short S

In the early days of WW II, the rumblings of this four-engined bomber marked the beginning of the RAF's efforts to increase its air strike capabilities. This one is for four .10 engines and four-channel control.

■Frank B. Baker

The Short Sterling has a unique appearance that sets it apart from other World War II bombers. The Short Brothers Aircraft Company, which built the originals, is now the longest continually operating airplane manufacturer in the world.

THIS AIRCRAFT was the first British four-engined bomber of World War II, and it served throughout that period. The oft-told tale of the Sterling is that its performance was severely constrained by an Air Ministry requirement that its wingspan be limited to 99 ft. in order to fit in existing hangars. Ironically, the plane rarely saw the inside of a hangar during the war.

Early in the war Sterlings, along with Wellingtons, were the mainstay of the bomber command. They flew most of the missions over Europe. As the war progressed, the performance of the Sterling was found lacking, and it was relegated to other roles. It was widely used as a glider tug, particularly in the famous Arnhem drop of the book and movie, *A Bridge Too Far*. It also served as a multi-engined trainer for bomber crews.

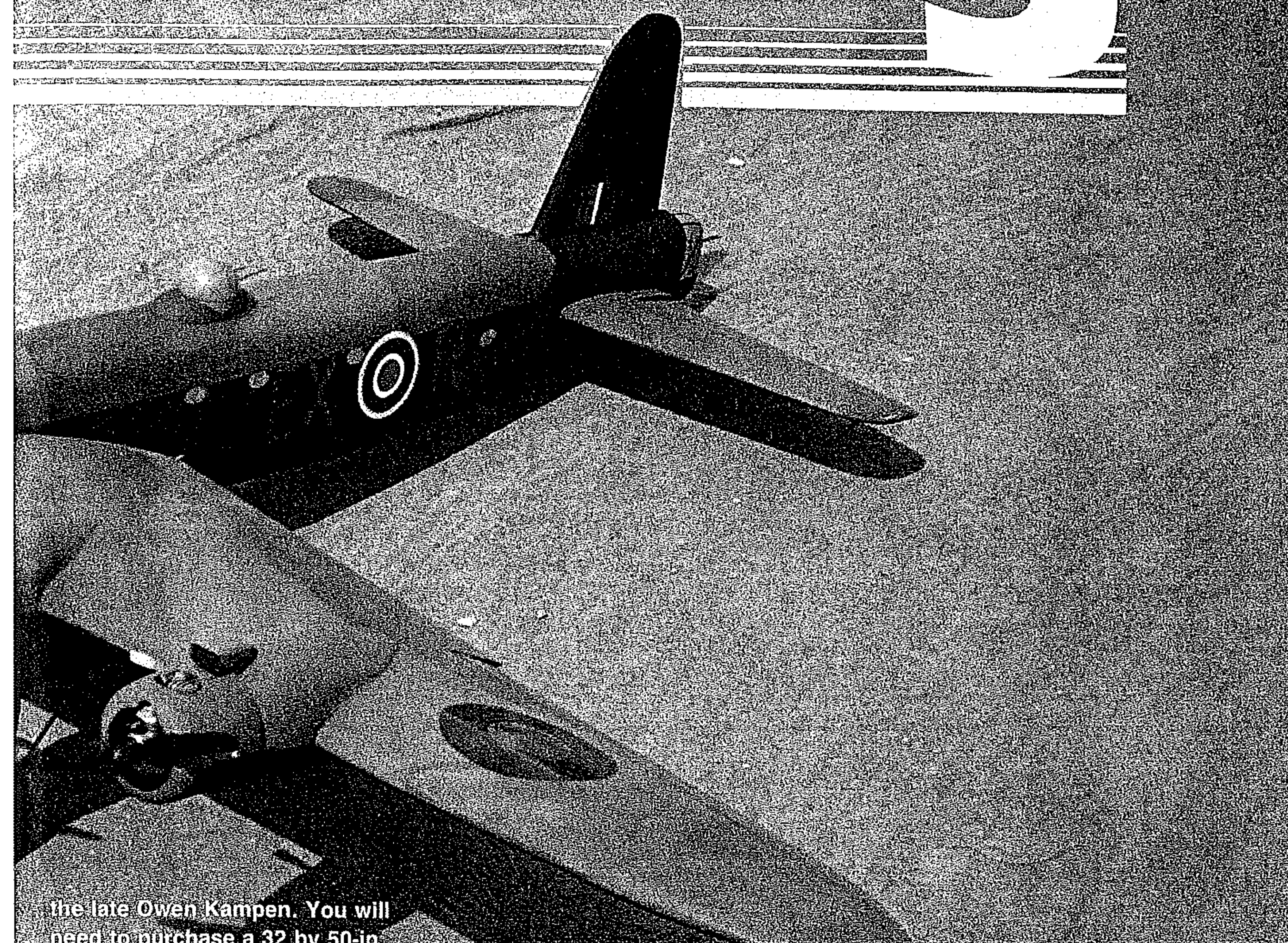
Although some 2,382 Sterlings were built from 1939 to 1945, none survived the smelters in the postwar period. Given the British penchant for things historical, this is a bit unusual. Apparently they did not have a Paul Garber to preserve important aircraft.

The Short Sterling was a very large aircraft for its time, having a fuselage length of 87 ft.; the top of the cockpit was 22 ft. above the ground. In most photographs of British WW II bomber airfields, a Sterling could be seen standing with its nose way above the other aircraft.

For me the Sterling is one of those aircraft so plain as to be beautiful. However, it is rarely modeled. About 20 years ago I built an Avro Lancaster, which I still fly, so I decided to build the Sterling to the same scale. This resulted in a model with a 74-in. wingspan and a 65-in. fuselage. As usual, I powered it with four O.S. .10 FSR engines, although four O.S. Max 15s could be used.

Fuselage. Due to the size of the fuselage, I decided to use the rolled plywood approach pioneered in the early 1960s by

terling



the late Owen Kampen. You will need to purchase a 32 by 50-in. sheet of 1/32 plywood. I ordered mine from Sig.

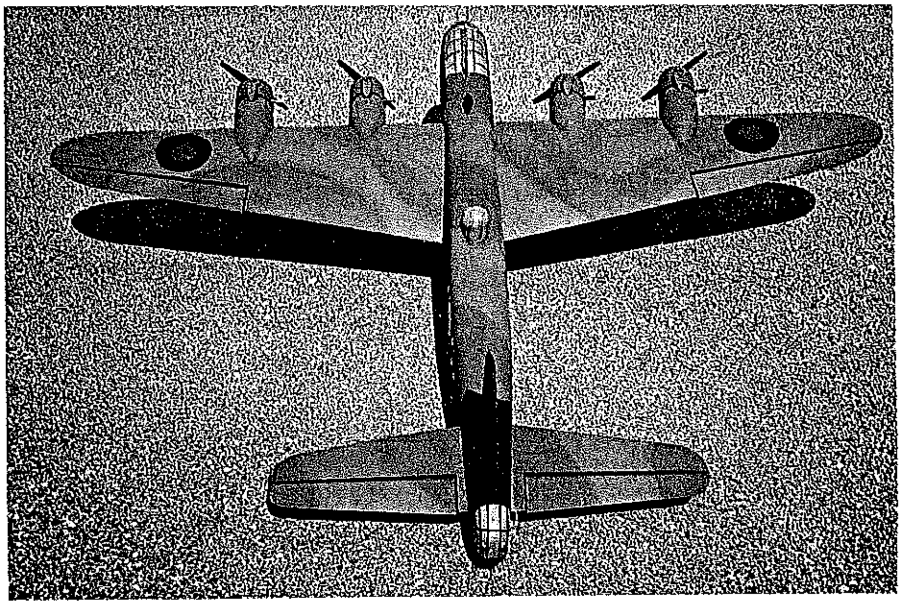
The technique is to build a minimal fuselage of balsa, then wrap it with a thin plywood skin. This results in a very light yet strong fuselage. The first step is to build the primary fuselage structure. It consists of 1/4-in. balsa formers with 3/8-in.-sq. upper and bottom stringers and 1/4-in.-sq. side stringers. Formers 3, 12, and 14 have additional ring formers to assist in gluing the plywood.

