

A 1.20-size warbird for
the sport flier



P-51 MUSTANG

by Stephen Scotto



OK; let's admit it. Everyone wants to build a P-51. It drips power, courage and heroism. It's an icon of WW II fighters; why shouldn't you build one? That's the question Chris Chianelli asked me, and it's why he proposed this project. A 1/6-scale model yields a 74-inch wingspan—big enough to fly right yet still small enough to transport. The new, larger displacement, 2-stroke glow engines fit this size perfectly.

SPECIFICATIONS

Model: P-51 D Mustang

Type: sport-scale

Wingspan: 74 in.

Wing area: 900 sq. in.

Length: 64.5 in.

Weight: 14 lb.

Wing loading: 36 oz./sq. ft.

Engine req'd: 1.20 to 1.50 4-stroke;
1.50 to 2.10 2-stroke

Engine used: Webra 1.20 2-stroke with
Slimline Pitts-style muffler

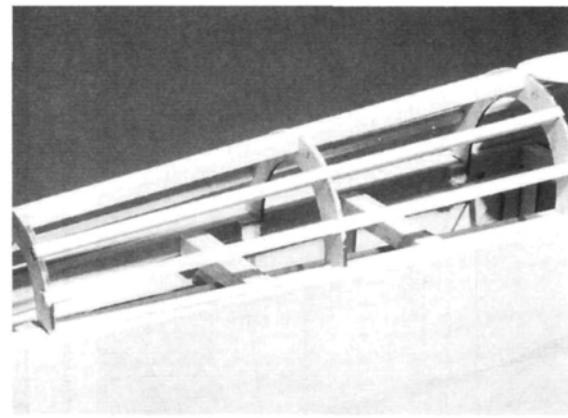
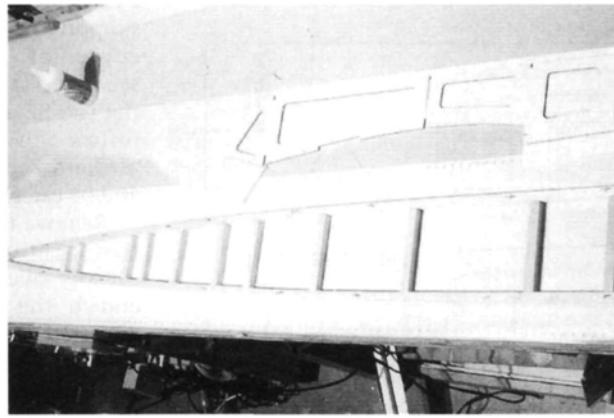
Radio req'd: 4-channel (elevator, throttle,
aileron and rudder; flaps, retracts and
bomb drop optional)

Radio used: Futaba* 9-VAP

Retracts used: Robart no. 622

Comments: designed by Stephen Scotto, the plan was drawn using ModelCAD and was developed using Lloyd 3-views from Bob Holman*. The model uses traditional built-up construction and employs balsa and plywood throughout. Building tabs are included on the wing ribs, and they ensure the proper amount of washout at the wingtips. Fiberglass cowl and air scoop, formed canopy and drop tanks are available from the author; ordering instructions are on the plan.

Left: the fuselage is built around this longeron framework made from $\frac{1}{2}$ -inch-square balsa. Note the lite-ply doubler already attached to the balsa fuselage side. **Right:** aft of the turtle deck, the stabilizer support pieces have been added and sanded to blend into the fuselage sides. Note that the rudder pushrod tube has already been installed.



THE MODEL

The model is intended to be an attractive and practical airplane that any experienced modeler could build and fly. It has a scale outline, but the fuselage and the wing have been simplified. Standard modeling materials and fittings from normal hobby outlets are used in its construction. To ease wing construction and to produce $2\frac{1}{4}$ degrees of washout at the tips, I added alignment tabs to the ribs.

The prototype was pulled by the brawny Webra* 1.20 2-stroke engine. Four-stroke fans should use at least a 1.20 engine. The engine is side-mounted, and the cylinder head extends out of the cowl. This allows excellent cooling and provides enough room for a Pitts-style muffler.

The prototype used 10 servos. Fortunately, you don't need the expensive, oversize units. Each flap and aileron is driven by its own servo while the elevator is driven by two servos linked together. The rudder, bomb drop, throttle and retract valve make do with one servo each.

CONSTRUCTION

Start with the stabilizer and vertical fin; they are airfoil-shaped, and to ensure warp-free construction, they use the half-shell construction method. Each half is built flat on the board, then the halves are joined to form the final shape.

