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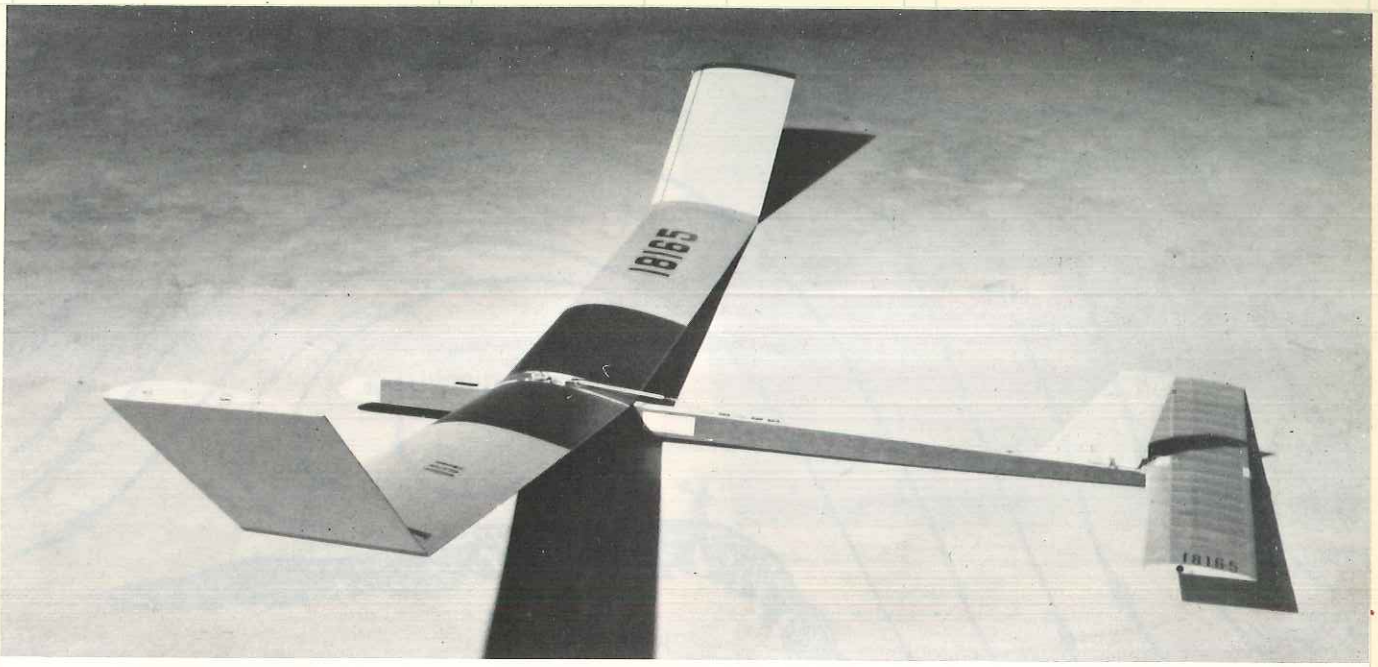

WOODWIND A/2

A breakaway from the usual thin, undercambered, fragile, warp-loving Nordic wing is the main feature of this all-sheet design . . . built for normal rather than ideal weather conditions. By JOHN KROUSE.

DESIGN PHILOSOPHY

Most Nordic A-2 enthusiasts "get their kicks" by building high-performance, "still-air" gliders . . . they are aerodynamically challenging and aesthetically pleasing. Unfortunately, these fragile, sensitive craft seldom live up to their designer's optimistic expectations. Consequently, "Woodwind" was conceived to cope with the *actual* weather conditions which usually exist at most FAI trials . . . namely, WIND! The principal objectives were to develop a model having the following flight characteristics: (1) good gliding efficiency, (2) excellent stability (static/dynamic-longitudinal/lateral), and (3) ability to manipulate fairly tight turns for remaining in the core of small-diameter, low-altitude thermals; and also to keep the glider within reasonable retrieving distance (and timers' eyesight) for all those three-minute-plus flights. In addition to these rather ambitious performance goals, durability and reliability were essential for FAI competition.