The 1/4-in. hard sheet balsa wing saddle is also installed in the basic frame. Half formers are also used at formers 6 and 10. Be sure to slip some small slivers of 1/64 balsa between the full and half formers so that an X-Acto or Zona saw can go between them.

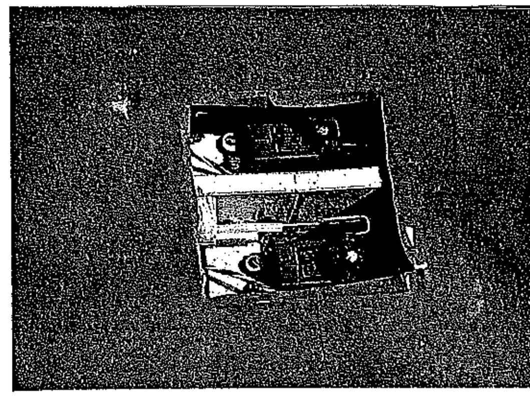
Eight rails of 3/8 x 1/2-in. maple are installed in the bottom of the fuselage for the wing hold-down screws. Again, leave space for a saw blade width at formers 6 and 10.

It is crucial that you install the nylon elevator and rudder control cable tubing at this time. Use RTV silicone to attach the cables to several formers along their lengths. Leave the tubes a bit too long in both the front and rear.

Since the plywood is somewhat expensive, I recommend that you first lay out the

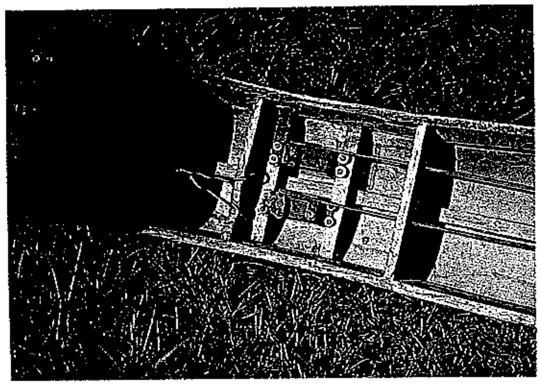


Frank sprayed on the dark green camouflage pattern last without using any masking tape. That way the edges of the color have the feathered appearance of the full-size airplane.



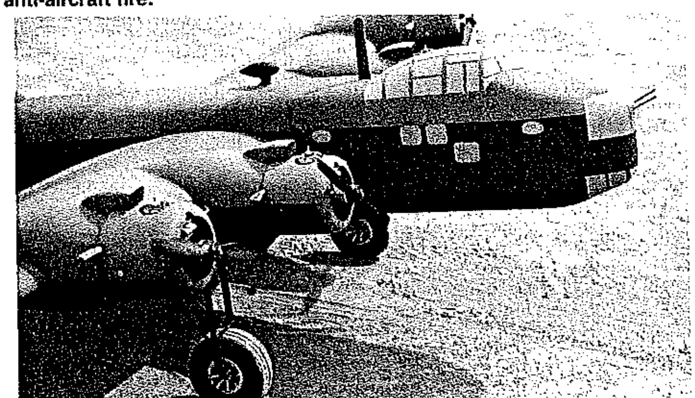
The engine and aileron servos are mounted in front and behind the main wing spar so that the cables do not pass through the spar.

The Sterling sits quite nose high. In the full-size bomber the pilot actually sat 18 ft. above the runway. The Sterling's weak link was its low service ceiling which left it prey to anti-aircraft fire.



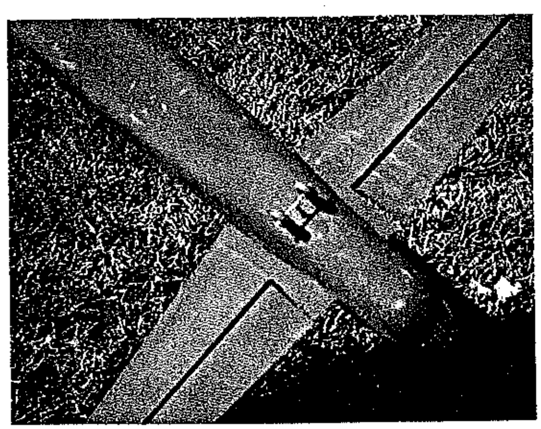
The rudder and aileron servos are mounted on beams across the cavernous upper fuselage.

fuselage sheeting on a piece of thin, flexible cardboard. The basic measurements for the fuselage sheeting are given on the plans. This will allow you to test the fit and location of the cutouts.



Left: The O.S. .10 engines are mounted in a simple but functional manner. The "L" brackets hold the fiberglass cowls in place. Right: The cowls hide the engines but still allow easy access to the glow plugs and needle valves. The radio mast and ADF housing provide realism.

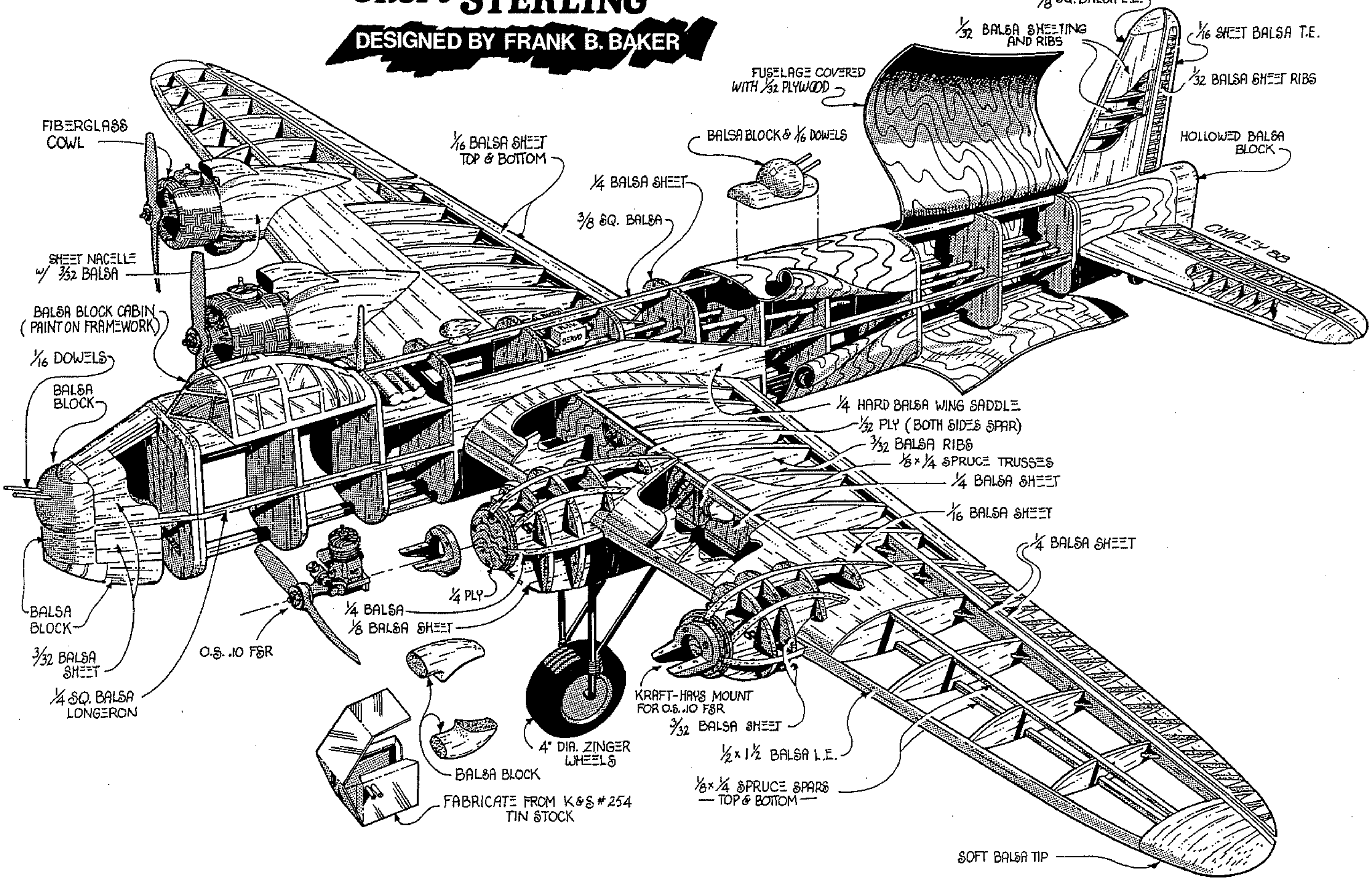
The rolled ⅓₂-in. plywood fuselage is both light and strong. The D-tube front of the wing not only makes the wing very strong, it also provides a rigid platform for the engine mounts.

