DORNIER 'SKYSERVANT'

A TWIN ENGINE SPORT SCALE MODEL OF THE GERMAN DORNIER DO 28 D-1 STOL AIRCRAFT CURRENTLY IN USE BY THE LUFTWAFFE

BY COLONEL JOHN H. WORMLEY, U.S.A.

● When one's reflexes slow to the point where Quarter Midgets seem to be getting too fast and you have a pair of good .15's, what choices are left? Not being ready to become an editor or helicopter pilot ('copters fly slow, don't they?), I decided to build that multi-engine plane I have always dreamed about.

Fortunately, when I left for a tour of duty in Germany three years ago, I took with me a large supply of balsa, anticipating some long winters for building. So when the idea for the "twin" struck, I was ready. The S.T.O.L type of aircraft seemed a good choice for a beginner's project. The "Islander" and "Twin Otter" were being considered when I saw the Matchbox 1/72 scale Dornier "Skyservant" kit. Not only was this a different plane, but one that I felt I could design, build and fly — two QM's attached to a box with wings!

Every aviation enthusiast knows that Dornier has, over the years, designed many strange and wonderful multi's with from two to twelve engines in all imaginable positions. The Do 28 is no exception. It is in current use by the Luftwaffe and in 26 other nations throughout the world. It is a simple, sturdy aircraft, these being good basic concepts for both full scale and model planes. The "Skyservant" has been in service since 1968 and in 1972, it set six FAI world records for it's class.

It is powered by two 380 hp Lycoming engines, has a span of 51' and a length of 37.4'. Maximum weight is 8516 pounds. Take-off run is 920'. Maximum speed is 199 mph. There are transport, survey, ambulance and passenger versions. Dropping parachutists or cargo along with STOL operation are model possibilities as are numerous military and civilian finishes.

Although I have been building model airplanes for over 35 years, I have never built one I designed. Therefore, as an Army dentist, my qualifications are like those of the aviation pioneers, i.e., if it looks right, it should fly right. Well, it looked okay to me.

The wing, uncluttered by engine nacelles, has more usable surface, allowing a shorter span. The engines mounted farther forward and close in should lessen the "P" factor"[1] effect should one engine quit. I chose to enlarge the Matchbox model eight times, making mine 1/9 scale. (I found the plastic model parts are easier to measure unassembled if you ever go this route.) The main deviations from scale on this model are: (1) a shorter, wider flying stab is used to minimize flexing, (2) the engines are closer together for less vibration, (3) the wing slot design is for building ease and (4) in place of ailerons are full span flaps. The results are simplicity, but with the intended scale-like appearance.

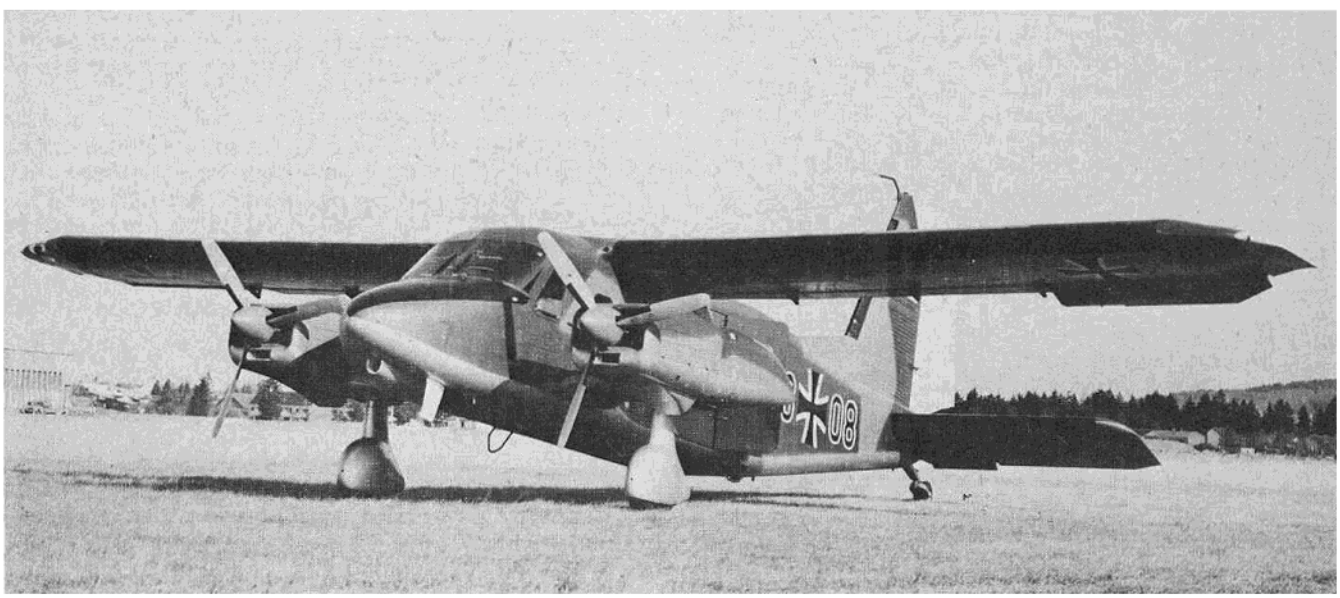
The RCM Britten-Norman "Islander"[2] influenced me to go without ailerons as the Do has a very large rudder. This allows realistic STOL operation with only four channels. A fifth channel could give flaperon operation. Scale area ailerons and flaps would complicate wing construction.

