SPECIFICATIONS

Type: *Sport scale seaplane (adaptable to land)*
Wingspan: *70 1/4 inches*
Weight: *6.75 pounds (108 ounces)*
Wing Loading: *27 ounces per square foot*
Power Req'd: *.50 to .60 4-stroke; .40 to .50 2-stroke*
No. of Channels Req'd: *4 minimum; 5, if flaps are desired*
Materials: *Balsa and ply, conventional structure*

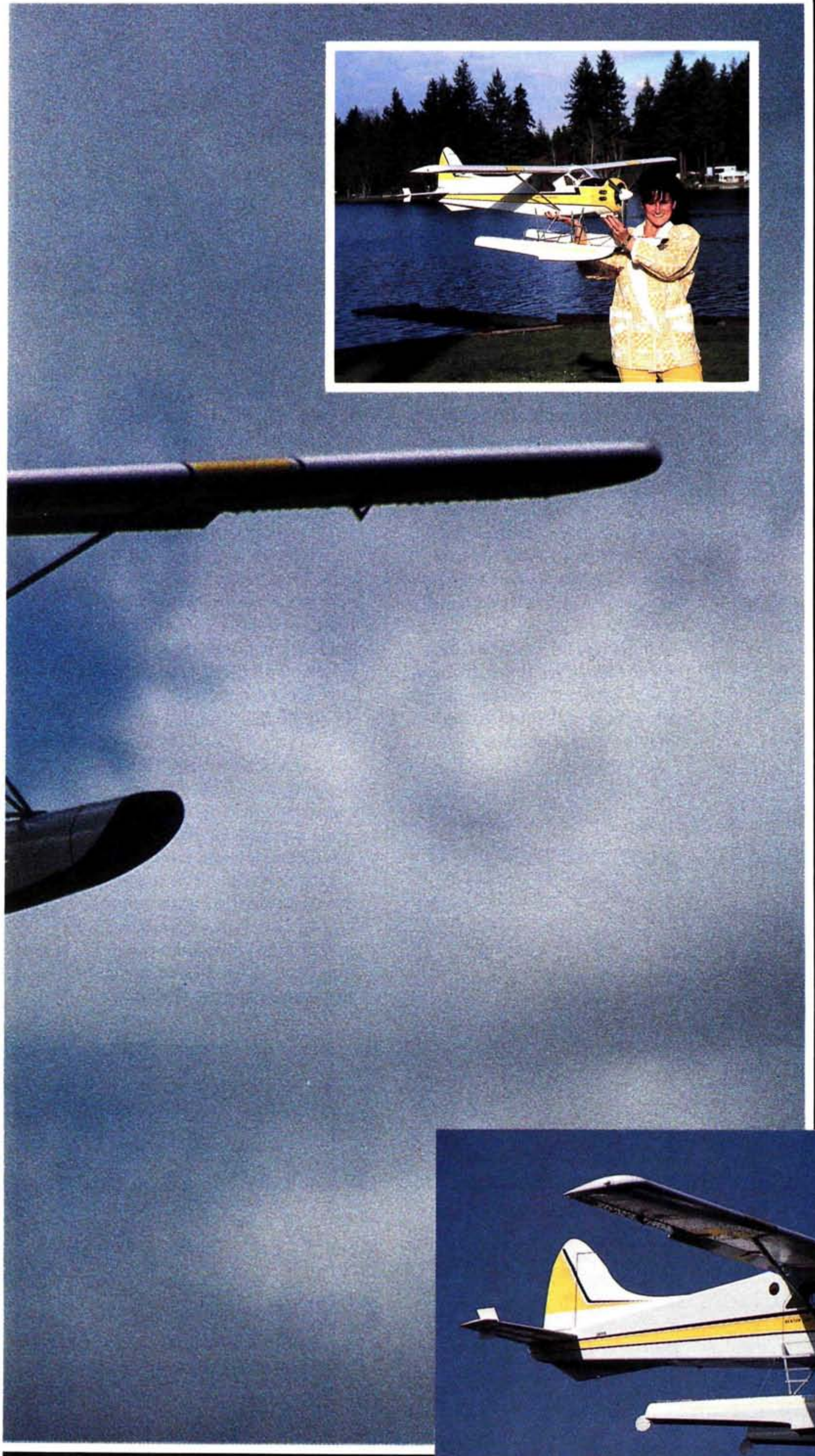
by ED WESTWOOD

A great model of deHavilland's "plane for all seasons"

THE BEAVER BUG bit me last year while I was photographing float ships for an article on float fittings. After wandering about in a sea of these ships, there it was: big, kind of ugly, narrow, long-wing, fat and stubby—guilty on all counts. But if you want to pick a seaplane that's one of the most revered for pure hauling ability and solid flying qualities, this is it.