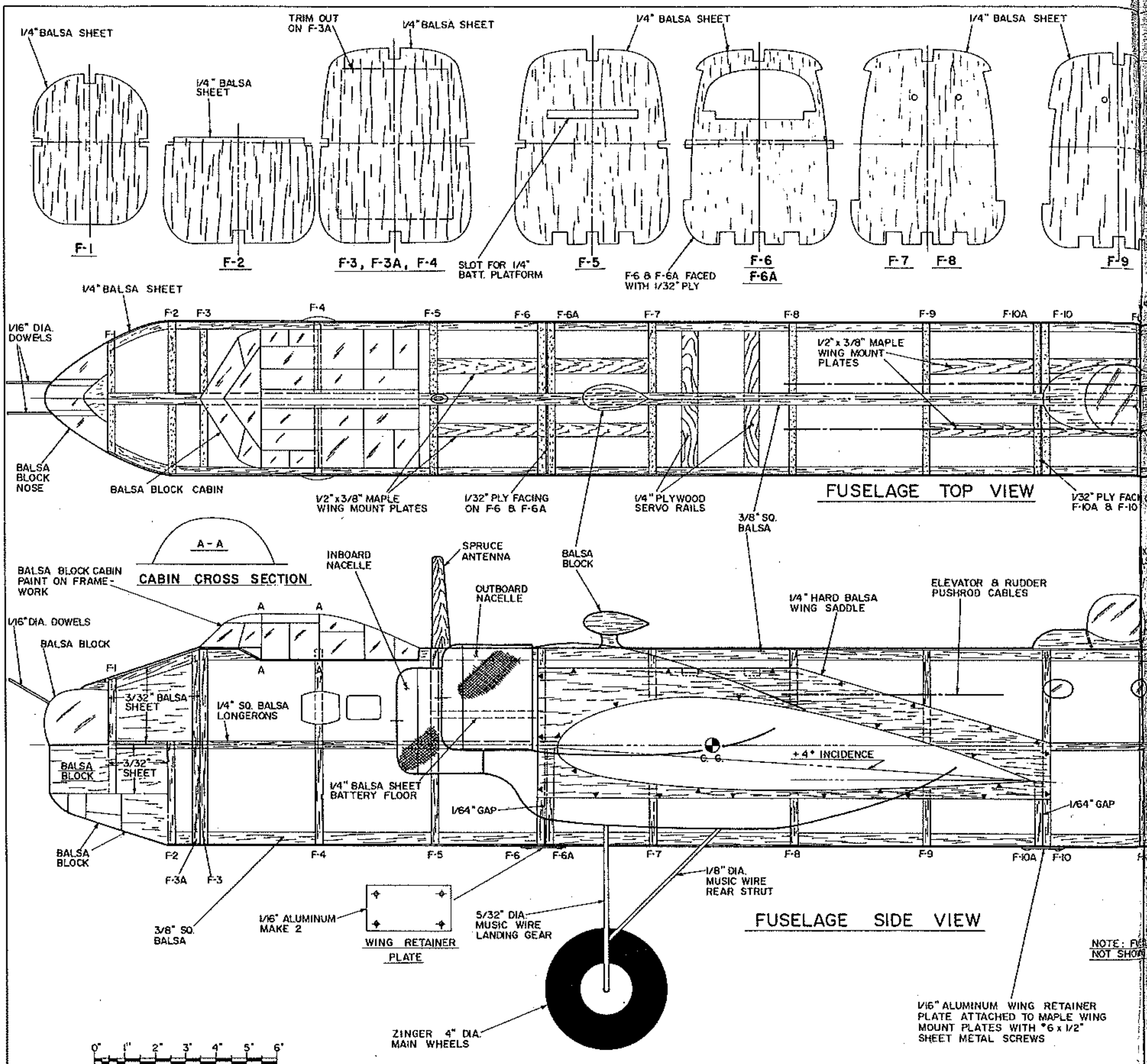


The dual tail wheels were used to support the weight of the Sterling on the grass airfields used by the British RAF during the war.

Short STERLING

DESIGNED BY FRANK B. BAKER





You will be using every inch of the plywood, so lay out the basic fuselage covering along one edge of the sheet. Draw a pencil line lengthwise down the middle of both the top and bottom of the fuselage plywood. Lay a thin bead of epoxy glue down the ⅜-in. stringer on the top of the fuselage, and place the fuselage on the plywood—using the pencil line for alignment. Note that the region from former 14 to 16 will be covered in a later step.

Once the epoxy glue is set, the interesting part starts. Set up a pan of warm water, and add about a half cup of household ammonia to it. Use a piece of sponge to really wet down both sides of the plywood. Put lots of aliphatic resin (white glue) on all the formers and stringers from former 2 to the front former 12, but not on the rear ring former of 12 or the top of front ring former 3A. Be sure to put lots of glue on the ¼-in. wing saddles.

Now wrap the plywood around the fuselage. Initially use masking tape to hold things in place. The masking tape will not stick to the wet plywood, so stick the tape to itself. At the bottom of the fuselage the plywood will overlap about ¼ in.

Once the plywood is essentially in place, it must be bound tightly to the formers. I use electrician's rubber tape for this purpose. Measure off and mark each former location on the plywood, then wrap at formers 2 through 12 as tightly as you can with the tape. The tape will stretch quite a lot, and you will also be sliding the plywood towards the bottom a bit. The goal is to insure that good contact is made between the plywood and the formers. You will probably find that the initial masking tape becomes loose in this process.