Before starting construction, the serious builder should have the Matchbox kit and obtain "Skyservant" literature from Dornier.[3] As you will be cutting your own parts, the scale details can be done to your desires.

I dislike building wings because most of them are supposed to look straight. Therefore, I started with the expensive part, the fuselage, where all the balsa went. I knew then I would have to finish the project. Having built numerous planes from kits and plans, I found sometimes parts do not fit, so please measure and fit carefully before applying the glue.

Cut the fuselage sides from 3/32" balsa. To obtain appropriate width sheets, butt glue several lengths of stock material with Titebond. (Titebond is used throughout except where noted.) Be sure both sides are identical and use a straight-edge to assist with the long cuts. Do not cut openings until the ply doublers are fitted. Cut the doublers with all openings from 1/8" aircraft plywood. The critical part is locating and cutting to the same size, both openings for the motor nacelle strut. The beauty of this plane is that everything is very square which allows accurate alignment. Use a spray contact cement to attach the doub-

The full-scale Dornier Do 28 'Skyservant'. Photo courtesy of Dornier Aircraft.



The author's twin .15 powered Dornier 'Skyservant'. 1/72 scale Matchbox model in foreground.

lers. Cut former F-1 from 1/4" balsa, F-2 from 1/8" ply and build F-3, 4 and 5 from hard 1/2" x 1/4" balsa, measuring the length from the appropriate locations on the actual fuselage sides. Note that F-5 is behind the doubler, so add an extra 1/4" to the width. Use a square to assemble these formers. While the glue is curing, add 1/2" triangular stock and 1/4" diagonals to the sides behind the F-5 position. Bevel the edges of the triangular pieces behind F-5 so that they will meet F-5 when the tail is drawn together (see top view). Using a right angle, or square, to align them perpendicular to the side, glue F-1 through 5 to one side. Fill in-between the formers at the bottom edge with 1/2" triangular stock. At the top edge, add the 1/4" wing saddle and the 1/4" triangular pieces. When dry, glue on the other side.

Draw a straight line, longer than the fuselage, on the paper covering your workbench. Mark the centers on the bottom front or back sides of F-1 and F-5 and line up on the centerline drawn on the bench top. Pin securely. Score the inside of the fuselage behind F-5 to allow a sharp bend. Bevel the triangular stock at the tail and draw the tail together and glue. Use a square to line up the center of the tail over the center line and also to keep the body sides perpendicular to the bench top. Fill in the scored line behind F-5 with an epoxy fillet. Sheet the top of the fuselage from F-5 half way to the tail with 1/8" material, the grain running crosswise. Add the bottom sheeting from F-1 to just beyond F-5. Balsa blocks are glued in place to form the cabin roof. Now you should have a huge, rigid, square box to work with.

Cut the nose profile from 1/4" sheet. Glue to F-1. With 1/4" scraps, add the thickness at the nose. Sand off at an angle for proper placement of the 1/4"

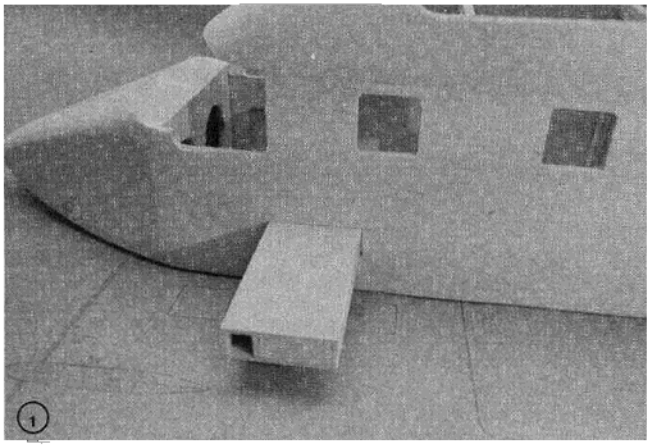
TYPE AIRCRAFT
Twin Engine Sport Scale
WINGSPAN
66½ Inches
WING CHORD
9 Inches
TOTAL WING AREA
586 Square Inches
WING LOCATION
Top of Fuselage
AIRFOIL
Flat Bottom
WING PLANFORM
Constant Chord/Tapered Tips
DIHEDRAL, EACH TIP
1¾ Inches
O.A. FUSELAGE LENGTH
50 Inches
RADIO COMPARTMENT AREA
(L) 20" x (W) 6½" x (H) 7½"
STABILIZER SPAN
28 Inches
STABILIZER CHORD (incl. elev.)
6 Inches
STABILIZER AREA
153 Square Inches
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Center of Fuselage
VERTICAL FIN HEIGHT
11 Inches
VERTICAL FIN WIDTH (incl. rudder)
8 Inches (Avg.)
REC. ENGINE SIZE
(2) .15 - .21 Cu. In.
FUEL TANK SIZE
(2) 4 Ounce
LANDING GEAR
Conventional
REC. NO. OF CHANNELS
3 — 5
CONTROL FUNCTIONS
Rudder, Elevator, Throttles
Flaps and/or Flaperons
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Balsa and Ply
Wing ..... Balsa, Ply & Hardwood
Empennage ..... Balsa and Hardwood
Weight Ready-To-Fly ..... 124 Oz.
Wing Loading ..... 30½ Oz/Sq. Ft.

