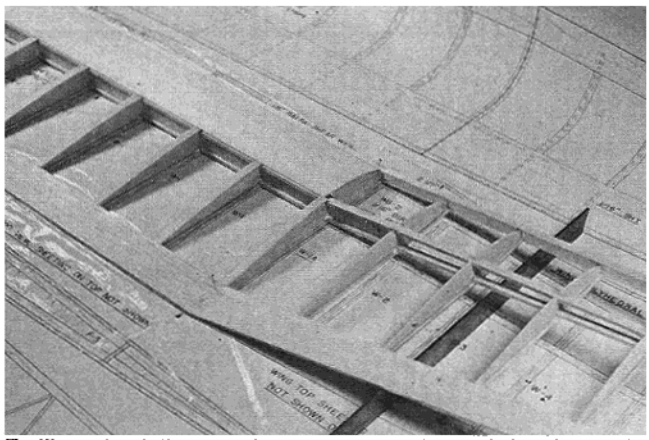
per plan and glue together. Install the towhook assembly into the bottom of the fuselage, between F-2 and F-3. Note that the bottom piece of 3/8" square spruce is flush with the bottom surface.

Install the 1/8" O.D. nylon tube antenna housing in place along the left side of fuselage. Note on plans where antenna exits at rear of fuselage.

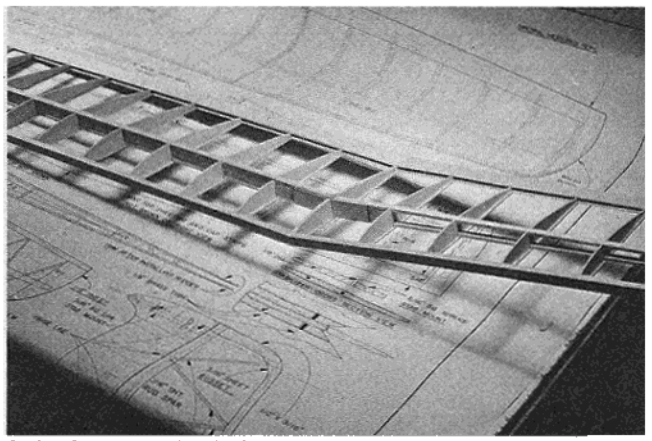
The vertical fin should be made now by gluing three pieces of 1/16" sheet balsa together per the plans, being sure to note the grain direction. Two of these are required. Glue and pin the 3/16" sheet balsa R-3 into place. Now take the 3/16" O.D. nylon pushrod housing (I used Su-Pr-Line's "Nyrod®). Bend it to match the contour of R-2 using a gap filling CA adhesive to do this, then put R-1 in place next. The ball end fitting I use is from Rocket City with the 2-56 threaded end. Screw it onto a 3/8" to 1/2" long piece of 2-56 threaded stud. Now drive the pre-cut piano wire through the hole in the ball end. It probably will have to be placed over a hole in a board or into a vise and then forced through.

The whole assembly, including the inner pushrod, should be slipped through the 3/16" nylon outer housing, the 1/16" balsa sheet sides are glued into place. Now sand the fin leading edge to the general contour. Place the fin over the plans and draw two lines indicating where the fuselage sides will be glued; also draw a line where the flying stab mounts will go.

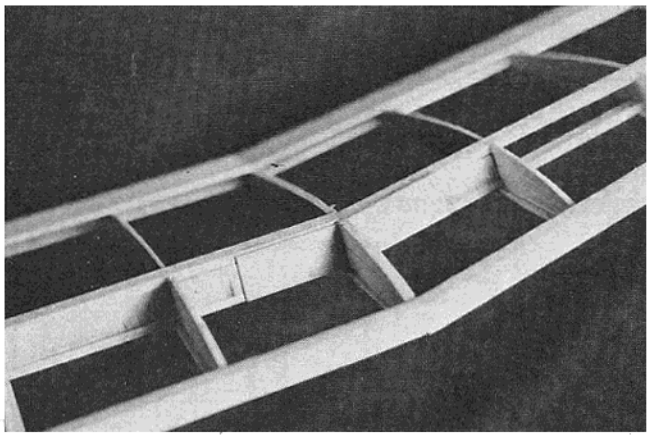
Now place the rear portion of the fuselage on top of your workbench, with the curved area hanging over the edge. Put a right angle triangle up against the side to be sure its at a