Next, sight down the fuselage to make sure that in the wrapping process you have not twisted or bowed it. Since the glue is not set, you can align it easily. Re-wet the plywood from formers 12 to 14, and bend the plywood around the frame. The slits are there to compensate for the compound curves in the lower fuselage. Use some masking tape to hold down the plywood. Check that there are no overlaps at the tucks and that everything fits. You may have to cut the tucks a bit higher or wider for fitting.

Remove the masking tape, re-wet the plywood, and add white glue to formers and stringers from former 12 to 14, but not on the rear ring former at #14. Rewrap the plywood, using rubber tape to hold it in place. Let the whole assembly dry for a couple of days.

While the fuselage is drying, build the rudder and elevator assemblies. These are of straightforward, conventional construc-

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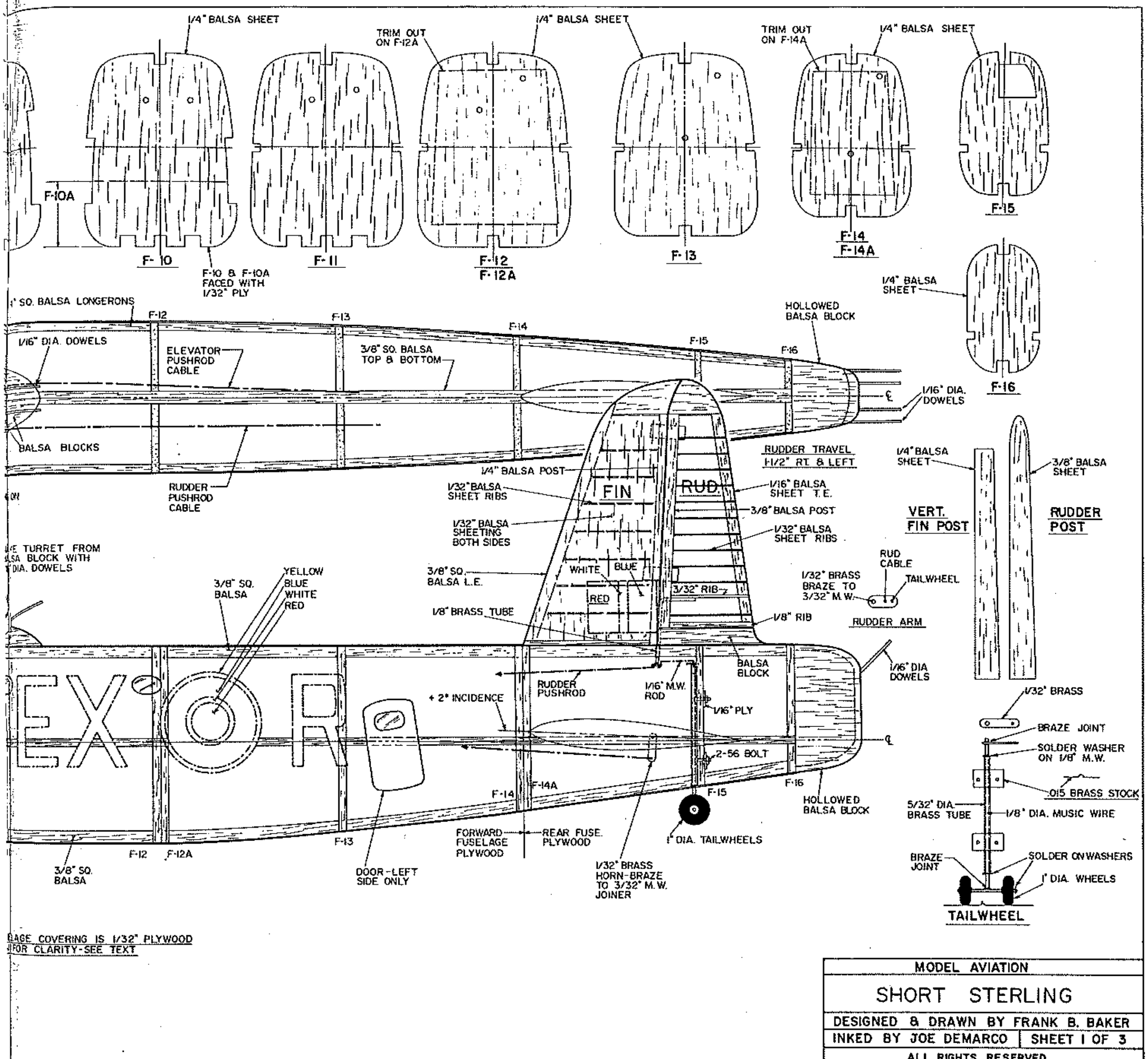


tion. Both the vertical fin and stabilizer are covered with 1/32 sheet balsa. Be sure to keep these assemblies as light as possible. Cut out the rear center section of the elevator, and set it aside. Also fabricate the steerable dual tail wheel assembly and the rudder control horn assembly.

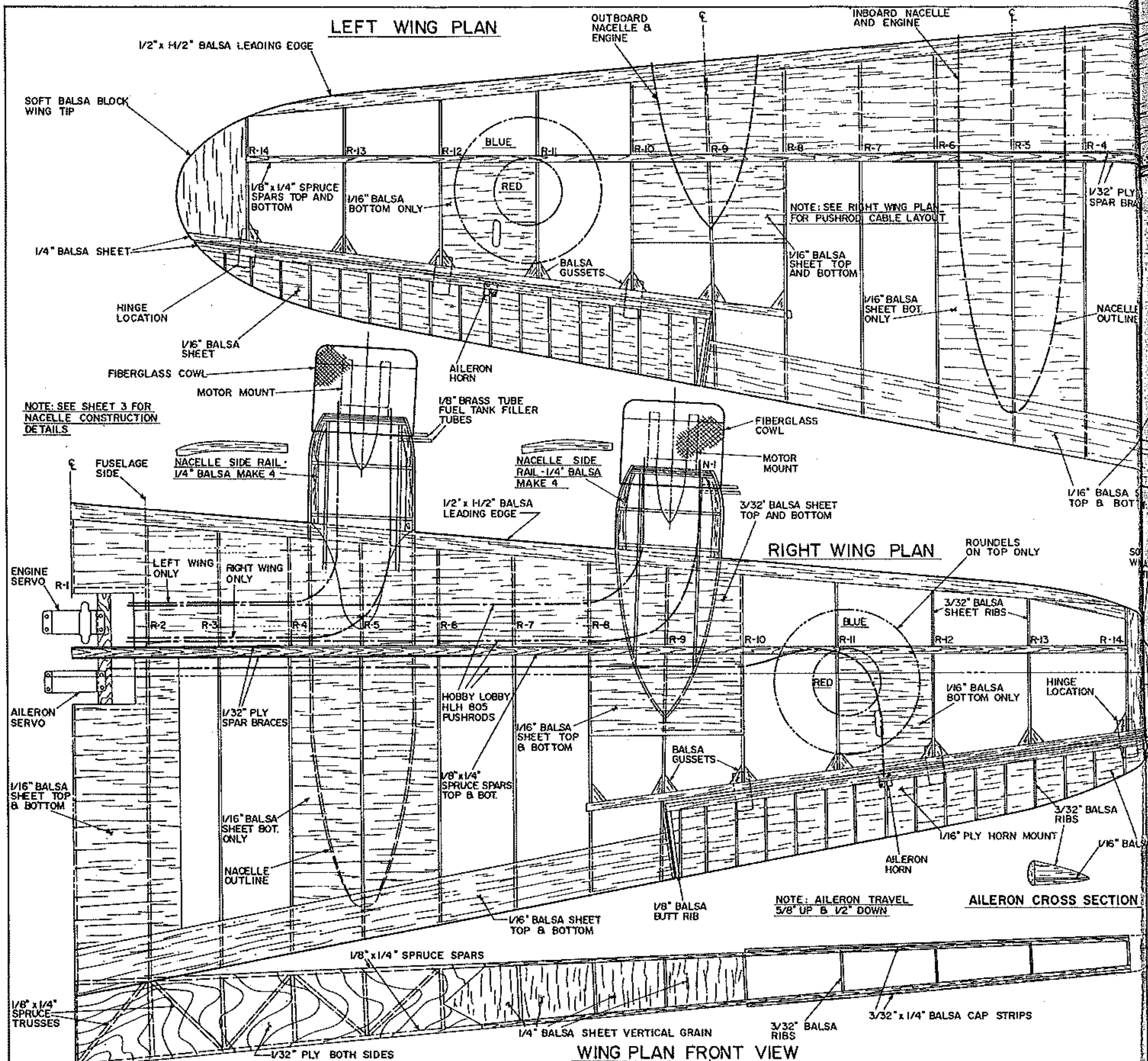
When the fuselage is dry, trim the plywood at former 14 to end at the line where former 14 and its rear ring former join. Now comes the most critical part of the operation. Measure from the front of the fuselage to where the slots between formers 6, 6A and 10, 10A are located, and mark them. Also measure up to the top of formers 6A and 10A on the fuselage side, and mark the chord line of wing rib #2. Due to the taper of the wing, the rib is shorter than the distance from former 6 to 10, so there is a short horizontal section at the leading edge (LE) and trailing edge (TE). Use an X-Acto knife or Zona saw to cut the plywood at formers 6 and 10. If all goes well, you should be cutting between the two formers. Also cut along the line you drew on the fuselage side. With a bit of luck, you should be able to lift out the lower fuselage section at this point.

