Photos by Bob Meuser

CLOUD 9

Highly-developed, contest-going Wakefield model is a steady winner.

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THE FAI Wakefield event is, I believe, the most challenging and enjoyable event in free flight competition. The ultimate goal in this international competition is the Wakefield Cup, the oldest and the most coveted award given for a competitive model airplane event. The FAI free flight events have been the subject of more progressive thinking and applied aerodynamic theory by top model designers than any other field of free flight model aviation. Wakefield is no exception!

For those who plan to embark on the long, bumpy road to success in FAI Wakefield competition, it is never too soon to start laying the groundwork. To meet the keen competition, it is best to start the next qualifying season with at least two well-tested models, plenty of good rubber, and lots of determination. Whether the FAI program is your bag, or if you plan to fly just in local competition, here is a design that is time-tested, having qualified for the U. S. finals twice — at Bong Field, Wis., in 1966, and for the Albuquerque finals in 1970.

The development of Cloud 9 dates back to late 1964, after the West Coast semifinals at Tulare, Calif. I was flying a straightforward, constant-chord model using 14 strands of ¼" Pirelli (see p. 89, Zaic's 1964-65 *Yearbook*). After analyzing the reasons for not placing higher at Tulare, the conclusion was that a model with increased power output was needed, as well as one that would be more sensitive to the weak morning thermals. With these goals in mind, plans were drawn for Cloud 9.

During this time, my close association with Howard Timlin, noted for his Saturn and Solar power designs, served to inspire the lines of the new model. His ships were beautiful and meticulously constructed.

Main considerations for the evolving design were a small stab, around 25%, and a short nose-moment arm, with the CG placed around 60% of chord. These changes from the previous models resulted in buoyant, thermal-sensitive glide characteristics. The aspect ratio was increased, and thinner airfoils with lower profile thickness were employed. A 16-strand motor was used, coupled with a 22" dia. x 26" pitch prop. This combination seemed to take the best advantage of the reduced drag. All of these factors resulted in a model with good penetrating qualities and excellent early morning still-air time, averaging around 3:30.

Two variations of the basic Cloud 9 layout were built during the time the 50-gram rule was in effect. The first model employed the Benedek B-7406 f. The use of this airfoil resulted in superior still-air times, but the second variation using the B-6405 b section seemed to have better penetrating qualities in all types of air. When the new 40-gram rule came into effect in 1966, a new variation was built to its requirements. This model had the same basic layout, but with reduced areas and thinner airfoils. The idea was to minimize drag as much as possible and shoot for altitude. Although performance was good, it couldn't compare with the climb and glide qualities of the original Cloud 9 layout, which is presented here.

The only major modifications made to convert the orginal for the new rule were in the location of the rear motor anchor and in the propeller design. It was decided that a further reduction in diameter and increase in pitch were needed, along with a reduction in blade area at the tips. Still, the goal was altitude with a high-power, short-burst climb. The new propellers took best advantage of the limited amount of energy available in the 40-gram, 16-strand motors, although prop time was only around 29 seconds.

The front end assembly might seem a little far out, but certain basic considerations led to the use of this system. The inner portion of the prop blade was eliminated, since it seems of little or no value. The system lends itself extremely well to replacement of damaged blades or to experimental pitch variation.

At Bong, Cloud 9 performed as well as any Wakefield on the field. However, because of the builder's poor judgment, the new model was not adjusted well enough for the tur-

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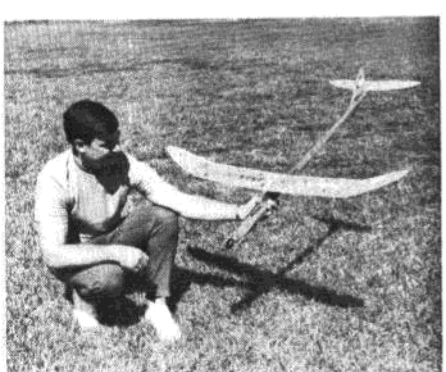
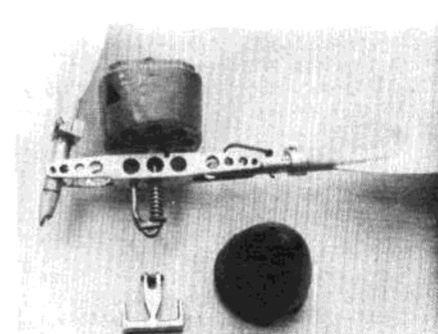


Although an FAI Wakefield is not fast, streamlining and low-drag airfoils with wrap-resisting structure improves performance.