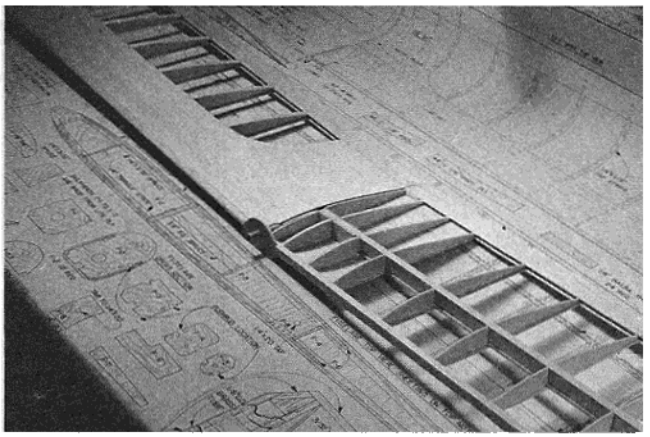
Trailing edge fully assembled, top spar strips and sheeting are in place. Set the outboard dihedral before sheeting the outboard wing panels.



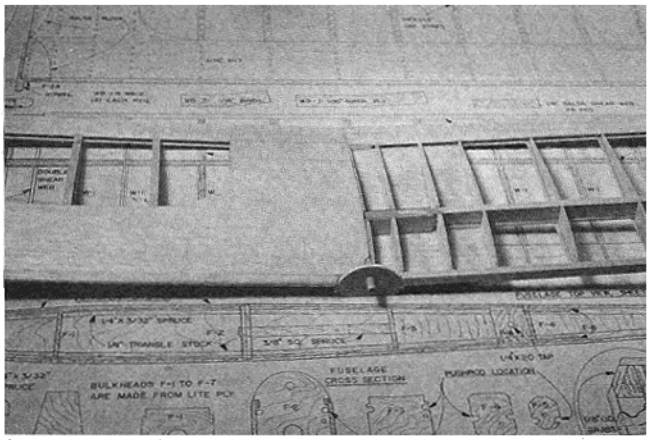
Left wing assembly before sheeting and top capstrips.



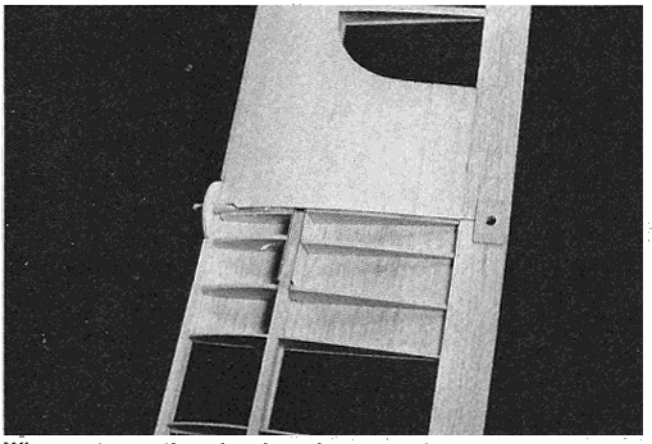
Outboard wing panel with 1/16" birch ply dihedral brace.



Wing center joint with F-2A in place. Set dihedral before sheeting.



Another view of wing center section.



Wing center section showing wing mount brace at trailing edge.

90° angle, now, slip the pushrod through the fuselage bulkheads. As you do this, guide the vertical fin into place and be sure that you check to see that the lines you drew are parallel to the fuselage sides, also check to see that the vertical fin is at a 90° angle before gluing it in place.