The next stage is to complete the rear of the fuselage. Drill a 3/32 hole through the upper fuselage stringer, and insert the rudder control horn through it. Install the steerable tail wheel assembly, making sure that it moves properly and that the rudder horn does not hit anything. Now remove the rudder horn.

The elevator assembly is installed next. Cut away the side stringers to accommodate the elevator, but leave enough at former 14 to support the LE of the elevator and at #15 to support the rear elevator spar. Install the elevator assembly at a +2° angle of incidence, and glue it in place; be sure to check it for alignment.

In the front of the fuselage, install the servo rails, and mount the rudder and elevator servos. Cut the nylon tubing in the front compartment to accommodate the servos and connectors. Run a length of control cable down to the elevator, and cut it to length. Insert a 1/16 music wire Z-link in the elevator control horn, and solder it to the cable. Pin the elevator in neutral, and cut the cable at the servo end to accommodate an adjustable quick link and threaded connector.

Cut a template from posterboard to cover the rear fuselage above the elevator. Once it fits, cut out the shape from plywood. Locate the hole for the rudder horn and drill it. Again, put epoxy glue along the upper stringer, and attach the plywood to the stringer.



Insert the rudder control horn from the bottom, and install the 1/16 music wire link to the tail wheel steering mechanism. Wrap the rudder control rod that sticks above the fuselage with some masking tape so that it cannot slip back down inside the fuselage. Insert a 1/16 music wire Z-link in the rudder horn. Slip a proper length of control cable in the rudder tubing, and solder the Z-link to it.

Spot glue the vertical fin to the fuselage; insert the rudder control rod in the rudder, and glue it. Then connect the rudder hinge pins. Hold the rudder in neutral, and install the quick link assembly at the servo end. At this point, hook up the rudder and elevator servos to a radio, and exercise the controls. Everything should work smoothly and have the proper range of motion.

Once you are satisfied that all the controls work, the rear of the fuselage can be "buttoned up." Wet down the plywood, liberally apply glue to the fuselage formers, and bend down the plywood. You will need to use a combination of tape and pins to hold it in place. Then cut out the plywood for the bottom of the fuselage, and glue it on. Cut out the necessary parts for the front of the fuselage, and glue them in place. The region from former 1 to 3 is covered with 3/32 sheet balsa. I used some 4-in. sheet that was soaked in the water-ammonia solution, and it covered the area easily.

Carve the nose and tail blocks to rough shape, glue them in place, then final shape and sand them. The cockpit is carved from a balsa block and fitted to the fuselage. Use Red Devil "Onetime" spackling compound to fill in all the cracks and joints. Then give the fuselage a good overall sanding with 220-grit paper. Carve the upper turret coaming, and attach it. Also install the balsa faring between the rudder and fuselage—as well as the section of the elevator that goes between the movable part and the fuselage.

Wing. Construction begins with the main spar. This spar is a bit unusual, but is very light and strong. First, cut out the dihedral braces from 1/32-sheet plywood. These are about 30 in. long, and if you laid out the use of the sheet properly, the plywood should be available.

Pin one of the braces down to a building board, and glue the 1/8 x 1/4-in. spruce spars to the top and bottom. Note: The 1/4-in. dimension is vertical. Then use white glue to install the 1/8 x 1/4-in. pieces of spruce that form the Warren truss. Let the glue dry, and then glue the other dihedral brace to the top of the assembly. Mark the rib positions along the plywood dihedral brace.

Cut out all the ribs from 3/32 balsa. Use a fine-line marker pen to draw the centerline of each rib on both sides. Cut out the sections of ribs 1-6 that correspond to the spar

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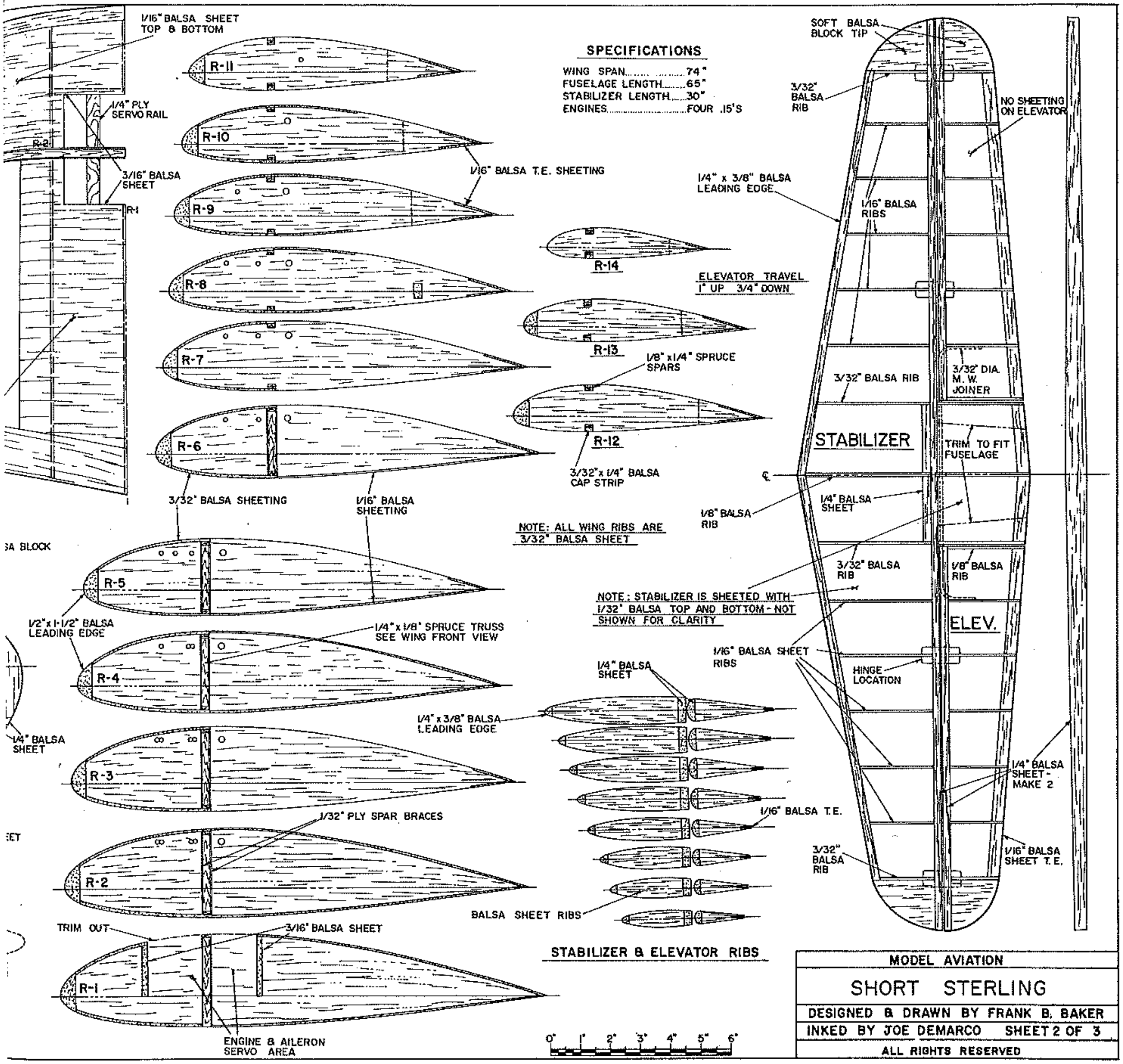