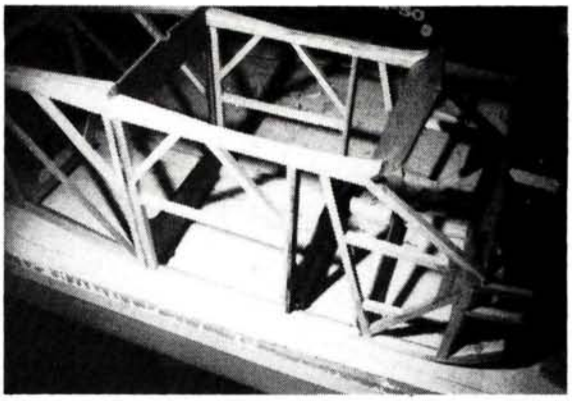
Unionville Hobbies of Canada* kits a 96-inch machine, and Ikon N'West* kits another big one here in the States, but where's the small one? Since the Beaver is so popular in full scale, why no .40-size examples? The primary reason is probably the problem of getting the CG far enough forward without adding weight; next come the difficulties involved in designing a film-covered, open-frame ship that looks like its full-scale tin brother, and in constructing a torsionally stiff high-aspect-ratio wing with slotted flaps.

deHAVILLAND DHC-2 BEAVER



PHOTOS BY ED WESTWOOD

The author's Beaver on static display at the annual Puyallup, Washington, show. Got everyone's attention, was an obvious favorite!



Fuselage sides joined. Structure is sturdy but not heavy.

Assuming these problems can be overcome, you still have to keep the ship light enough to fly well and still look to scale.

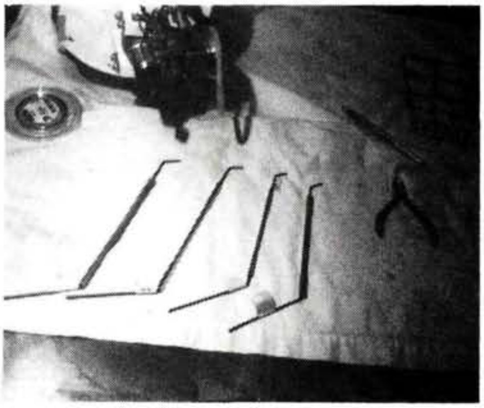
These were the problems that confronted me as I began drawing. Since the external configuration was fixed for me, I just had to put a light, strong, structure inside and a big 4-stroke up front to balance the short nose moment. I knew that if I did need nose weight, putting it in the float tips would minimize the amount needed.

Before I tell you about construction, I'll just touch on my performance goals. This ship is designed to look, fly and sound like its full-scale counterpart. It isn't an acrobatic machine, but with a strong .40 4-stroke, or even a .50 (if you're brave), when it breaks water, you can point it straight up, and only its diminishing size will make you level off.

Of course, for scale-like takeoffs and landings, flaps are mandatory. Dropping the flaps on the turn to final will allow you to point the nose down at a 30-degree angle and spot your landing for maximum scale realism. My side-mounted Saito .50 is admittedly slightly large for this 6.5-pound ship, but I remembered trying to fly off the Pine Hollow reservoir in the hot summer sun with a pooping .40. This year, I was ready, and it was the only place where I really needed full power on takeoff. Back at sea level on cooler days, half throttle is all that's needed. The engine even sounds like the big 450hp Pratt & Whitney chugging by.

CONSTRUCTION: This is straightforward, but I recommend that you read the text while perusing the plans, and pay special attention to the assembly sequence. You'll notice that the scale float struts exit the fuselage sides above the bottom and must be locked into place after the fuselage has been completed and covered. The struts

