



### INTRODUCTION

In the early 1960's, George Wing, the President of Hi-Shear Corporation, undertook the design and development of a radical light twin aircraft. The aircraft was built in response to a marketing study which revealed that there was an identifiable need for an efficient two placed business twin. Moreover, a high performance, quality constructed aircraft was expected to have considerable appeal to the sport pilot.

The prototype, Wing Derringer, N3621C, powered by two Continental IO-200 fuel injected engines, flew for the first time on May 1, 1962. The IO-200 engines developed 115 horsepower each, and were replaced by 150 horsepower engines on the second prototype. The original accumulated more than 300 hours before it was retired. The number two aircraft was first flown in November of 1964 and was lost during an early test flight. The third aircraft was used for static structural tests.

The fourth Derringer was powered with two 160 horsepower Lycoming IO-320BIC engines and was used to obtain FAA type certification. A fifth pre-production aircraft was also built to serve as a demonstrator.

By 1968, it was apparent that the Derringer was clearly a success in terms of performance, and the aviation press was giving it a big build-up. The July 1968 issue of *Flying* said: "If you grow misty-eyed over impeccable machinery, lovingly crafted without regard to crass marketing formulas, the Wing Derringer is for you. Magnificent. Never have we seen so beautifully built a machine on the short side of a half million dollars."

Similarly gushing statements were made

in the February 1969 issue of *Sport Flying* and the June 1968 issue of *Private Pilot*.

Unfortunately, legal problems with the production contractor prevented the Derringer from reaching the Market. However, the fourth and fifth aircraft are still flying, and are based at Torrance, California.

I chose one of the two remaining aircraft, N7597V, as the subject for a 1/4 scale model. The Derringer's size is ideal for 1/4 scale reproduction. At this scale, the model is small enough to allow for a single piece wing that is easily transportable. It is adequately powered with two standard .60 engines, yet it is large enough to provide the visual impact and the flight stability associated with larger 1/4 scale aircraft.

The model design was based on 3-view drawings found in the January 1964 *Air Progress* and the manufacturer's sales brochure; copies of which may be available from the Hi-Shear Corp., 2600 Skypark Drive, Torrance, California 90509.

Two intentional deviations from scale were made. The first is the retraction sequence of main gear. The model's main gears retract simplistically inboard toward the fuselage, and are not covered by any doors. The full sized Derringer uses a rather complex arrangement which allows the gear to fold completely within each nacelle. The retraction is similar to the F8F Bearcat sequence where the upper portion of the leg slides tipward while the gear is coming up. The Derringer's main gear retraction is depicted clearly in the previously mentioned issues of *Air Progress*, *Sport Flying* and the manufacturer's brochure.

The second deviation from scale is the use of a non-laminar flow airfoil. The full sized Derringer employs a NACA 652415. I felt safer using a thick 23000 series airfoil to