assembly. Now glue the rear sections of ribs 1-6 to the dihedral brace. Be sure that the tips of the ribs in each panel form a straight line. The lines drawn on the ribs will help ensure that the ribs are properly aligned. Once the glue is dry, remove the assembly from the board and install the fronts of ribs 1-6.

Slip ribs 7 through 14 between the upper and lower wing spars, and spot glue them in place with cyanoacrylate glue (CyA). Try to build in about ¼ in. of washout at rib 14. Now sight down the ribs to make sure they are properly aligned. Also sight from the front and rear of the wings to make sure that they are not warped. When properly aligned, glue ribs 7-14 with white glue. Install the leading and trailing edges, as well as the webbing between the ribs. I ran the trailing edge all the way out to rib 14, even though the aileron area will be discarded later. This allows you to check the wing alignment.

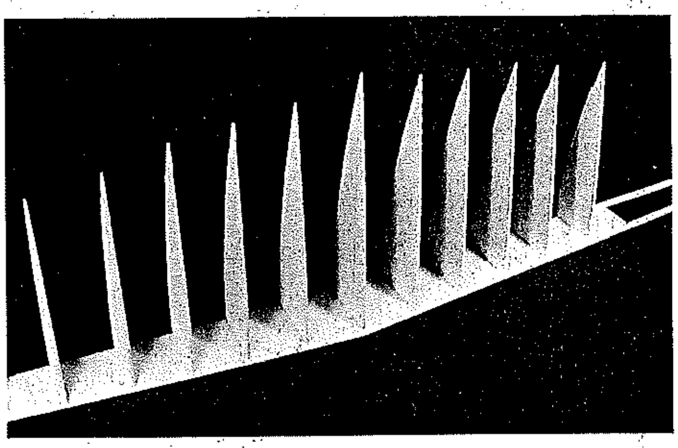
Install the ¼-in. balsa aileron spars in the wings. Note that this spar goes through a hole in rib 8 to give better strength to the outer wing panels.

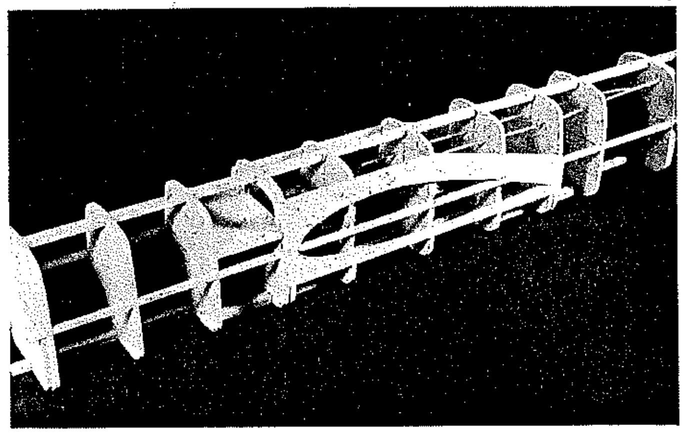
While we are here, you might as well build the ailerons. Cut out the sheet of 1/16 balsa that forms the core. Glue on the ¼-in. LE and sections of 1/16 sheet at each rib position, both top and bottom. Rough carve the aileron to shape, pin it to the wing, and do the final shaping. Install the hinges and horns to finish the job. This is the quickest and simplest way of building ailerons that I have found.

Install the servo rails, and sheet the top of the wing from the spar to the LE, from rib 1 to rib 10, with 3/32 balsa. Carve the leading edge to shape, and cut out the hole in the top sheeting for the servo compartment. Feed the nylon tubing for the engine controls and ailerons through the ribs. Note that the engine control tubing has a different placement in the right and left wings and that it comes out through the top wing sheeting. Be sure to leave plenty of excess length to the engine control tubes where they exit the wings (the nacelles plus the engines are longer than you think). Again use some RTV silicone to hold the tubing in place.

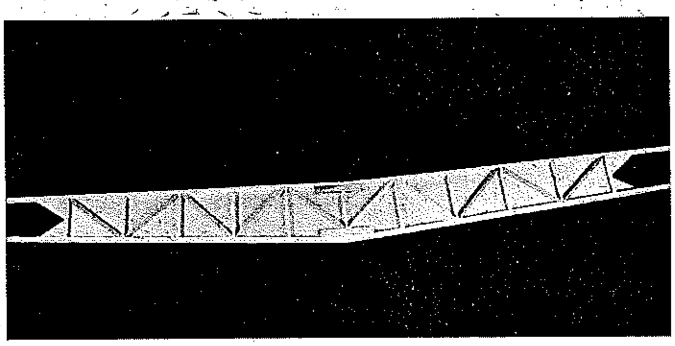
Run some cable through each tube to make sure it moves freely. Now add the 3/32 sheeting to the bottom of the leading part of the wing and the 1/16 sheet to the top and bottom where indicated on the plans, and cut out the aileron servo hole.

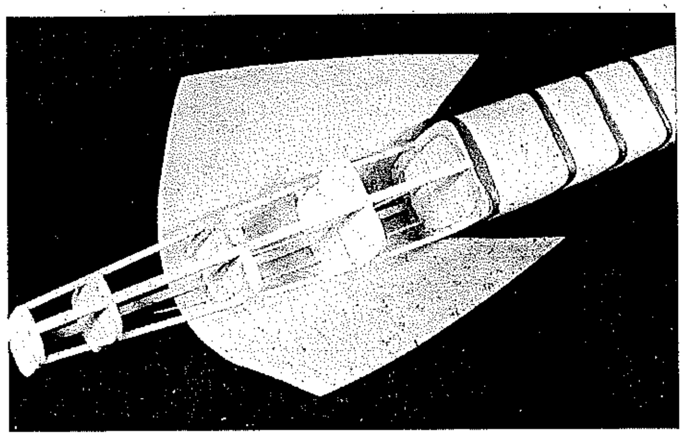
Next we will fit the wing to the fuselage. Cut a sheet of 3/32 balsa to fit the top of the wing where the fuselage sides contact the wing. Mark the centerline of the chord at the leading and trailing edges. Align the chord line with the wing chord line on the fuselage. The wing is at +4° angle of incidence. Mark the rib outline with a pencil





Left: When gluing the ribs to the spar, it is important to keep the trailing edges properly aligned to prevent building in a warp. Use your favorite method for keeping everything square. Right: Because of the 1/32-in. plywood skin that's used as sheeting, only a minimal 1/4-in. balsa fuselage frame is required. The root airfoil has been cut from the 1/4-in. balsa wing saddles to facilitate removing the lower fuselage section after skinning.