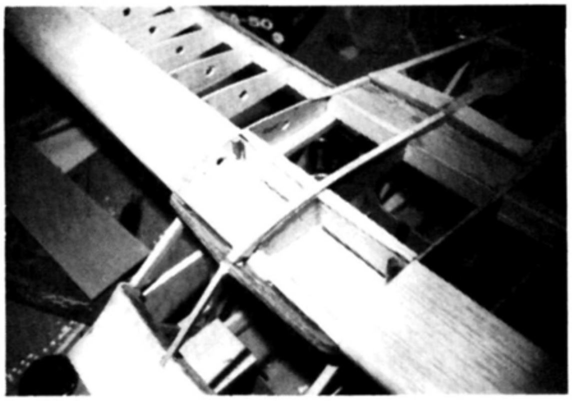
A LOT OF AIRPLANES have been referred to over the years as "classics," "workhorses," "sturdy," "pilot's airplanes" and other terms of endearment, and the deHavilland Beaver is no exception. To quote: "The Beaver: Sturdy bush aircraft developed by deHavilland Aircraft of Canada Ltd., puts on military garb and joins up—with the United States. Over 300 of these rugged craft are slated to be flown across the border to our Army and Air Force during the coming months.The L-20 version will be basically the same airplane that deHavilland sells for $26,450 flyaway Toronto." This quotation was taken right out of the June, 1951 issue of *Model Airplane News!!* This old bird of the land is worth two in the bush! ■



3/32 wire fittings. Streamlined aluminum tubing is slipped over wire before lower bend is made.

ORDER THE FULL-SIZE PLANS ... PG.136

Robart differential bellcranks are used for aileron control.