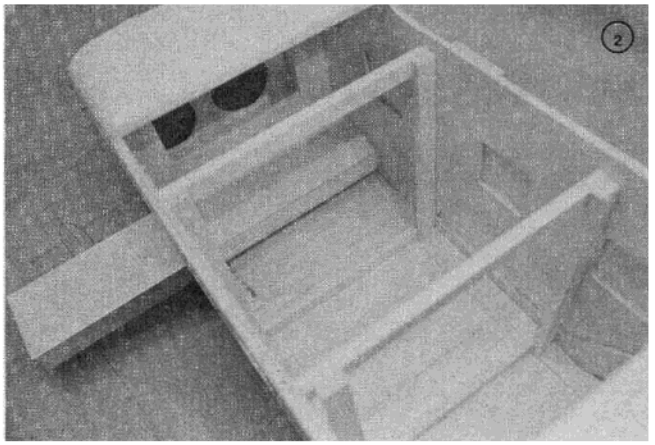
sides (see top view). The instrument panel — top and bottom — are filled in with 1/4" pieces. Add the 1/8" ply cross piece behind the bottom section of F-2, flush with the bottom edge of the motor nacelle strut. Strengthen the joint with 1/4" triangular pieces underneath.

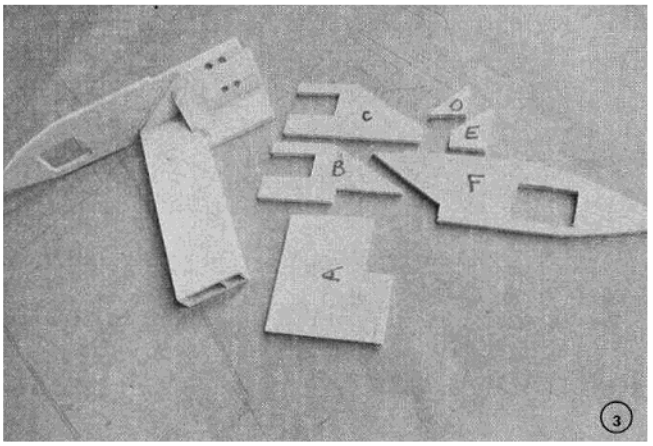
The next two steps require the greatest care; they must be done now while the fuselage is still open enough for good access.

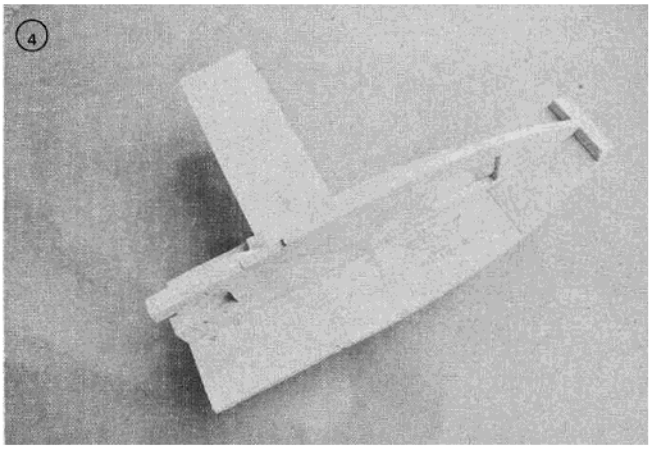
Cut 1/8" aircraft plywood to build the motor strut. I clamped a straight-edge to my Dremel jig saw table to guide these cuts. Use a fine blade and go slow, cutting the width of the top and bottom pieces to exactly the length of the fuselage opening. Try them in the opening. The fit should be snug. Cut enough 1/8" ply strips to give you three full length pieces plus the diagonal stiffeners. Measure the height of the fuselage opening, subtract the thickness of the top and bottom pieces (they may not total 1/4") and cut the strips to this measurement. Glue the three full length strips in position on the bottom sheet with the front and rear pieces flush with their respective edges. Clamp and allow the glue to set. Add the 1/4" ply L.G. reinforcement. Add the diagonals and end pieces. Finally glue the top sheet on, keeping all edges flush. When thoroughly set, fit the strut to the fuselage. A good frictional fit is desired. Center the strut, then drill six holes in a staggered arrangement (top view) through the strut and 1/8" ply platform to receive 6-32 socket head bolts and blind nuts. Remove the strut and cut through the center with a razor saw.