The fuselage 1/8" planking on top and bottom goes on next. Be sure that the grain runs crosswise. Be careful that you do not twist the fuselage out of alignment.

A great deal of effort must be put into sanding the contours of the fuselage. I prefer using a coarse sandpaper just to do this part then a 240 grade paper to prep the wood before priming and painting.

Flying Stab:

The right and left sides are the same; build them on the same drawing. Start cutting four pieces of 1/8" O.D. brass tubing 1½" long. Cut two S-1 tips from 1/8" balsa sheet. Cut four spars from 1/16" sheet balsa 11¼" x 3/4" x 1/4". Cut the 3/16" x 1/4" sticks to length, then drill two 1/8" diameter holes for the brass tubing. I stack the balsa sticks on top of each other as well as the 5/16" square stab supports and drill at the same time. Pin everything that has been cut in place and glue the 3/32" x 3/16" diagonals over the plans. After building both stab

halves, slip the 1/8" brass tubes into place with the piano wire inserted in the tubes. Check the alignment to see that the wires are parallel then glue the brass tubes into place. Be careful not to glue the piano wire to the brass tubes. Use epoxy for this step.

Rudder:

The rudder is built directly over the plans. Build the inner part first. When dry, remove from the plans and glue on the 1/16" sheet spars. Sand completely to shape then set aside for mounting later.

Wings:

Wings are the most important part of any aircraft. Take your time building them and they will reward you with outstanding performance.

Start by cutting out a complete set of ribs. Next cut out the trailing edge pieces. Four are cut from 1/16" sheet balsa 24" long by 1¼" wide. Use light to medium grade wood. Bevel the edges on the rear of the lower halves, about 1/2". This is so that when you lay the top half in place it will follow the top rib contour. Next cut the four outer panel trailing edges. They measure 15¼" long by 1¼" at rib W-1A to 3/4" at the tip. Bevel the two lower halves, 1/2" back from the edge as you did the center panels. Place Saran Wrap or waxpaper on top of the plans. Next pin down the trailing edge halves that are beveled.

Now pin down the leading edge 3/8" x 1/4" balsa. Put 1/8" scrap pieces under the Saran Wrap to hold the trailing edge off the building board. Let the scrap pieces protrude past the inside of the leading edge 1/16" so that it will hold up the front of the bottom capstrips. Note that the capstrips should be flush with the bottom of the leading edge.

Pin and glue the bottom capstrips into place. Cut and fit, then glue the bottom 1/16" balsa sheeting at the center section into place.

Next, trial fit, then pin into place, the 1/8" x 1/4" spruce spars. Notice that you must cut for the outer dihedral braces. Now pin the center ribs together and notch them to fit the 1/4" diameter dowel. Glue the side supports (W-1B) into place. Push the front of the ribs firmly into place, being sure that the front contour touches the lower capstrip properly. At the same time I use a cyanoacrylate glue to hold everything in place as I go along. Cut and glue the center section ribs (W-1A) to clear the 1/16" birch ply dihedral braces (WB-1). Glue the right side dihedral brace in place while the right wing panel is pinned to the bench.

Cut the outer (W-1A) for the dihedral brace to slip into the tip panel. Glue the 1/8" shear webs in place, gluing only the bottom and ends at this time. The upper 1/8" x 1/4" spruce spars are now glued in place, the pins are removed from the trailing edge and the top trailing edge is installed.

The 1/16" leading edge sheeting is next. Bevel the front edge slightly so it makes a good fit with the leading edge. Cut the front wing sheeting so there is about 1/16" of the top spar exposed; this helps to hold the front edge of the top capstrips. At this point, only sheet the center panel which is pinned flat on the board. Now, remove all pins holding down the outboard panel and raise the panel 2½" measured under the last rib (W-7). Glue the outer polyhedral braces and complete the wing sheeting on the right panel. After glue has set, remove the right panel from the building board. The left wing is built in the same manner except that no sheeting or capstripping is to be installed on the top until after the two halves are joined at the center with a 2½" dihedral measured at the polyhedral break (see detail on plans). After completing the joining of the two wing halves, the 1/16" ply plate can be installed. Trial fit the wing onto the fuselage, then glue the fuselage wing mount (F-8) into the fuselage. Drill and tap for a 1/4-20 nylon bolt. Use a 1" long nylon bolt to hold the wing in place.