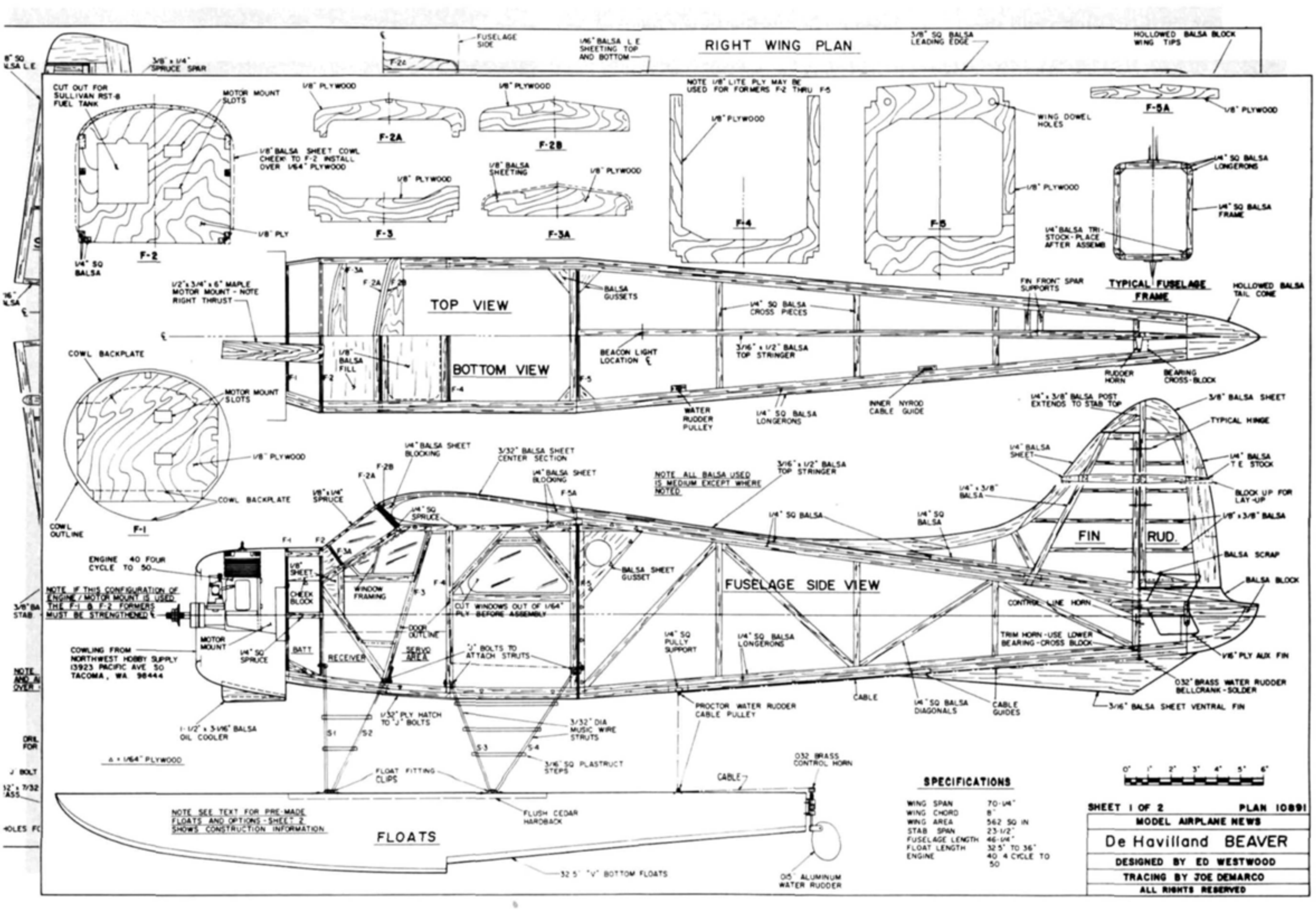


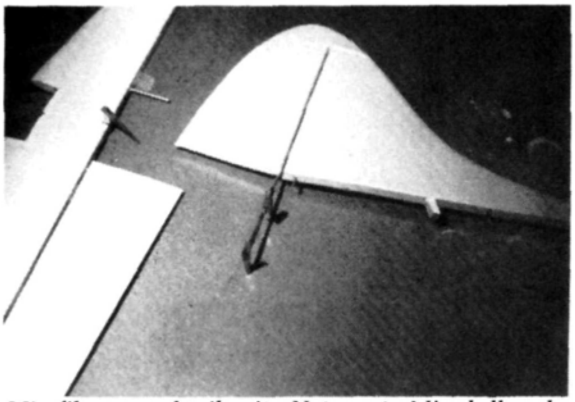
Wing/fuselage joint. Note fiberglass tube hold-down screw bushings.

can be removed and straightened, or replaced fairly easily following a bad dunk. The one-piece wing is keyed and locked to the cabin top, rather than to two panels on each side of the fuselage as in full scale, and this eliminates alignment problems and control connection difficulties. Finally, all surfaces and the floats are vented to eliminate any differential-pressure sucking caused by changes in altitude and temperature.

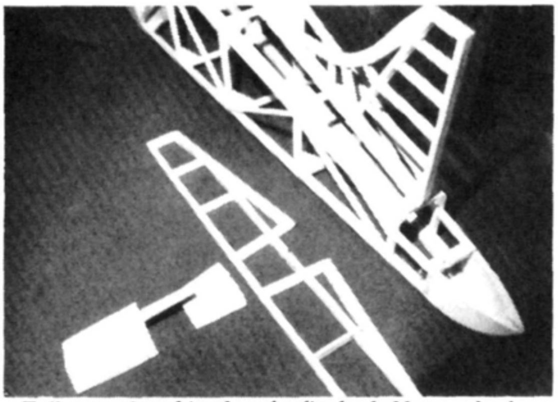
• Fuselage: This classic built-up box structure differs only in assembly sequence. The bulkheads are secured to one side, and the other side is attached to form the forward box. The rear sides are drawn together and the additional inner longerons secured, and then the assembly is glued together in the usual way.

The fuel tank, servos, J-bolts, strut-attachment plates and control rods are installed before the 1/64-inch sides are secured. The chines are then rounded, either by using a balsa plane, or (as I did) a router and a 1/2-inch carbide bit. The junction where the plywood and sides are exposed by the contouring might have to be filled slightly, so be patient as you complete this step.





Micafilm covered tail units. Note control line bellcranks used to keep all pushrods inside fuselage. All adjustments are made at the servos.



Tail cone pinned in place for fit check. Not much of a stab, but it does the job very well.

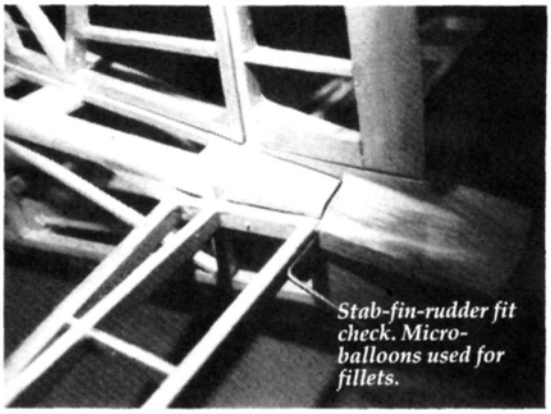
Now the front is sheeted and the lower-windshield extension panel carefully joined to the rounded top between bulkheads 1 and 2. The 1/8-inch cheek panels between these bulkheads are added last and feathered in at the top and bottom. Drill the engine-mount holes, check the engine for fit, and set the fuselage aside.

• Tail Group: Assembly is straightforward, but care must be taken when blocking up the elevator and rudder trailing edges to ensure proper alignment; the upper ventral LE must also be blocked up 1/16 inch to be centered. Hinge slots are made before covering so that those little wooden chips aren't left in the bays.