Build the engine nacelles. Cut pieces B, C, D, and E from 1/4" plywood. The remainder is balsa (Figure 3). The unusual exhaust arrangement of the Taipans was used to advantage. The









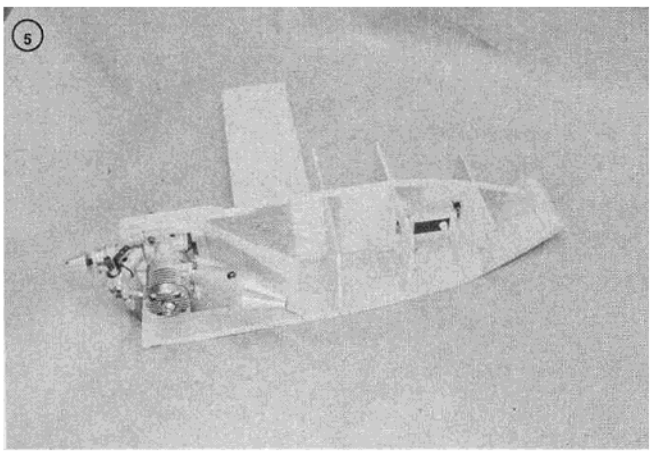


Figure 1: External view of fuselage with fitted nacelle strut. Figure 2: Internal view of Dornier fuselage. Figure 3: The basic nacelle pieces. Figure 4: The nacelle profile backbone and 1/4" bottom sheet in place. Figure 5: The engine, firewall, and nacelle formers in place.

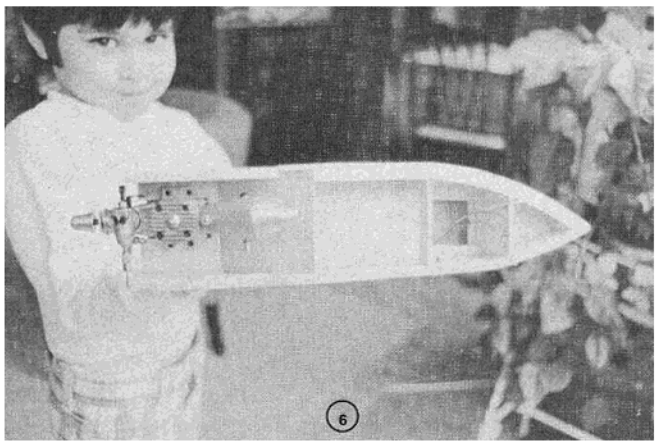
use of other engines will require the builder to modify the construction to suit. The nacelles are built around a profile backbone (Figure 4, 5, 6). The formers extending from the backbone are for convenience in framing the structure. Cut away as necessary for the servo and fuel tank. My original intent was to slip the engines in place through the side openings, but engine difficulties forced me to make removable cowls for better access. Glue the top sheeting to the formers. Notch the triangular stock to aid in curving at the upper rear edges. Add a servo extension harness before the side sheeting is completed. Figure 7 shows the construction of the side hatches of 1/32" ply over the balsa cut-out. Hold in place with flat head screws. The warm air exhaust covers were vacuum formed for uniformity. Also, because of their resultant thinness, warm air flow is less restricted. Hollowed balsa blocks make up the leading and trailing edges. Form a thin gasket of RTV silicone rubber on one cut end of the strut. This will insure a snug butting of the two to dampen vibration.

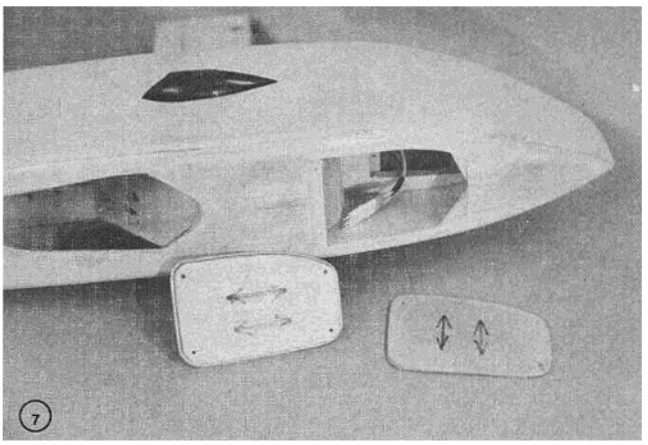
The bearing blocks of the flying stab are next (Figure 8). The large piece is glued inside the fuselage with the smaller piece protruding through the side. The 1/8" square balsa inside is to aid in positioning. I used 5/16" O.D. brass as the rotating and connecting portion of the spar. A drill press is needed to set up the appropriate angle for drilling the 5/16" holes. This allows the bearing blocks to approximate the angle of the fuselage sides, while having the brass tube perpendicular to the center line. Burnish the drilled bearings with the brass tube to give an almost free rotation but with no slop. Don't use files or sandpaper here. Leave the tube long to aid in lining up the bearings in the fuselage. With the body again pinned to the board, level the brass tube as viewed from the front or rear and line it at right angles to the center line as viewed from above. Glue the blocks in place without gluing the tube.