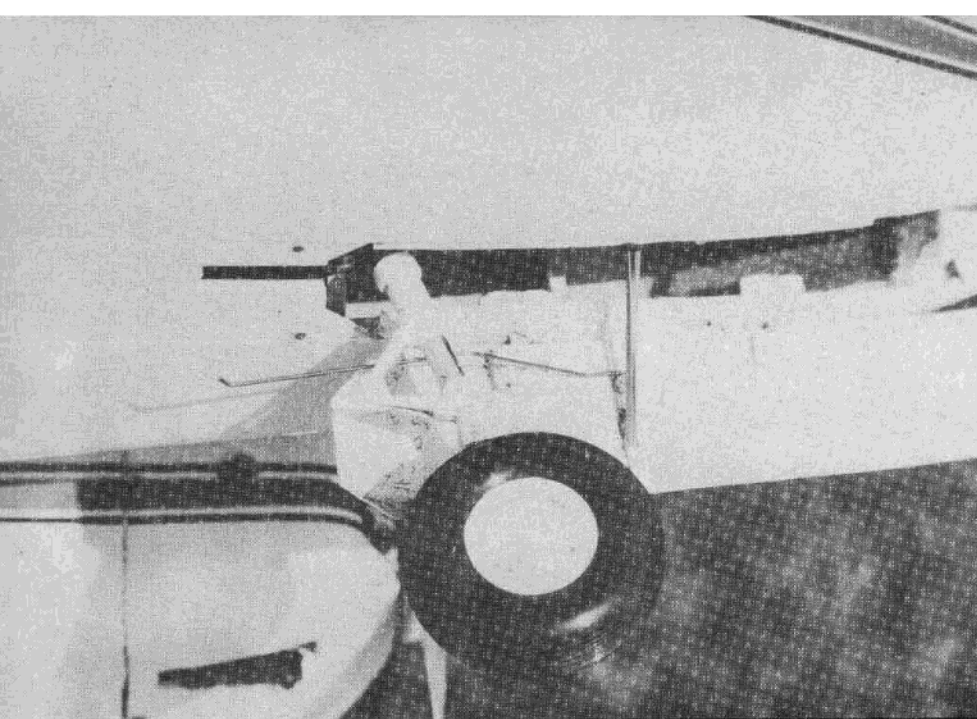
# THE WING DERRINGER

**RCM is proud to present, what we feel to be, one of the most outstanding One Quarter Scale Twins. Powered by two standard sixties, the Derringer's performance and flying stability will amaze you.**



**By  
Mark A. Frankel**

**Photos By  
Jim Lipschutz**



provide high lift and gentle stall characteristics.

One attribute which came closer to scale than I intended is the model's weight. I projected that the model would gross at 15 pounds, however, it finally flew at 25 pounds. This caused all sorts of concern about a wing loading in excess of 50 oz./sq. ft., and the ability of the Rhom retracts to withstand the landing shock. Nevertheless, the model flies, and it is surprisingly docile. Furthermore, the landing gear has withstood numerous sod field landings with no apparent damage. Of course, the model would be infinitely more enjoyable at a lower flying weight, and I suspect that an 18 pound gross is achievable. The plans reflect several structural changes from my model in an effort to lower the weight. I will discuss these modifications in the building notes.