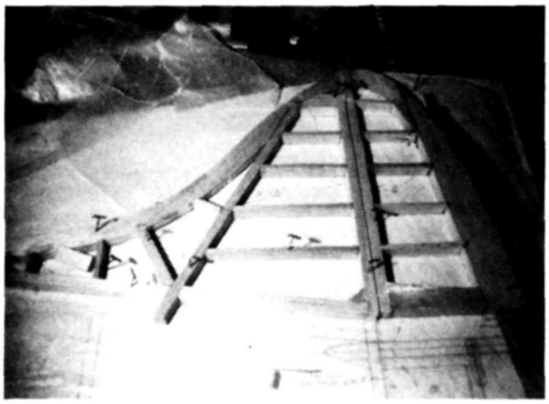
Remember to drill out the inside of the elevator balances and add at least six B-Bs. Hinges can be either the easy type or the standard pinned ones, but whichever you choose, seal them well with silicone after installation. The auxiliary fins are installed before joining the elevator, but after covering. Holes are drilled in the elevator and rudder root blocks to accept the 4-inch control-line elevator horns.

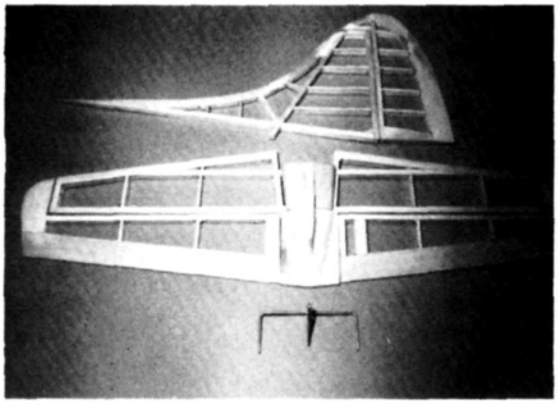
Groove the stabilizer and fin trailing edges before covering to allow a proper recess for these units when they're installed. The rudder/fin assembly is attached to the covered fuselage first. Hinges should be permanently installed in the fin, but not glued in the rudder until the horn has been properly established in the fuselage and accommodation has been made for the lower bearing. Remember to cut off the lower angle of the horn to accept the .032 brass water-rudder bellcrank. (This is soldered into place after the access hole in the bottom of the fuselage has been closed.)

Small 1/32-inch tabs are secured to the ventral fin corresponding to the fuselage cross-braces. The fin is attached with No. 2 sheet-metal screws through the tabs. The tail cone and center elevator fairings are carved from soft balsa. Make the cone slightly wide so that it can be sawn down the center and hollowed, then glued back together. I painted these items: first, with a couple of coats of dope and then with matching Formula-U*. If your color scheme is white, like mine, white tub sealant is the ideal filleting material to close the fin/fuselage, stab/fuselage and tail/cone fuselage joints. Remember to coat the quick-links with light grease before closing the fuselage. To ensure proper tail alignment, be sure to lock the wing into place before securing the vertical and



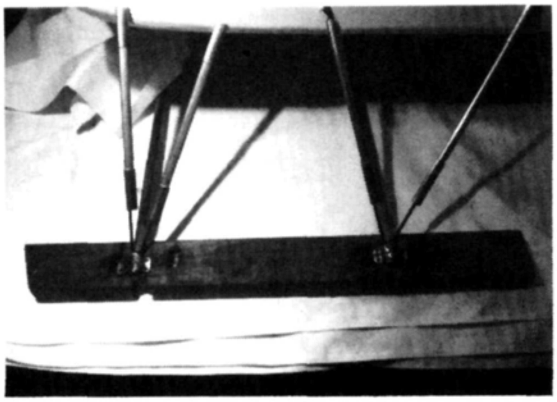
Stab-fin-rudder fit check. Microballoons used for fillets.



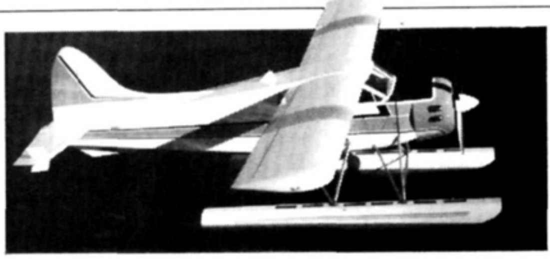


Left: Completed tail group prior to covering.