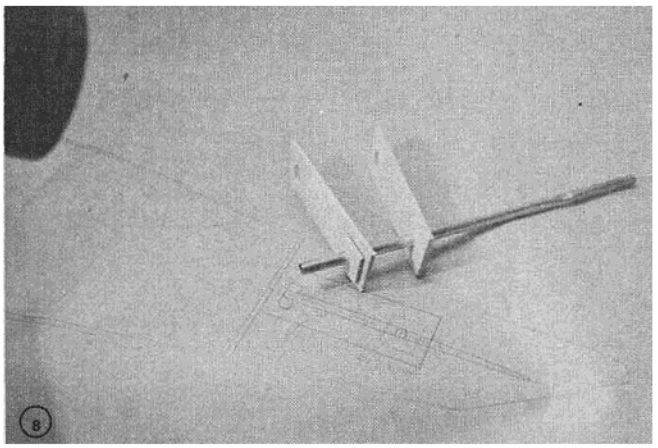
Sheet the remainder of the top of the body. Do not cover the bottom. Cut the fin slot, add the anterior block and 1/2" triangular internal fin bracing. The fin and rudder are from 1/4" medium balsa.

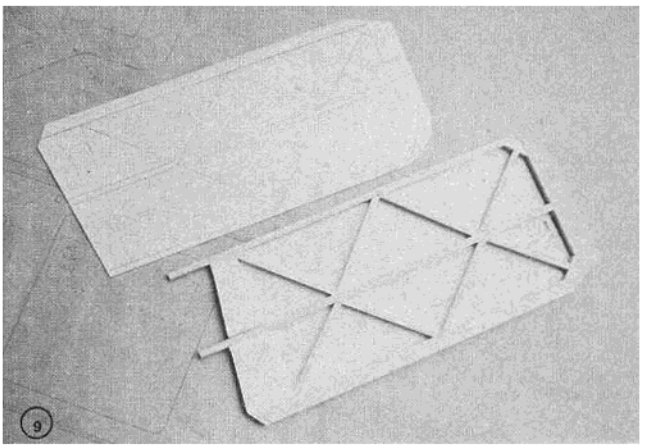
The stabilizer sheet is cut to outline. With a ballpoint pen, draw the construction lines on two of these (Figure 9). Glue the L.E. spar, T.E. and diagonals in place. Add the top sheet. Using the brass tube as a cutting tool, work it on the square spar to round the corners up to the stab shoulder. Put the tube in the bearing blocks flush with one side. Place one half of the stab in position and fit the shoulder to the side of the fuselage. Reverse the tube and fit the opposite stab half. Note that the tube is still long at this point for handling ease. Finish the fuselage sides in the stab area now, as this will be difficult once the stabilizer is in place. I covered the sanded area with TopCote. Cut the brass tube to protrude about 1/32" beyond each side. I recommend finishing the stab, or at least the shoulders, before gluing in position. Lay wax paper over one side with holes for the L.E. and spar. The spar hole should be the exact size to prevent gluing the joint tight. Epoxy the spar into the brass tube without filling the other half with glue, then epoxy the L.E. brass joiner to that half of the stab. Turn the fuselage over and epoxy the other half of the stab into both tubes. A plywood block is made to fit around the spar tube. It should be thick enough to bring the attached control horn to almost contact the bottom of