Aerodynamically, a close-coupled layout employing a relatively large horizontal/vertical tail and rudder were selected. Generous amounts of dihedral (both inboard and outboard) and tip washout were incorporated into the rectangular planform wing to avoid spiral dives while "thermaling." Structurally, sheet balsa covered wings were chosen to resist warps and flutter . . . two problems frequently encountered by Nordic flyers (usually with disastrous results). The *spruce* spars are absolutely necessary to prevent buckling!

It is the author's opinion (based on some early British wind tunnel data reproduced in the 1970 and 1971 National Free Flight Society Symposium Reports) that properly designed flat-bottom airfoils glide *almost* as well as similar undercambered sections, in addition to being less critical to trim for varying weather conditions. So far, "Woodwind's" performance seems to support these claims.

CONSTRUCTION

Fuselage: Start by building the vertical tail/rudder assembly from 1/32 - 1/16 - 1/32 inch balsa ply (see plans for auto rudder details). Then proceed to the slab-sided fuselage, which was chosen for its simplicity and accuracy in aligning wing/stab/fin. After cutting a sheet of medium soft 1/8 x 3 x 36 inch balsa into 1-1/2 inch wide strips, glue the upper medium hard 3/16 x 3/8 inch longeron in place with a slow drying adhesive such as Titebond (used almost exclusively).

Make "keel" from two 3/8 x 3/8 inch pieces of spruce, cement lower longeron in place (leave space for FAI Supply adjustable towhook), and allow to dry overnight on a *perfectly flat* workbench, with weights to prevent warping as glue sets. Then add 1/8 x 3/16 inch piece of balsa at rear, and install completed vertical tail/rudder assembly. Add another 1/8 x 3/16 inch strip of balsa over fin and glue the remaining piece of 1/8 x 1-1/2 x 36 inch sheet on top of the entire fuselage assembly, again leaving to dry (under pressure) overnight.

After trimming excess balsa and fairing pine nose block, clamp two pieces of 1/32 inch plywood on both sides of the fuselage in vicinity of the wing, drill holes for dethermalizer eyelet, auto-rudder pin, etc., and round all corners . . . especially at the back end. Give two coats of dope, sand lightly, cover with Japanese tissue, and give a few more coats of dope. Install tow hook with wood screws (pre-drilling 1/16 inch holes will prevent spruce from splitting), but do NOT add ballast until wing and stab are finished. Set the fuselage aside and proceed to construction of the wing.

Wing: First, make two *identical* rib

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templates from 3/32 inch plywood. Cut all ribs for both left and right wing panels slightly *oversize,* drill 1/8 inch holes, and insert two pieces of straight 1/8 inch steel wire (round ends) through the ribs. Then sand entire stack to final shape using a large sanding block, with the plywood templates as guides on the ends of the "rib sandwich." This is very important, since perfect uniformity of the ribs will provide a good bond with the balsa sheet covering, and will guarantee balanced aerodynamic loads for a straight tow and consistent glide.

Remove the appropriate inboard ribs (see plan) from the stack, enlarge 1/8 inch holes to 5/32 inch, and cut notches with a razor saw by spot gluing a piece of *slightly undersize* spar stock in place. Now, you're ready to start construction of the wing!

Using your flat workbench, build both inboard panels at the same time. After attaching balsa "leading-edge spar" to the bottom sheet, glue ribs in place. Let balsa sheet extend about a 1/4 inch beyond ribs at the trailing edge. Insert 1/8 inch I.D. nickel-plated steel tubes through 1/32 inch plywood reinforcements and glue to ribs. The pre-drilled guide holes should automatically insure *exact* alignment of both wing halves. Next, install spruce spars, making sure that they are perfectly flush with rib contours. Likewise, sand leading-edge spar and trailing-edge sheet overlap to airfoil section. Finally, attach the upper sheet surfaces to the completed "sub-assemblies," using several pieces of 1/2 x 1/2 x 36 steel bar stock to hold in place. Titebond glue is recommended, since acetone based cements (such as Ambroid, Testor's, Pactra, etc.) dry too quickly, while water-based adhesives (such as Elmer's) dry too slowly.