Far left: Rudder/fin framework in build-up stage.



Soldering the float-mounting clips to the strut assemblies.



horizontal stabilizers.

• Wing: This isn't simple, so take a deep breath and follow me. Start by making the rib templates out of 1/16-inch plywood. Drill two fine holes in these templates so that they can be pinned to the 3/32-inch sheet for cutting. Do the same with the flap and the aileron templates. Note that the templates must be made slightly undersize, since the No. 11 blade will slightly enlarge the cutout. Try a couple of ribs, and check for size before you cut them all.

The spars and upper and lower aileron and flap panels are now cut. Don't forget to mark each one somewhere so that they won't be mixed up in final assembly. Before assembling the ailerons and flaps, dope both sides of the sheet to minimize shrinking and warping during final painting. As with the tail group, cut the aileron hinge slots before securing the top sheet. A word to the wise here: CA is very difficult to sand; I usually use Sig-Ment* for any joints I'll have to sand; it takes longer to dry initially, but the results more than offset the time spent on it. Before sheeting the leading edge, the 1/8-inch-wide carbon strips are glued to the upper and lower surfaces of the spar using CA.

Sheeting is tricky. Mark the underside of each sheet for the rib and spar locations. Now put a thin line of Titebond over the lines and onto the corresponding wing members. Let it dry. Spray the other side of the sheet so that it will naturally curve slightly, and iron the sheet to the wing with your sealing iron on a high-temp setting. To ensure that you don't build any warps into the structure, be sure to block the wing securely first. My ship has no washout and flies well without it, but if you err, err on the side of washout.

Now make a leading-edge template and contour the leading edge. The wing tips are made of solid, but hollowed-out, soft-balsa blocks. Mark the outline from the wing, and then cut and sand it to the exact contour. Attach the tips, and give them a couple of coats of dope, lightly sanding between coats. The two wing panels are joined in a jig, which is made by attaching four female rib patterns to a 6-foot 2x6. If you don't do this, you won't be able to align them properly, so take the time to make the jig. While in the jig, the root doublers are fitted and glued into place. Don't attach the top sheet yet.

Now take the wing out of the jig, finish any of the bottom work in the root, and put it on the fuselage. Measure from tips to tail until you're satisfied that it's aligned, and temporarily fix it in place. The fiberglass stub hold-down screw tubes are installed, and the center is sheeted. Of course, some trimming will be necessary to ensure that the top of the wing center section matches the fuselage; that's why you don't finish this area in the jig. The rear wing alignment dowels are slipped into the holes in the bulkhead and tack-glued to the underside of the root trailing edge. Drill through the upper fuselage saddle sides and into the pre-placed hardwood blocks. Tap the blocks for 10/32 nylon screws while the wing is still in place. Now the wing can be removed and the rear alignment pegs epoxied permanently.

The wing is now turned over and the bellcranks and pushrods installed. The .032 brass strut plates are installed next; be careful to ensure that the angle is correct, of course. These are active struts, so take the time to ensure that they're anchored well. Temporarily attach the ailerons and line up the 60-degree differential bellcrank pushrods to the horns. Mark the ailerons for the horns, remove them again, and secure the horns. At this point, I'm assuming that you've already applied the final paint to the ailerons, but if you put the horns on first, you can always take them off for painting. The wing-top trailing edge just ahead of the flaps has a piece of 1/64-inch ply secured with 1/4-inch triangle stock just below for support. This is the slot director, and I fiberglassed the underside with 3/4-ounce cloth to ensure that the covering wouldn't cause it to bend upward when tightly shrunk.

• Struts and float fittings:

1. Wing Struts: Although my struts were exactly 13.4 inches long from pin to pin, it's always

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a good idea to measure the hole-to-hole distance while the wing is being installed in case your fittings are slightly different. When that has been done, cut the 1/2-inch aluminum streamlining tubing to length, and stuff tufts of cotton into each end. Drill some small holes in the ends and JB-weld the threaded rods into place. Bevel the 5/8-inch streamlining tubing end covers to match the wing and fuselage strut angles, and slide them over the struts. Check the fitting's end widths to ensure that the strut covers will slide over them (file them, if necessary).