The wing fairing blocks are now rough cut and shaped then glued on the wing while it is attached. Finish contouring the blocks to fair into F-2A and the fuselage at the trailing edge of the wing.

The wing tip blocks are installed and the entire wing assembly is sanded smooth. Pay extra attention to the area where the capstrips meet the leading edge sheeting. These must be flush and smooth or they will show up after covering. One final note: When covering the wing, be sure to put in 1/8" washout at each tip on the outer panels.

Finish And Covering:

After installing the radio gear and checking all controls to see that they work freely, remove the servos and battery pack leaving only the Nyrods® in place. Carefully sand the entire airframe with 320 sandpaper. The several prototypes were primed on the fuselage only with three coats of automotive primer with lots of sanding between coats, using 400 grade paper.

Use your favorite paint for the fuselage and fin and one of the plastic films for the wing, rudder and flying stab.

The towhook can be installed at this time. The placement should be 1/8" ahead of the C.G. The hook used on the prototype was purchased at a local hardware store for a nominal cost. It is a regular "L" hook used for various things in the household. Drill a small hole in the 3/8" square spruce and screw the hook in. It's a good idea to put a few drops of cyanoacrylate glue on the hook to keep it from working loose.

Flying:

In setting up your control surface throws, they can be set for maximum throw. Make sure that the stab does not reach the end of the slot in the fin and cause your servo to stall. Start with a middle hole on your servo output wheel or arm and set up the throw to give you the full movement at the stab without touching the ends of the slot. The rudder can have the full throw of about 30 degrees each way.

After carefully checking your complete installation to see that all control surfaces are moving in the right direction, and are free from any binding, go through a range check with your radio.

Check the C.G. adding ballast as necessary. If you are using mini-servos, it may be necessary to add a little weight. The Challenger was designed to accept even the larger type standard servos.

Test glide your Challenger from a slight rise, if possible. This will give you a little altitude so you can observe the flight characteristics of your new creation. Do the necessary trimming and adjusting of the control surfaces to obtain a straight and gentle glide.

Now comes the time for the high start or a trip to your favorite hill. Your first launch will certainly be a great thrill as will the many to follow.

Carefully watch your first flight and do your final trim adjustments. Add nose ballast as required. I hope you have as much enjoyment from your Challenger as we have — happy landings. □

CHALLENGER
Designed By: Peter Neuer

TYPE AIRCRAFT
2 Meter Sailplane
WINGSPAN
78½ Inches
WING CHORD
8 Inches
TOTAL WING AREA
580 Sq. In.
WING LOCATION
Shoulder Wing
AIRFOIL
Mod. Eppler 205
WING PLANFORM
Constant Chord Center
Tapered Tip Panels
DIHEDRAL EACH TIP
Center Panel 1¼"
Tip 1⅞"
O.A. FUSELAGE LENGTH
40 Inches
RADIO COMPARTMENT AREA
(L) 7⅛" x (W) 1⅝" x (H) 2"
FLYING STAB SPAN
23¾ Inches
FLYING STAB CHORD (incl. elev.)
4 Inches (Avg.)
FLYING STAB AREA
81 Sq. In.
STAB. AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Top of Fin
VERTICAL FIN HEIGHT
7⅛ Inches
VERTICAL FIN WIDTH (incl. rudder)
6⅛" (Avg.)
REC. NO. OF CHANNELS
2
CONTROL FUNCTIONS
Rudder & Stab
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Balsa, Pop. Ply & Spruce
Wing ..... Balsa, Ply & Spruce
Empennage ..... Balsa
Wt. Ready To Fly ..... 26-29 Oz.
Wing Loading ..... 6.37-7.10 Oz./Sq. Ft.