After allowing at least 24 hours to set, remove excess sheet balsa, glue the spruce leading edge in place, and sand to the bevel shape shown on the plans, which simulates the "self-turbulating" effect of a sharp leading edge (see author's paper in 1972 NFFS Symposium report) but is less prone to damage.

The outboard panels are built in a similar manner, except there are no spars . . . use *light* wood. Block up the trailing edge tips 1/4 inch and fasten the top sheeting in three strips to allow for a slight amount of distortion due to the negative twist (washout). At this point, make sure that both inboard panels and both tips have identical planform shape (i.e. area) by trimming the trailing edges and dihedral ribs to match.

Now, sand all surfaces lightly, give one coat of 50-50 dope, sand again and cover with Japanese tissue (paper grain crosswise to wood grain for extra strength). An easy method of applying tissue which gives good results is to fasten all around the edges with thinner, and then water shrink before doping.

Give at least 4 to 6 coats of 50-50 dope to keep structure from absorbing moisture on damp days. The major portion of the bending load on a sheet-covered wing is carried by the skin. Unfortunately, balsa wood has an affinity for water, which seriously degrades its compressive strength . . . voila, buckled wings! Take my advice . . . I learned the hard way!

Painting the wing tips white will greatly improve the model's all-around visibility, whether in the air, on the ground, up a tree, etc. Finally, add tip dihedral by sanding to the proper angle (a la hand launched glider). Glue both tips at the same time with the trailing edges of the left and right wing panels back to back to be certain that both dihedral angles are identical. When finished, each wing panel should weigh slightly over three ounces, and will be virtually rigid and puncture proof, besides having smooth uniform surfaces with streamlined, undisturbed airflow. Construction of the conventional built-up, tissue-covered stab should be fairly easy. Naturally, it should be built as light and strong as possible!

Now, go back to the fuselage, and use one of the plywood rib templates (set at 3/8 inch incidence) as a guide to drill holes for the 1/8 inch steel wires. A drill press is a MUST for proper alignment. Bend wires as shown on the plans, countersink holes about 3/16 inch deep, and epoxy in place.

Finally, assemble the completed components (wing/body/stab) and add ballast (about 2.5 ounces should be adequate) until model balances at 50 percent of the wing chord. Install a small eyelet at this location on top of the fuselage, and suspend the entire airplane from a string to check *both* longitudinal *and* lateral balance. Model should hang perfectly LEVEL about its center of gravity. If it does not, add small wood screws to wing tips and lead pellets to nose, as needed. Believe it or not, most of the "trimming" for a Nordic A-2 glider actually takes place on the workbench and in the workshop!

FLYING

Fix rudder in neutral position with a piece of 1/32 inch wire, add about 1/8 inch incidence to stab trailing edge, and hand glide over tall grass. Adjust glide by changing tail incidence until model is just on the verge of a stall. Do NOT add weight to nose or tail of model. If the plane dives, raise stab trailing edge in small increments (one turn of adjusting screw), and vice-versa.

Now for that crucial first flight! Set rudder in neutral position with A/R pin, and allow about 1/8 inch rudder deflection as a safe starting adjustment for the glide. For average weather conditions (5-10 mph. breeze) locate the tow hook about one inch in front of the C.G. (move 1/4 inch forward in high winds, and 1/4 inch aft for a light breeze). Model should tow up *perfectly straight.* If it does not, carefully check all surfaces for misalignment, warps, balance, etc. and correct *immediately.*

When you are satisfied with the towing behavior of the model, adjust glide as follows: If plane stalls, decrease stab trailing-edge incidence (and vice-versa) until a smooth, floating glide is obtained. Next, vary the turning radius with gradual rudder adjustment. If tighter turns are desired, additional stab trailing-edge incidence will be necessary to prevent diving. On the other hand, if wider turns are wanted, less incidence will be required to avoid stalling. Now, with the help of a *little* "lift," every flight should be a MAX! ●

Earlier shoulder wing model. Top-mounted timer (also on latest version) keeps it out of the dirt. Don't be half-safe, light fuse, too!

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