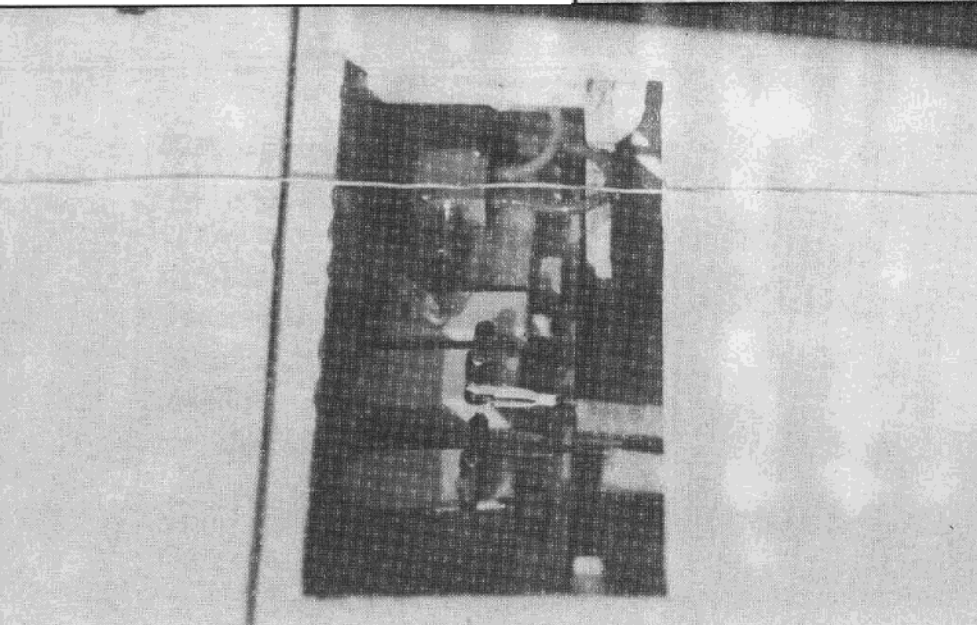
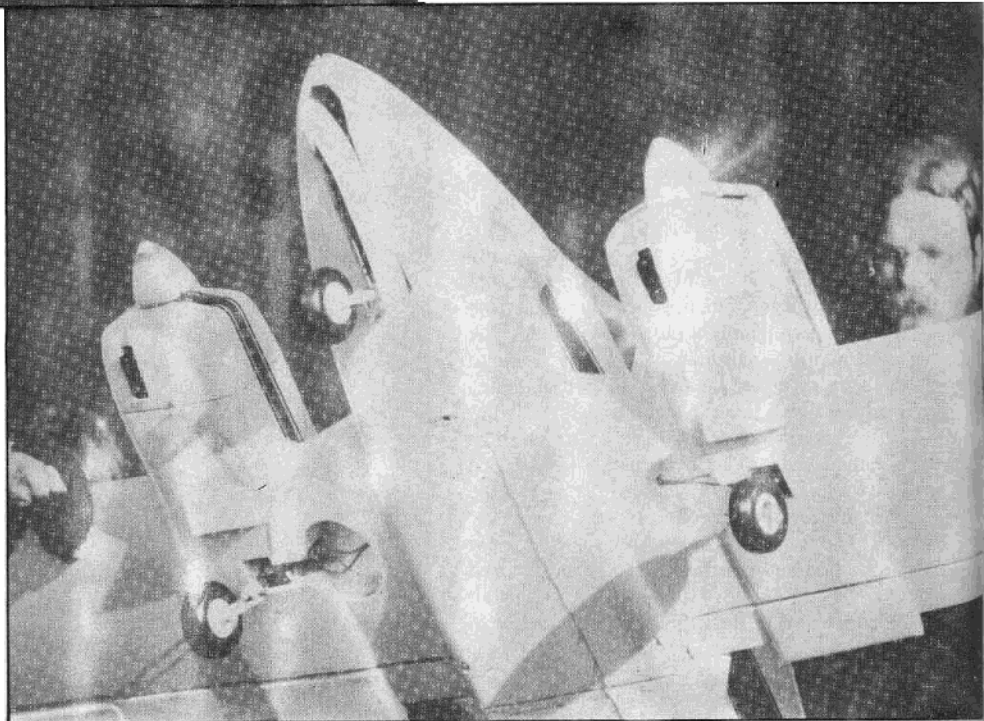
#### BUILDING NOTES

The fuselage is simply two slab sides of

1/8" balsa doubled from the nose to the trailing edge of the wing with 1/16" plywood. Bulkheads F1 through F12 are cut from the appropriate material. The wider bulkheads are assembled from two pieces cut from 4" wide stock glued together at their centerline and reinforced with strips of 1/4" square balsa at the bulkhead's top and bottom.

F6 and F7 are glued in position between the fuselage sides. Use a slow drying epoxy for this step since it is essential that you have the time to align the sides. Accuracy at this point will insure a true fuselage. When dry, the remaining bulkheads are glued in place. The 1/4" turtle deck top and the 1/8" fuselage bottom are added, followed by the 1/8" x 1/2" nose planking and the 3/4" lower nose blocks. Finally, the 3/16" turtle deck sides are added which run from F7 to F11.

The canopy is built by tack gluing F6A and F7A to F6 and F7, respectively. The 1/2" soft balsa roof is glued between F6A



and F7A, and a lower canopy framework is formed of 1/2" x 1/4" balsa as indicated by the dotted lines on the plans. Once dry, the canopy can be removed from the fuselage and put aside until the interior detail is completed.

The nose block is carved from hard block balsa, while the tail blocks are formed from polyurethane foam (2 lb./cubic ft. density.)

The emmpenage is constructed in the traditional built-up fashion. This is an area where considerable weight can be saved. Part of my weight problem stemmed from the fact that I used foam tail surfaces. I carelessly applied too much contact cement, and I used relatively heavy balsa for skin. The result was an overweight tail that required almost 2 pounds of lead in the nose to achieve the proper Center of Gravity. Therefore, be extremely careful with the materials used in the tail.