The entire plane, including the ball-bearing streamlined prop assembly, took six years in development. Has interesting rubber hook.

Cloud Nine

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bulent conditions, and spun in for a 33-second flight in the fourth round. (The original Cloud 9 had been slightly damaged in the previous round.)

Later, Cloud 9 was flown at the '66 Nats, Glenbrook, Ill., with only a few seconds under four straight maxes. The model was wound for the fifth and last flight, with about two and a half minutes needed to win. Launched directly into a boomer, it proceeded skyward with great haste; then there was a loud cracking sound! The rear motor anchor had come loose, allowing the still half-wound motor to snarl itself into a ball in the nose, causing the model to dive in for about 25 seconds. There have been instances where some of the best fliers have beaten themselves under similar circumstances, but goofs like this can only be overcome through much practice and conditioning — an important part of any FAI competitor's schedule.

Cloud 9 has more than satisfied all of the primary objectives. Early morning still-air time averages three minutes plus and the climb is of a docile, forgiving nature, showing excellent stability in all conditions. The model has excellent penetrating qualities throughout the power burst, rolling into a steep, steady cruise all the way up. It has enjoyed a considerable amount of success in competition, having placed within the top three, including several firsts, in many West Coast meets in past years.

Construction

Wing: Because of the thin B-6405 b section used, certain structural considerations, such as the shallow, wide spars, must be made. This spar arrangement was chosen because it allows the greatest resistance to rib distortion. Begin building the wing by laminating the entire leading edge. Soak the 1/16" strips in boiling water, pin in place on the plan, using small balsa blocks against the wood, and allow to dry. When dry, cement the strips together using balsa cement or Titebond. While this is drying, shape and notch the trailing edge and pin in place. Be sure it is blocked up the required amount to insure proper airfoil contour at each rib station. Cut out all ribs, using a 1/16" plywood template, cutting only the bottom of each spar notch in its proper location. The various rib sizes are cut by merely rotating the template as illustrated.

After the ribs are all cemented in place (except diagonal, false ribs and dihedral ribs), the top spars are installed. The spruce spars for the inboard panels are formed and laminated in the same manner as the leading edge. The spar notches are completed by using the spars as guides and a sharp razor. Each spar must be the correct length to insure a good joint when the panels are joined to the correct dihedral angle.

Next, cement in the diagonal ribs (except at dihedral joints) and the 1/16" sq. diagonals. After the panels are dry, join to the correct dihedral angle, joining the tips and center panels first, then the center joint. The bottom spar is installed in the same manner as the top, and all gussets cemented in place. The false ribs are not cemented in place until the leading edge is shaped and sanded.

Stab: The stabilizer is built in the same manner as the wing except that there is no dihedral joint. I used 1/32" sq. spruce railroad stock for the diagonals, however, 1/16" sq. light balsa would do just as well. Careful wood selection is essential here, as the stab weight should not exceed .25 oz.

Fuselage: The diamond-type fuselage, nothing more than a box turned edgewise, was employed because of its simplicity. Yet it affords pleasing lines and a streamlined cross section. Spruce longerons are used throughout for durability, because it is this part of the model that takes most of the abuse. The aft portion of the fuselage was built up primarily for weight reduction, but 1/16" sheet should work out fine for this portion in place of the 1/16 x 1/8" crosspieces, if light C-grain balsa is selected.

The sides are constructed in the conventional manner, one on top of the other. Note on the plans that the 3/32" sheet sides are separated with pieces of 1/16" scrap balsa so that the outside surfaces are flush with the 1/8" sq. longerons. The pylon is built up of 1/4" sheet balsa as noted on plan.

After assembly and prior to sanding (make the lower portion slightly oversize), mark the centerline on bottom using a ballpoint pen. To achieve the V-bevel needed to fit snugly on the fuselage, hold sandpaper taut over the top of the fuselage. Align the mark with the top corner and carefully sand in the required bevel with a fore and aft motion.