2. Float struts: Each float down-strut is separate (not the ideal configuration, but since the struts exit the fuselage above the bottom, it was the only way I could make it look right). There are four of them on each side, and the plans show the sizes. Bend the top angles first, then slide the 3/16-inch aluminum streamlining tubing over them, along with the 1/4-inch, end-joint covers. (Do this before bending the bottom angles.) Block up the fuselage, slide all the struts into the appropriate holes, and lock them into place (after covering the fuselage, of course). To improve sag-resistance, the strut wires are joined at their lower ends. This is accomplished by bringing together the two strut bottoms and the 1/8-inch spreader with its 1/4-inch streamlining-tubing cover in place. Wrap the ends with copper wire and solder the three pieces together, capturing the spreader in the center.

The 1-square-inch float clips are made of 1x1 1/4x.032-inch brass stock. Make a "dummy" end stub that's identical to the one you just soldered together, and notch a hardwood block to accept both the end assembly and the brass clip. Put the dummy assembly over the clip and put them both over the notch in the block. Now hit it sharply with a hammer, or squeeze the whole works in a vise. This will form a "U" in the float clip. Make four of these clips. Put them all on their respective struts, which, in turn, are positioned over a horizontal surface marked like the float top. Solder them to the float struts by first tinning both the clips and the strut ends and "sweating" them together. Certainly there's an easier way to attach the floats, but this is a scale ship, and I devised this method to keep it close to scale. I didn't, however, put the spreaders through the floats themselves—one has to draw the line somewhere! I did this to keep the float itself simple and to offer an easy attachment if the floats have to be

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changed.

The streamlined covers and their end sleeves are now expanded to their full lengths. The ladder steps are epoxied to the strut covers. (Make these out of $^1/_4$-inch flanged Plaststruct, painted aluminum.)

3. Floats: This ship is light enough to handle 32-inch floats. In fact, the EDO 4960s scale out at about 32.5 inches. The Goldberg* 36-inch Cub floats, although heavy, are close to them. If you have access to a hot-wire setup, you can follow the drawings to make a couple of very satisfactory, scale-looking, V-bottom floats.

When preparing the cores, I first dado the $1^1/_8$x$^3/_8$x15-inch strong-back slots in the tops. I then cut two hard balsa or cedar strong-backs to match the slots. They're "Titebonded" into the slots and weighted down, inverted, over a waxpapered flat surface to ensure a flush surface. Then the step blocks and transom plates are installed, again using Titebond. Using either Sig Corebond or Dave Brown* Sorghum adhesive, the top $^1/_{64}$-inch skins are rolled on and trimmed. The bottoms are glassed with 4-ounce cloth. I find it easier to cover the Vs with cloth than to try to fit the angled $^1/_{64}$-inch bottom panels. The epoxy also seals the chine, and with a little sanding on the bottom, the float is ready for painting.

As for painting, I spray them first with Pactra* Prep; I sand; and then I spray them with Formula-U. To simulate the walkways, I bond 120-grit wet-or-dry sandpaper, cut to shape, to the top of the completed floats. A red danger stripe for the prop and a flat-black nose bumper are nice finishing touches.

• Water Rudders: $^1/_2$A nose-wheel steering assemblies are used for the water-rudder supports. Cut off the coil-spring ends, and solder the rudder retaining clips onto the bottoms. Drill the clips for a 2-56 screw, shape and drill the rudders. Align them vertically, and attach the bases to the rear of the floats with No. 2, $^1/_4$-inch sheet-metal screws.

Since the arms are actuated with only one line from the air rudder, a return device must be used to pull the rudder in the opposite direction. The plans show how to make return springs, but rubber bands stretched from a stand-off screw would work just as well. Tie the cable, which can be of any non-stretch material, to the air-rudder arm, then through the guides and pulleys around to the water-rudder arm. After straightening the rudder against the return-device tension, attach the cable to the water-rudder arm. When both lines have been attached, the return devices will work against each other, and the air-rudder shaft will have no tendency to turn by itself.

• Covering: To keep the weight down, I covered all flying surfaces with mica film. I covered the rear fuselage with MonoKote and painted the $^1/_{64}$-inch sheeted front with matching Formula-U. I also painted the floats with Formula-U, but all the struts were left a natural aluminum.

The wing tips, tail fairings and cowling were also painted. Trim was a combination of spray-can yellow Formula-U and MonoKote trim. Flat black was used on the upper cowl and the float bottoms flat grey. (Rustoleum seems to work well here.) The door outlines, window frames and trim tabs were all done with Chart Pak $^1/_{32}$-inch black tape. After painting and trimming, all surfaces were sealed with clear Formula-U, masked close to the trim so that the slight yellow tint wouldn't be too noticeable.