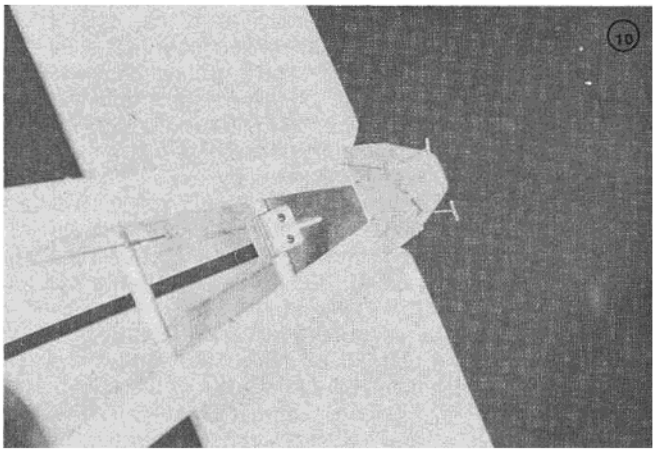
FIGURE 6: Nacelle with top sheeted; 1/4" over engine, 1/16" on remainder. 1/4" triangular stock between formers is for carving bulk when rounding corners. Note servo extension wires. FIGURE 7: Nacelle access hatch – 1/32" ply glued cross grain to section cut from side. Note ply overlap and 1/8" ply inserts for screw attachment. Figure 8: Bearing blocks and 5/16" brass tube showing angle to fit fuselage sides. Figure 9: Stabilizer construction. Figure 10: Stab control horn on plywood block. Figure 11: Underside view of slot.

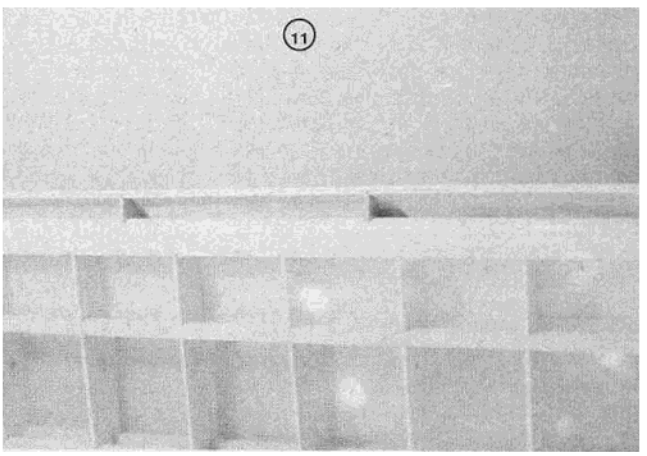








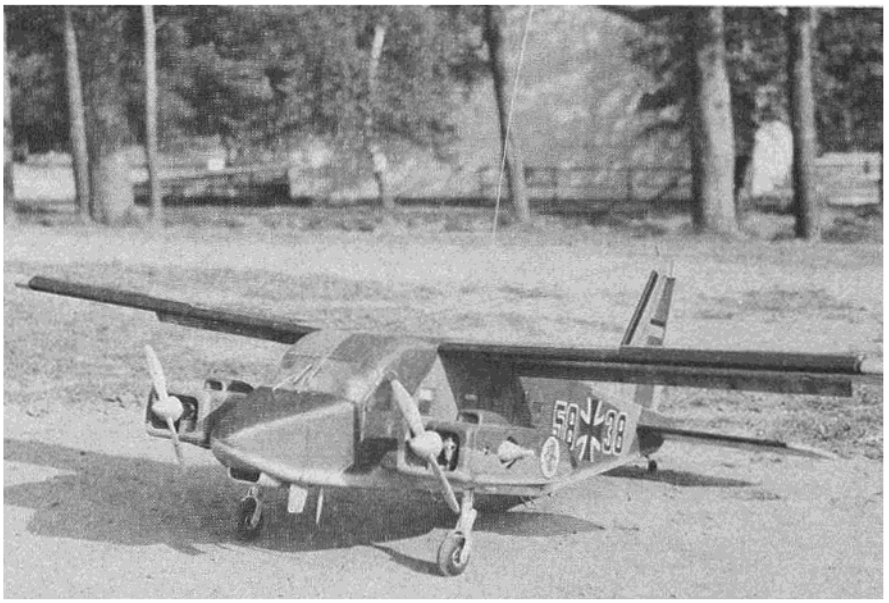




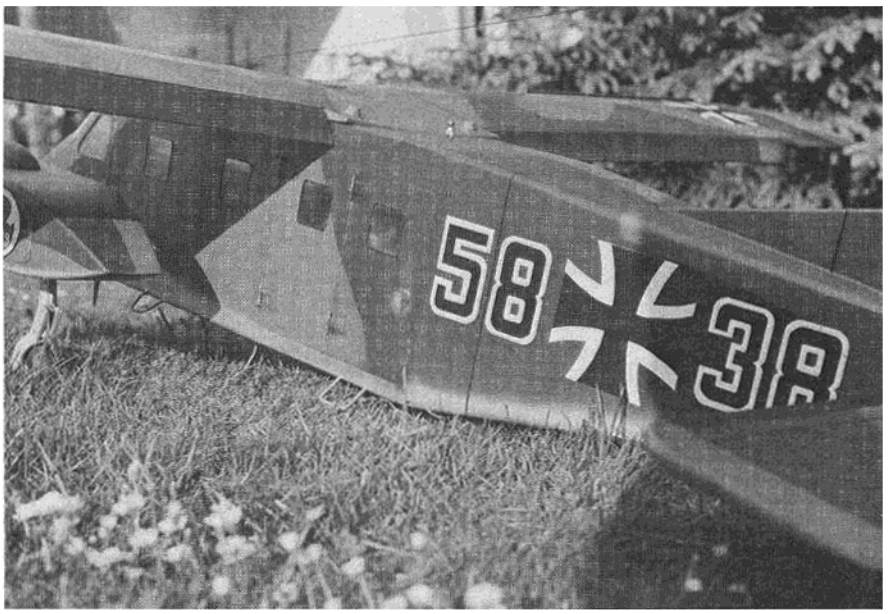
the fuselage (see side view and Figure 10). Finish sheeting the bottom. For adjustments, I fitted a 1½" More Craft "Inspect-It" cover, over the control horn tip. Reinforce the cabin block at the doubler joint with 1/4" triangular pieces. Add a 1" strip of 1/16" ply to the bottom flush with the wing opening to take the load of the wing mounting tongues.