## WING DERRINGER

Designed By : Mark A. Frankel

### TYPE AIRCRAFT

Quarter Scale

### WINGSPAN

87½ Inches

### WING CHORD

13⅛ Inches

### TOTAL WING AREA

1137½ Square Inches

### WING LOCATION

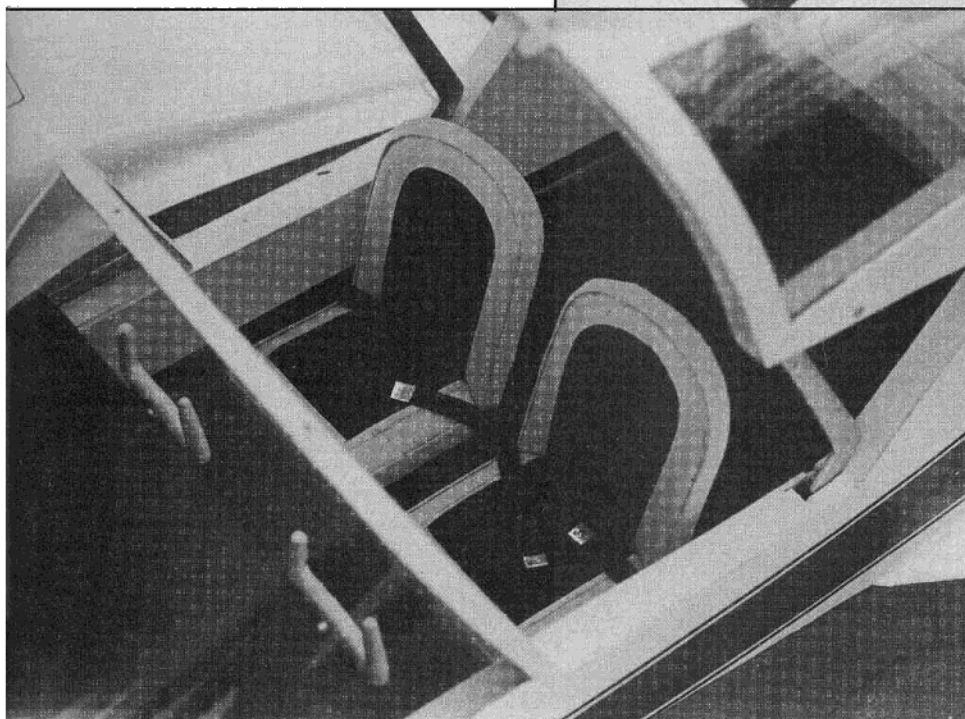
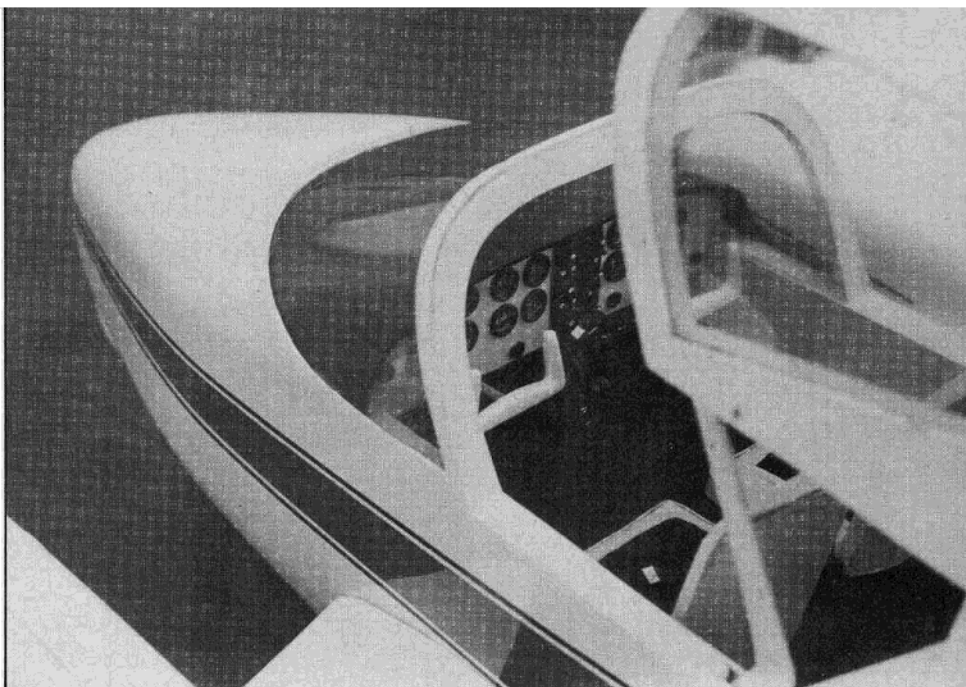
Low Wing