After the front 1/16" plywood facing is cut out to the correct shape, cemented in place and allowed to dry, the nose section of the fuselage may be shaped to the contour shown and faired into the plywood face. The tailpost is made from a piece of scrap balsa and beveled in the same manner as the wing. When installing the plywood stab rest, use scrap balsa corner filler blocks between the fuselage and stab rest on both sides for support. Shape these to a streamlined shape before cementing in place.

The 1/16" ply rear anchor reinforcements are drilled first, then cemented in their exact locations. When dry, cut the holes through the balsa sides. I use a piece of 1/4" aluminum tubing with the end filed to a sharp edge, cutting with a rotary motion. The fin is built in much the same manner as the wing and stab. The lifting section is used for right turn effect.

Prop: As previously mentioned, this type of front end assembly was chosen to eliminate the inner portion of the prop blade area. A little more initial effort is required, but it is worthwhile for several reasons. The blade pitch angle is adjustable (recommended for experimental reasons only). Most important, if the blades are damaged, only new blades need be made, instead of the whole prop assembly.

To set the pitch, use a jig consisting of a triangular template mounted on a block and two plywood plates cemented on the end of the block, with a notch in each one to accurately position the prop shaft square with the top surface of the block. These plates are spaced by an amount equal to the distance between the aluminum face plate and the rear of the bearing housing (about one inch) and protrude out from the block one inch. The ends of the plates are slotted (using a 3/32" drill in a drill press and a razor saw), making sure they are aligned perpendicular to the top surface of the block. When the prop assembly is mounted this gives positive shaft alignment between two points.

The only machining required is in making the aluminum hub and bearing housing. The rest of the parts can be made from aluminum plate, using a jeweler's saw and a file. The detachable aluminum T-bar coupling allows winding without prop breakage due to blown motors. After the motor is wound, a 1/16" or two mm wipe rod is inserted thru the hole to transfer the coupling to the shaft.

Select wood with a density of about 10-14 lbs. per cu. ft., straight-grained, with as few flaws as possible. I lay both blanks out on the same block, with tips facing the same direction and in line so that the ring pattern is the same through both blanks. This affords uniform blade flex, which is important during the initial power burst. The whole prop assembly should come out between 1 1/4 and 1 3/8 oz., but should not exceed 1 3/8 oz.

Covering and Flying: The entire framework is given two coats of dope thinned 50-50, sanded between each coat. Use silk and nylon reinforcement wherever specified; it is important for strength and durability. The model is covered with Japanese tissue and given three to four coats of dope thinned to 50-50. If nitrate is used, add about 8-12 drops of castor oil per oz. for plasticizing. After covering, epoxy the wire hooks to the stab, drill a 1/16" hole through the tailpost and epoxy a piece of 1/16" brass tubing in the hole as shown for the DT line.

Prior to making the first test flight, make sure all the flying surfaces are flat. Then, using a heat lamp, wash in the righthand wing panel about 1/16" on an inch. This provides cross control, which will help keep the right wing up during the high-power part of the climb. Balance the model at the correct point, with the motor installed. Incidence angles must be as shown on the plan. Also, shim the stab for the indicated correct tilt angle.

Begin test flying by making a couple of hand glides. If the glide is flat with a noticeable right turn, the model is ready to have a few winds put on the motor. First, shim the top of the nose block 1/16" for down thrust and the left side 3/32" for right thrust. This will give about two degrees down and three degrees right. Put about 50 winder turns on the motor and release the model gently, straight ahead into the wind. The model should then make a steady, gentle climb to the right. If the model turns too tightly, remove a little of the right thrust and try again, until a gentle right turn is attained.

Now for full power turns! Wind the motor to about 90% capacity (approximately 85 winder turns for 16 strands of 1/4" Pirelli). Launch the model directly into the wind at about a 45 degree angle and watch for any dangerous tendencies such as banking too much under high power or approaching a stall condition. If the former is the case, remove down and right thrust by small degrees until a steep, steady climb is achieved. It may be necessary to add a small amount of left tab for additional cross-control. If the model tends to stall, check the incidence setting and add down and right thrust to bring the nose down. When the model is properly adjusted, the thrust setting should be 1 degree down and 1 degree to 3 degrees right.