We finally made it to the wing. For building ease (and lack of airfoil knowledge of the author) a proved flat bottom airfoil is used. If your building board is flat, your wing will be straight. Pin the hardwood spars, notched L.E. and T.E. and bottom sheeting over the plan. Glue the ribs in place. Put 1/16" ply webbing where shown on the plan. Notch the top spars at the last full chord rib (W-2) to allow cracking to taper them down to W-3 and the wing tip. Add the bellcrank platform. Sheet the L.E. to cover the first top spar. Cut the flaps from the T.E. and recess the L.E. for the slots. The wing halves are butt joined at the center, blocking up one tip for a total dihedral of 3½". This angle will vary with each wing so make your own dihedral brace patterns. Cut the braces from 1/16" ply and add behind the L.E., on each side of the front and rear spars and ahead of the T.E. joint. Hinge the flaps near the top edge and carve away enough material on the underside of both T.E. and flap L.E. to allow about an 80° deflection. I mounted the servo upright, with the mounting lugs under the wing surface and the rotary head protruding into the wing.

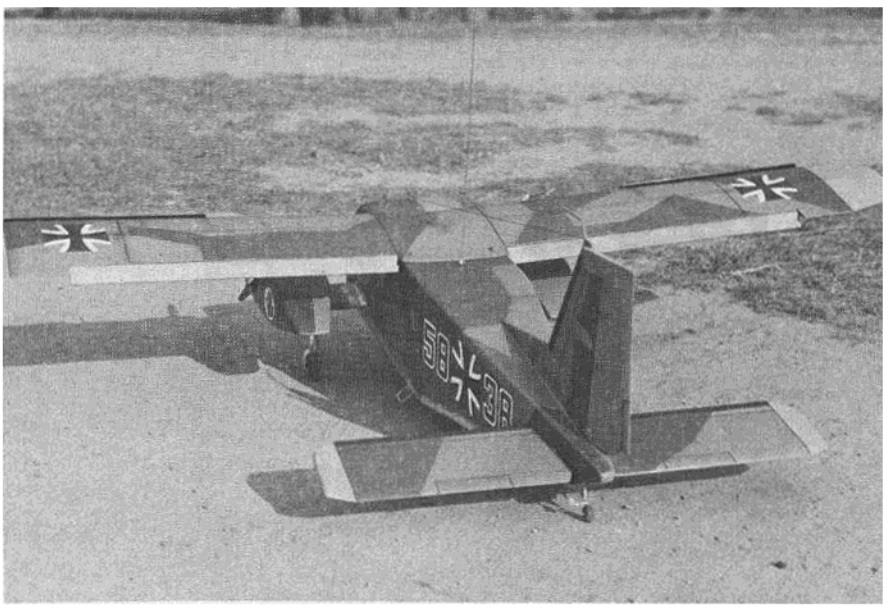
Now is a good time to line up the wing on the fuselage. When properly fitted to the wing saddle, pin or rubber band the wing securely in place. Fit the tongues under the L.E., tight against the cabin block and extending back to the first spar. Epoxy in place. Sheet the top center section. Cover the sheeting with lightweight Celastic. Capstrip the top spars from the Celastic lip to feather into the first open rib. Feather the Celastic into the L.E. and T.E. with DAP. A 1½" inspection cover is used over the servo output arm. Capped ribs were not necessary as the Perfect Paint camouflage over TopCote gives a very realistic finish. Reinforce the center wing under the mounting tongues with Celastic. After the linkages are in place, sand and cover the wing with TopCote. Note that washout was not used. Glue the plywood slat braces to the recessed L.E. Finish one side of a section of 1/16" sheet with sealer or resin of your choice. Cut the section long enough to fit between the slat braces. Then score the unfinished side, full length at approximately 1/16" intervals to allow bending the slat like a rolltop desk and glue, finished side down, between the braces (Figure 11). Cover the entire length of the slat with another 1/16" sheet. Sand the L.E. round and taper the T.E. surface



BELOW: Close-up of side details and insignia.