Above: The Warren truss is made of 1/8 x 1/4-in. spruce spars top and bottom with a 1/32 plywood full-depth shear web front and back. The resulting spar is both light and strong. Right: When gluing, the plywood skin is held on the fuselage frame with rubber electrician's tape.

and then cut away the plywood. Use a Dremel sanding drum to trim the upper fuselage until the wing fits snugly. Check the wing for alignment in all directions.

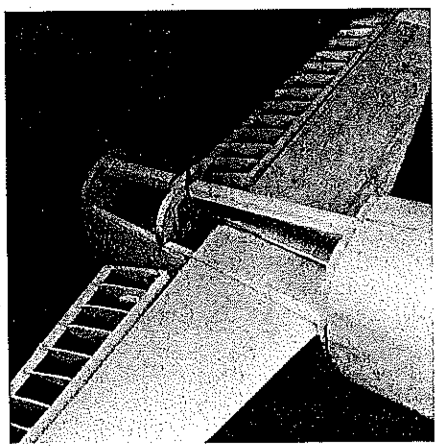
Do the same thing on the bottom fuselage section that was removed, but leave about 1/8 in. excess. Put the wing in the inverted fuselage, and then trim the lower fuselage section until it is flush with the rest of the fuselage bottom. Glue this section to the wing. Fabricate the two 1/16 aluminum plates and drill them. Then position them on the fuselage, and drill pilot holes for #6 sheet metal screws. Wax the screws, then screw them into the maple rails that are under the plywood. These plates are a very strong yet unobtrusive means of holding on the wing.

Fabricate the fuel tanks from tin plate, and bend the landing gear parts. Cut out all the nacelle parts. Coat the plywood firewalls with epoxy glue to fuel-proof them. Install the engine mounts, and glue the fuel tanks to the firewall with epoxy. Start with the inner nacelles. Mount the 3/32 sheet inner nacelle walls with 1½° out-thrust. Set the wing at +4°, and adjust the formers until their horizontal centerline is at 0°. This will result in the engines having 2° downthrust. Glue the firewall to the formers so that there is an additional 1½° out-thrust. The total out-thrust on each engine should be 3°.

Add nacelle formers 2, 3 and 4. Solder a length of 3/16 brass tubing to one of the 5/32 main landing gear legs. Then place the 4-in. Zinger wheel on the tubing, insert the other landing gear leg, and solder it. Be careful to not overheat the brass, as the tires are vinyl and melt quite easily.

Cut out the three sections of 1/8-in. Siglite and 1/32 plywood formers for the landing gears, and use epoxy to glue the sandwiches together with the music wire in the middle. Bevel the front sandwich to fit the wing and nacelle contours, and do the same for the rear one. Cut the lower nacelle keel from 1/4-in. sheet balsa, and install it with a press fit. Do whatever other trimming is needed to make the two landing gear plates fit.

Glue the landing gear plates to the wing and glue in the lower keel. Note: Even



The author brazed the steerable tail wheel together on his model. Double former provides additional gluing surface for the skin.

though the nacelles have 1½° out-thrust, the wheels must be parallel to the fuselage centerline. Install the music wire landing gear crosspiece, using copper wire to bind it and the rear 1/8-in. music wire landing gear support to the 5/32 main gear—and then apply solder. Again, keep heat away from the wheels, as the vinyl melts easily.

Feed the engine control nylon tubing through the firewall, and hold it in place with RTV. The installation of the outer nacelles follows basically the same procedures. Be sure the thrust lines of the outer and inner engines are the same and that both have 3° out-thrust.

Install the engines, ailerons, and engine and aileron servos. Run the appropriate cables, and solder on threaded connectors to the cables with quick links at the engines and ailerons. Again, hook up the radio and exercise the controls. The engine throttle controls should be especially free moving and operate in unison over the same range.

Cover the nacelles with 3/32 sheet balsa that has been soaked in ammonia water. Cut some lengths of 1/4-in. aluminum tubing to fit between the nacelle and the landing gear crosspiece. Use a Dremel tool to cut a slot in the length of the tubing. Fill the tubing with auto body putty, and then slip it over the 5/32 landing gear wire. Close the gap as best you can, and add some more body putty. This will add some diameter to the landing gear legs; plain music wire looks too skimpy.

The engine cowlings were made of fiberglass cloth and Hobbypoxy 2 glue using the "balloon" method. I used a wood lath to turn down a form from a pine block.

Finishing. Once the construction is completed, give the whole airframe a final sanding, and wipe it clean with a tack rag. The wing, nacelles, rudder, and elevator were covered with Goldberg Colortex. This gives a result comparable to medium-weight silk. The fuselage was given a brushed coat of Sigbrite primer, which was sanded away. This was followed by a sprayed coat of primer over the whole airplane.

The camouflage pattern I used is that shown in *Profile 142*. The photographs accompanying the article show the general pattern to be used. The whole upper surface was sprayed with one coat of Cheveron dark earth. When you get to the dark green areas, set up your spray gun to the finest possible pattern. These are not masked, as the edges were spray edges on the full-size aircraft rather than being masked.

The upper parts of the aircraft were masked off at the color separation line of the black. The whole bottom of the plane and the rudder were sprayed with Cheveron flat black. Two summers ago I went to England and visited a number of British aircraft museums with the express purpose of seeing what colors were actually used in WW II. Cheveron dark earth and dark green appear to be authentic. Color photographs of my Sterling and those I purchased of the prototype full-size aircraft match perfectly. I used gray paint for the Plexiglas areas.

All the roundels and lettering were masked and painted. I never can find decals that are the right size for my odd-scaled models.

Drill a 1-in. vertical hole in the balsa nose block from the bottom. Add lead weight here until the center of gravity (CG) is that