### AIRFOIL

NACA 23016

### WING PLANFORM

Constant Chord



### DIHEDRAL, EACH TIP

3½ Inches (6°)

### O.A. FUSELAGE LENGTH

69 Inches

### RADIO COMPARTMENT AREA

Ample Room (Any Radio)

### STABILIZER SPAN

32¼ Inches

### STABILIZER CHORD (incl. elev.)

8 Inches

### STABILIZER AREA

258 Square Inches

### STAB AIRFOIL SECTION

Symmetrical

### STABILIZER LOCATION

Mid-Fuselage

### VERTICAL FIN HEIGHT

16⅞ Inches

### VERTICAL FIN WIDTH (inc. rudder)

10½" Average

### REC. ENGINE SIZE

(2) .60 Cu.In.

### FUEL TANK SIZE

(2) 12 Ounce

### LANDING GEAR

Tricycle (Retractable)

### REC. NO. OF CHANNELS

6

### CONTROL FUNCTIONS

Rud., Elev., Ail., Throt.

Flaps, L.G.

### BASIC MATERIALS USED IN CONSTRUCTION

Fuselage ..... Balsa, Ply & Foam

Wing ..... Balsa, Ply & Foam

Empennage ..... Balsa

Weight Ready-To-Fly ..... 400 Ounces

Wing Loading ..... 50.6 Oz./Sq. Ft.



The tail surfaces are skinned with the softest 3/32" sheet available, but it should be sanded to 1/16" before finishing.

The stabilizer is epoxied in place on top of the 1/8" fuselage sides, and the fin is epoxied to the 1/4" turtle deck top. Note, however, that the fin obtains its rigidity by anchoring its spars to two 1/8" x 1" spruce strips glued between the fuselage sides. These strips are positioned by cutting an access hatch in the bottom skin between F10 and F11. This hatch will also provide access to the rudder horn when needed. The fin joint is further solidified by epoxying a 1" strip of 2 oz. glass cloth to the joint.

All cabin windows are made of .040 butyrate available from Sig. The side windows have a slight compound curve and, therefore, must be molded. Idea Development markets a neat vacuum forming machine that will handle this task easily. I made a mold of polyurethane foam which was sanded to shape while glued in place on the canopy frame. It was then removed and finished with several coats of resin.

The front and rear windshields curve in only one dimension and can be formed from flat sheet stock. To obtain the scale tinted glass effect, I dyed the windows in a solution of Rit's Kelly Green Dye before installing them.

The wing on my model is polystyrene foam, however, I show a built-up structure on the plans. Again, this is an area where considerable weight can be saved. Foam is quick, easy and accurate, but the amount of contact cement needed to secure the skin to a wing of this size presents a real weight problem. I am convinced that the built-up structure is well worth the effort in 1/4 scale. Furthermore, this wing is constant chord and all ribs are almost identical.

The wing is built in three panels, a right, left and center section. To achieve the proper wash-out, the trailing edge of each rib must be progressively elevated so that the tip rib trailing edge is 3/8" higher than the root rib trailing edge. The flaps and ailerons are razor sawn from the wing panels after the lower skin is applied. The right and left panels are joined to the center section with 1/8" plywood spar doublers. The forward spar doubler also serves as a mount for the nacelle. The wing tips are carved from 2 lb./cubic ft. polyurethane foam.