BELOW: Rear view of Dornier Do 28 'Skyservant'.



DORNIER SKYSERVANT

to give an airfoil shape and cover with TopCote.

I originally planned to screw a pair of belly mounted nose gears to the engine struts, having rendered them unsteerable. I couldn't find a mate to the one I had so, being saddled with the bolt-on idea, I adapted Sullivan "Realistic" gear by fabricating a bolt-on post to which the gear was attached. Reversing the Realistic gear's trail made them more realistic in appearance for a tail-dragger. Be sure to notch the mounting post for the set screws so the gear doesn't pivot. A steerable tail wheel is essential. A simple tiller arm outside the fuselage was connected to the rudder servo. I'm still giving serious thought to adding electric brakes working off full up elevator position to add to the STOL effect.

Cover everything with TopCote except the nacelles and their struts. Use an epoxy finish here to insure fuel proofing. Note the CG shown on the plans. The servos were placed at the CG with the battery stuffed into the nose and the receiver in-between. NyRod was used for the rudder and a 5/16" balsa pushrod stiffened with a 3/16" x 1/8" strip glued on edge operates the elevator. Be sure this pushrod doesn't sag in use or under "G" forces.

The signal wire to the left motor servo was interrupted with a switch to allow cutting it out of the system after starting, so the engine can be left idling while running up the right engine. Somewhere, back there, I extolled the virtues of simplicity!

We are now ready for flying. Not that I wasn't confident in my design. I didn't want to spend precious time and/or money finishing the plane if it happened to get caught by the treacherous German winds constantly plaguing us at Sembach Airbase during the testing stages. Also, I was eager to prove to my doubting friends that two 15's would fly the 7½ pound monster.

Make sure everything is sealed well before running the engines or subsequent finishing will be impossible. Taping a piece of TopCote backing paper over the open cabin, we headed for the field.

On a beautiful April Sunday, that is, rain was only threatening and gusts were only 20 mph, the engines were fired up. The fully muffled Taipans were turning 13,000 with 8/5 Power props. Vibration was nil. Ground handling with a little up elevator was excellent. So impressed with this steering was I, that the plane was way up the runway before I remembered to release the up for the tail to break ground. About the same time, the Do leaped skyward, a friend leaped from the pits screaming that my transmitter antenna was down! Shucks! With the plane a low speck above the runway, I started hauling antenna. One hand on the elevator stick, the other pulling like crazy, did not make for steady flying. Testing the power on stall characteristics was accomplished early in the flight with several recoveries *close* to the ground. Gratefully, all stalls happened with the nose dropping straight ahead . . . no snap rolls. I like to believe the slots worked effectively. On recovering the plane and myself, the remainder of the flying was very smooth. Anticipating the need for a lot of rudder, maximum throw proved too sensitive. The elevator required a touch of up trim. Dropping the flaps would almost loop the plane if down trim was not applied. Full throttle seemed fast . . . to me, anyway. At landing speed, the plane remains rock steady. For me, this was one of the most thrilling days of my modeling career. The Wright Brothers could not have been more excited.

Now the plane had to be finished before our club's (The Pfalz Flyers) scheduled Armed Forces Day exhibition. The 1/4" hardwood windscreen posts are fitted along with a ledge of 1/16" scrap to form a positive, recessed location for the windscreen material. I cut a paper pattern, then Zap-fitted the plastic shield in position. For uniformity, all side windows were vacuum formed. This also gives a nicely finished edge. Insert the windows from the inside and push flush with the outside. The windshield frame, pilots doors, and side doors are simulated with 0.5mm styrene sheet. Small styrene tubing is used for door hinges. Finally, before painting, the needle valve and glow plug holes were reamed smooth with a Fox prop reamer.

Using a Miller airbrush, the entire under surfaces are sprayed silver. RAF WW2 Ocean grey and dark green (with a little flat black) approximate the current Luftwaffe Grey and Green.[4] Perfect Paint covers the TopCote very well, with less than a half pint being used for the whole plane. Laid on pieces of brown wrapping paper masking, soften the camouflage color lines. Insignias were made with appropriately colored TopCote over white MonoKote trim background. Use the soapy water trick to allow sliding either material into proper position, then remove the excess soapy lube by a thorough burnishing. Wear and tear is a la Dave Platt.[5] Wheel pants are omitted from a number of Luftwaffe Do's as on 58 and 38, which I copied. Interestingly, only 1/4 pound was added with the finishing details and paint.

Most construction articles are idea articles. Also, there are probably other ways of attacking the same problems. I have had great pleasure from this project and will be only too happy to correspond with any fellow (no girls, please) modeler interested in this project. A SASE would be appreciated. Send to Col. John H. Wormley, 19009 Bloomfield Road, Olney, MD 20832.

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