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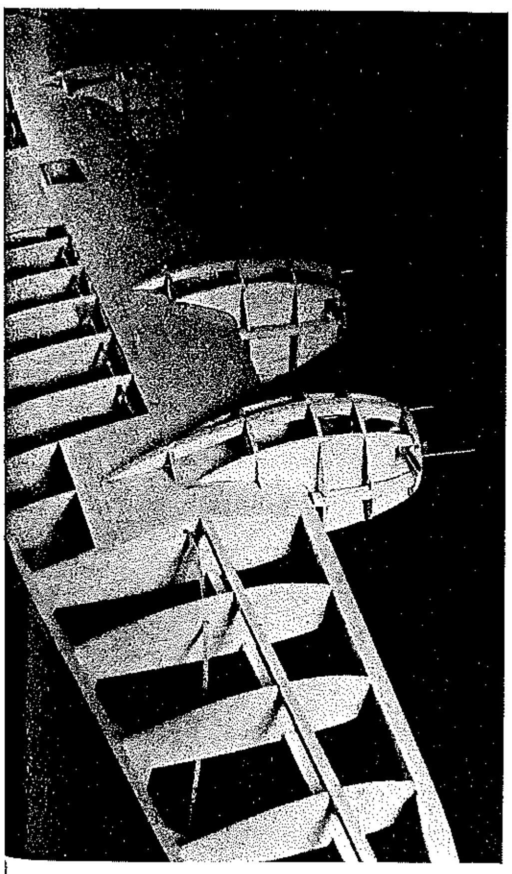
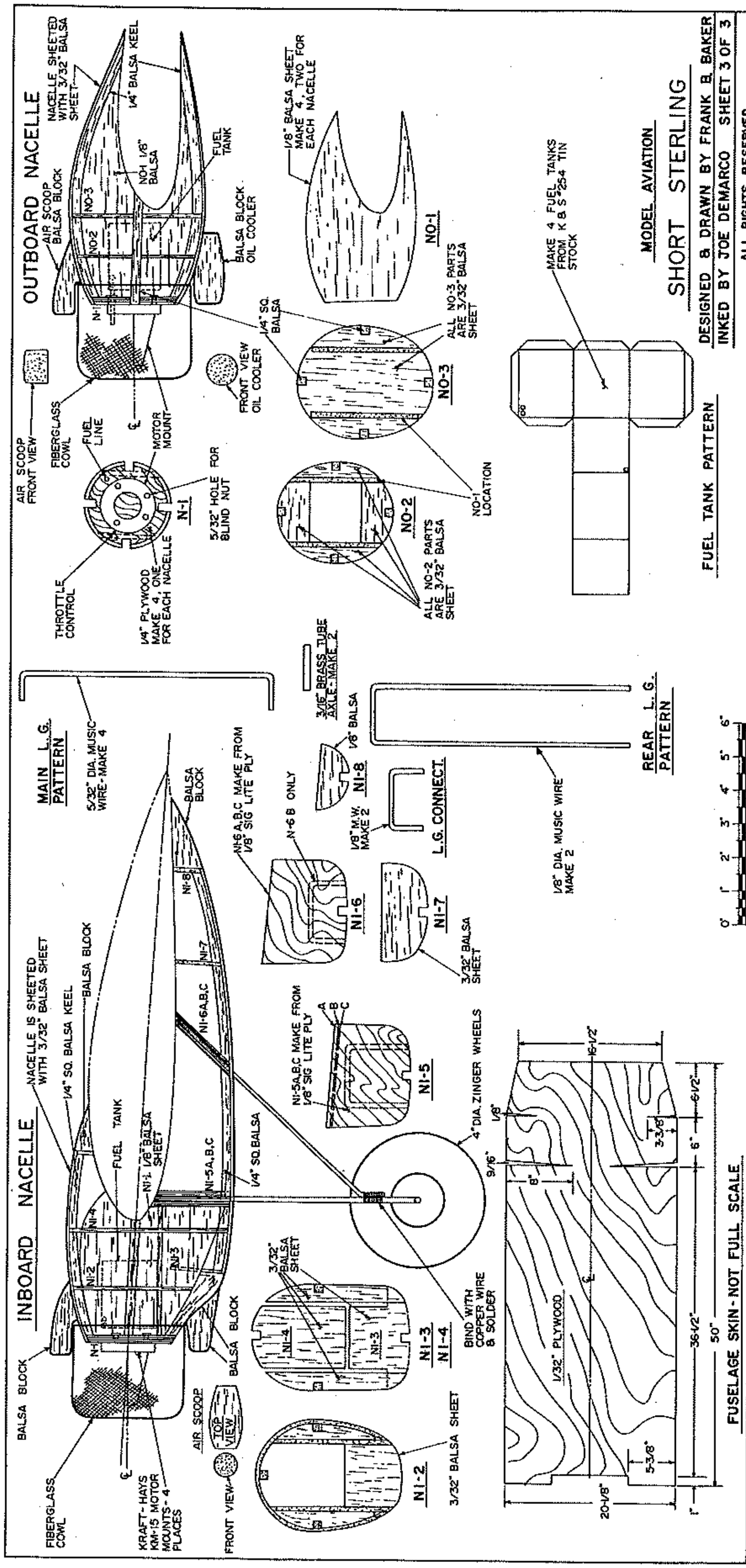


The sheet metal fuel tanks are built into the engine nacelles which will then be covered with 3/32 balsa sheeting. The cable in the nylon tubing is used to connect the aileron.



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Safety/Preston

Continued from page 22

small fire or thinking they had extinguished a fire which later reignited. No firefighter worthy of his badge will complain for being called out for any size or type of fire. And with all the CBs and mobile phones in use today, it gets easier every day to contact the fire department or ambulance service."

Have a safe month, and if you see a warning label on a product that you've not used before, please take the time to read it.

Sterling/Baker

Continued from page 33

shown on the plans. I used about 8 oz. in mine. Plug the hole with balsa and repaint.

Flying. Whenever I take the Sterling to the flying field, the usual question is "How do you get all those engines to start?" The procedure is as follows: Start with the left outboard engine, get it running at a smooth near-peak rpm, idle the engine, and stop it with a cloth. Repeat this for each engine. Top off all the tanks. Set the throttle at full open, and start each engine from left to right.

What usually happens is that each engine starts on the first flip. I don't bother to synchronize the engines but may adjust the throttle of an engine that does not seem smooth.

You have two choices for starting the takeoff run. First, have the engines at full throttle and have someone give the plane a short running start. If the running start is too slow, the plane will veer sharply to the left, and it is fun and games getting it to track straight. This is where the steerable tail wheel comes in handy. I have been corresponding with a pilot of a Sterling, who says the full-size plane was famous for the same veering tendencies, although to the right.

Second choice is to start with half throttle, steer with the rudder, and as the plane picks up speed, feed in the throttle.

In either case, let the ground speed build up. Then lift the tail and let the Sterling roll quite a ways before giving up-elevator to break ground.

I have an unfortunate habit of pulling my planes off the ground too soon. When this happens the Sterling will wallow around but will eventually sort itself out and fly. I highly recommend getting lots of speed before leaving the ground and making a gentle climb to cruising altitude.

Once airborne, the Sterling is reasonably fast and flies very smoothly. It is extremely realistic and majestic in the air.

Landings are made just like a full-size airplane. Make a wide base leg, and set up a long final approach. Pull the throttles back enough to get steady descent. A few feet off the ground, you can pull the throttles to idle, and the plane will make a nice wheel landing. It will roll a while before the tail settles.

As with any four-engined airplane, the best procedure is to land with all four engines running. The Sterling flies well on three engines, but if an engine quits, keep the nose down; it is prudent to land as soon as possible.

I hope you enjoy the Sterling, it is an impressive aircraft both on the ground and in the air.

Radio Technique/Myers

Continued from page 35

• *World Engines* stocks Rx's for its Expert series on all channels RC18 and above—but no flight packs—for its dealers. The Molex connector is still used, and World still maintains its metal-cased Tx module which is not intended to be interchanged in the field.

Jim Lanterman told me that the World Engines Expert Rx will be certified to the AMA Guidelines soon. Proprietary changes are anticipated which will differentiate their line from that of Polk's. The U.S.-made S-16 (large) servo is still offered.

What about synthesizers? I think that it's time to develop some synthesizers. Then one flight pack Rx could satisfy any Tx, and vice versa. If you can't get your dealers to stock flight packs, then it may cost extra to make up a flight pack from components—forever. Certainly the dealers are more likely to stock a couple of UNIVERSAL Rx's (i.e., with synthesized tuning) than a great many crystal ones. A dealer would only