The nacelles are constructed like a small box fuselage. N2 should butt against the forward spar doubler on a 0°, 0° thrust line. My cowls were made of balsa covered with 2 oz. fiberglass cloth, however, an all fiberglass cowl may provide more efficient cooling. An access hatch is cut in the upper nacelle skin between N1 and N2 to provide access to the fuel tank and throttle pushrod.

The model's finish is another area that can contribute significantly to its gross weight. I will describe the technique I used which yielded an attractive finish in minimum time, but it weighs a ton.

The entire model was covered with Silkspun Coverite except for the polyurethane foam area which received two coats of finishing resin. The Coverite then received two coats of Sig clear dope to seal

the fibers which were raised by the hot iron. This was followed by several coats of Dupont's #30 Automotive Primer Surfacer (plasticized by Southern Products Flex-All). The color coats were Dupont's Lucite, an automotive acrylic lacquer (with Flex-All added). This was topped by a coat of clear Dupont Imron, a two part polyurethane enamel. This finish is completely fuel proof, has withstood two intentional gear-up landings (which will be described later), and looks exactly like a factory fresh civilian aircraft finish, but it is not worth the pounds it adds to the airframe.

An alternate method would be to cover the wood with Permagloss Coverite which already has some finish built into it. This material should be able to provide proper adhesion for the color coats without the need for heavy primers. The color coats should be a high gloss enamel such as: Imron, Superpoxy or Hobbypoxy, thus eliminating the heavy lacquer colors followed by a glossy clear coat.

A light finish, a built-up wing, and the absence of excessive nose weight should go a long way toward reducing your model's weight. But more important than gross weight is the way it is distributed on the aircraft. Be sure that your model's Center of Gravity is located at the point shown on the plans. Be further certain that your engines are of equal power, and that they respond to throttle commands in unison. Ground run your engines through several tanks of fuel with the cowls in place to assure that they will not overheat. My first flight was made before the engines were properly adjusted and the result was nerve shattering. Shortly after climbing out, I retarded the throttles slightly. The left engine (the critical engine) was too lean at this setting, and managed to starve while I was in a left turn. I noticed the engines sounded different, and I suspected that one was out, but I couldn't tell which one until the airplane rolled over on its back and began dropping its nose. Fortunately I had enough altitude to chop the throttle on the right engine which stopped the rotation on what had become a well executed, but unintentional, inverted spin. I was a good distance from the runway when the aircraft recovered so I kept the gear and flaps up and touched down in the grass. The aircraft was undamaged, but several engine run-ups were performed before flying again.

The second flight was equally as eventful. Now the engines (two Enya .60 III's) were performing flawlessly; but on a low pass it became apparent that my huge fin and rudder were fluttering violently. About thirty spectators all chanted, "Your rudder is loose." I dropped the gear and set up for a handsome nose high landing. The landing speed seemed no faster than a high performance pattern airplane, but the roll-out was something to behold. The model touched within the first quarter of our 300' grass strip, but continued rolling well into the high grass. I guess a 25 pound airplane dissipates a lot of kinetic energy on roll-out. Upon examining the fin and rudder, I found that the fin had cracked, and I decided to saw the entire unit off and replace it with a built-up structure that is

shown on the plans. Further flights have proven the new vertical tail to be sufficiently rigid, and no additional flutter has been encountered. On a later flight we did discover some aileron flutter at full throttle, but this was corrected by narrowing the aileron gap under the wing and stiffening the torque tube mounting. Be sure that all of your controls are as rigid as possible. Thus far my Rhom retracts have absorbed the landing loads admirably, however, I have returned a set to the factory to have brass bushings and trunions substituted for the standard nylon parts. This should provide a greater degree of durability. Idea Development's Hydra-Locks also look interesting and I intend to install a set when I add the brass bushed landing gear units.

I hope to build another Derringer in the near future. This will represent N644W, the other surviving prototype. I am especially curious to see how light I can build the model --- after all, I have already demonstrated how heavy it can be built.

Please feel free to address any questions or comments to me in care of R/C Modeler. I would be especially please to see pictures of your projects, and I would be happy to help you with documentation if you choose to enter your Derringer in competition. □

**From  
RCModeler  
Jan. 1 1980**