• Cowl: I formed the cowl and then turned it over to Northwest Hobby* since I'm not skilled with fiberglass. The cowl they sent back fit perfectly, and all I had to do was install upper and lower inside backing plates and drill them and the front fire wall to accept the No. 4, $^1/_2$-inch Allen-head hidden attachment screws.

To ensure neatness, the locations of the engine opening and needle-valve hole were carefully calculated and measured before carving. I temporarily attached the unit to match the fuselage's paint lines, and I then removed it for painting. The lower oil-cooler intake was made with $^3/_{16}$-inch sheet blocks (sanded and faired). A 2-inch piece of $^5/_{16}$-inch brass tubing was JB-welded to the Saito* exhaust pipe to extend through the lower lobe of the cowling. It's marked approximately on the plans, but if another engine is used, some adjustment in hole position will be necessary.

FINAL ADJUSTMENTS: I found that my guess about servo and battery positions was right, and the CG came out at about 28 percent MAC, so no additional weight was necessary. The control throws are: elevator, $^3/_4$ inch each way; rudder, $^3/_4$ inch each way; ailerons, $^1/_2$ inch up and $^1/_4$ inch down; and flaps, 45 degrees down for full deployment.

The water rudders should be configured to move about $^1/_2$ inch each way. The switch is on the left side, and the charge

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jack is just behind it. I cut a small notch in the cowl to allow the head lock to be slipped through. Don't forget to install a tube on the engine vent port so that oil can be squirted in after a run.

PERFORMANCE: After a full charge and a final system check, I installed the wing, remembering to put a little Loctite* on the strut threads after they had been properly aligned, and locked them into place. Check your ailerons and flaps for correct operation and fuel up. I put one of those nifty quick fuelers in the cowl, and I recommend that you do, too. Start the engine, and check for power and a good idle.

Now for the moment of truth! Taxi around to get a feel for its water handling, and set the flaps at 25 degrees. Turn into the wind, and add up-elevator while bringing the power up gently. As soon as it comes up on the step, relax most of the aft stick, and the ship will fly right off the water in about 80 feet, accelerating all the way. Back off on the power, and bring the flaps up gradually as you gain altitude. During your stall tests, you'll find that the Beaver stalls gently straight ahead, and if the flaps are down at all, the ailerons will fly all the way.

On landings, gradually throttle back while adding flaps. I found the ship had little pitch-up tendency as long as I didn't dump the flaps all at once. Don't use full flaps until you're on final, and be prepared to add a little power just before touchdown, since full deployment of the flaps will rapidly bleed-off your air speed. In fact, for your first few landings, don't use more than 35 degrees of flaps. Now taxi back to the ramp and cut the switches. If *that* hasn't impressed 'em, nothing will. Happy landings!

**Here are the addresses of the companies mentioned in this article:*
Unionville Hobbies; *distributed by MDM Models, P.O. Box 739, Rancho Murieta, CA 95683.*
Ikon N'West, *P.O. Box 566, Auburn, WA 98071.*
Sig Mfg. Co., *401 S. Front St., Montezuma, IA 50171.*
Carl Goldberg Models Inc., *4734 West Chicago Ave., Chicago, IL 60651.*
Dave Brown Products, *4560 Layhigh Rd., Hamilton, OH 45013.*
Formula-U; *distributed by Pactra (Plasti-Kote), 410 N. Michigan Ave., RM. 1280, Chicago, IL 60611.*
Northwest Hobby Supply, *13923 Pacific Ave. S., Tacoma, WA 98444.*
Saito; *distributed by United Model Distributors, 301 Holbrook Dr., Wheeling, IL 60090.*
Loctite Corp., *4450 Cranwood Ct., Cleveland, OH 44128.* ■

SPORTY SCALE

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some how-tos and throw in a few "newsbreakers." Until then, try to practice and remember some of the basic rules that go hand in hand with being an expert pilot like you: Never increase the lubricating properties of your fuel with olive oil; never transport your scale model to the field on the roof of your car—with only the tail wheel strapped down; and the same clear silicone that you use on your wing saddle will *not* allow your canopy to slide open more easily. Although these are the inviolate rules of R/C scale, they, too, can be forgotten if you forget to check your six!

**Here are the addresses of the companies mentioned in this article:*
Model Engineering, *P.O. Box 58306, Raleigh, NC 27658 (919) 872-7569.*
Hobby Poxy Products, *36 Pine St., Rockaway, NJ 07866.* ■

SCHNEIDER CUP

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and, of course, the actual planning of just how the competition would be structured.

As word spread about this exciting new

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