Place the fin parts over the wax-paper-covered plans, then add the sub-leading and sub-trailing edges. Add the ribs, and use scrap balsa to form the mass-balance pocket. To eliminate high points, sand the ribs with a 12-inch sanding bar and skin with $\frac{1}{6}$ -inch balsa. Remove the fin from the board and build the other half (use the mirror image on the plan!). Glue the halves together with aliphatic resin, then add the leading and trailing edges and tip block. The stab is built in the same way: both top and bottom are built over the same drawing.

The rudder is built on a balsa core sheet with half ribs added to both sides. Cut the balsa core to shape and mark the position of the ribs on both sides. Glue

the balsa leading edge (LE) and the ribs into place on both sides of the core sheet. Add filler blocks on top and bottom, and rough-sand the rudder to shape. Final-shaping should be done when the fin has been attached to the fuselage. Cut the elevators from solid $\frac{1}{2}$ -inch balsa stock, and taper to shape.

WING CONSTRUCTION

First, decide which accessories you want to incorporate in the wing. It can be built with flaps, bomb drop and retractable landing gear; it's your choice. To reinforce the Robart* no. 622 retracts installation, ribs W4 and W5 are built from $\frac{1}{8}$ -inch lite-ply, with $\frac{1}{8}$ -inch and $\frac{1}{4}$ -inch aircraft ply doublers. A $\frac{1}{4}$ -inch aircraft ply landing-gear plate provides an extremely secure mount. If you choose to go with fixed gear, use doublers W4F and W5F as shown on the plan.

The wing halves are joined with a four-piece, laminated, $\frac{1}{8}$ -inch lite-ply brace. Aeroplane Works* cardboard conduits carry the leads to each servo. The flaps are built up with $\frac{3}{32}$ -inch balsa. If you don't want flaps, do not cut the dotted lines shown on ribs W2 through W7.

Make the wing skins from $\frac{3}{32}$ -inch balsa by edge-gluing the sheets together to form four larger sheets that are approximately 14 inches wide. Sand the joint lines flush, then roughly shape the four sheeting pieces. The separation line for the sheets should be over the centerline of the spar.

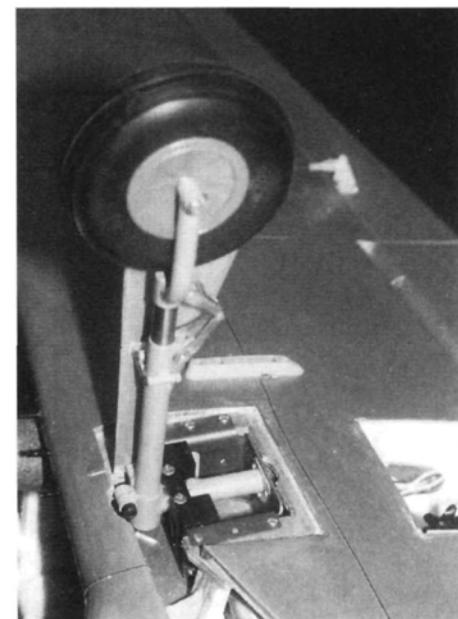
Build the wing upside-down over the plan. Attach the landing gear and servo doublers to ribs W4, W5 and W8. Drill the mounting holes for the servos now; it will be much easier than when the wing has been completed. Pin the bottom main spar to the board, and set rib W1 aside until later. Pin ribs W2 through W11 into place, and make sure that each rib is square to the building board. Install the servo conduits as shown on the plans, then use thin Zap* to secure the ribs to the main spar. Do not glue rib W1 into place yet!

Install the top main spar in the rib notch, make sure that it overhangs the

root rib and Zap it into place. Glue the $\frac{1}{8}$ -inch lite-ply center-section webs into place on both sides of the spars. Pin rib W1 into place, using the angle of the plywood webbing to set the dihedral tilt of the root rib. To help set the rib in place, put bulkheads W12 and W16 in the notches. When you are satisfied with the fit, glue everything into place and add W15. Glue the $\frac{3}{32}$ -inch sub-leading-edge pieces into place, and use $\frac{3}{32}$ -inch balsa sheet to make the vertical-grain shear webbing between the ribs.

To make it fit under the skin, the landing-gear plate must be beveled slightly at the main spar; after checking its fit, epoxy the plate into place. After the epoxy has cured, drill an $\frac{1}{8}$ -inch hole through the landing-gear plate about 1 inch into the W4A rib doubler, exactly where shown on the plan. Epoxy a piece of $\frac{1}{8}$ -inch dowel into this hole.

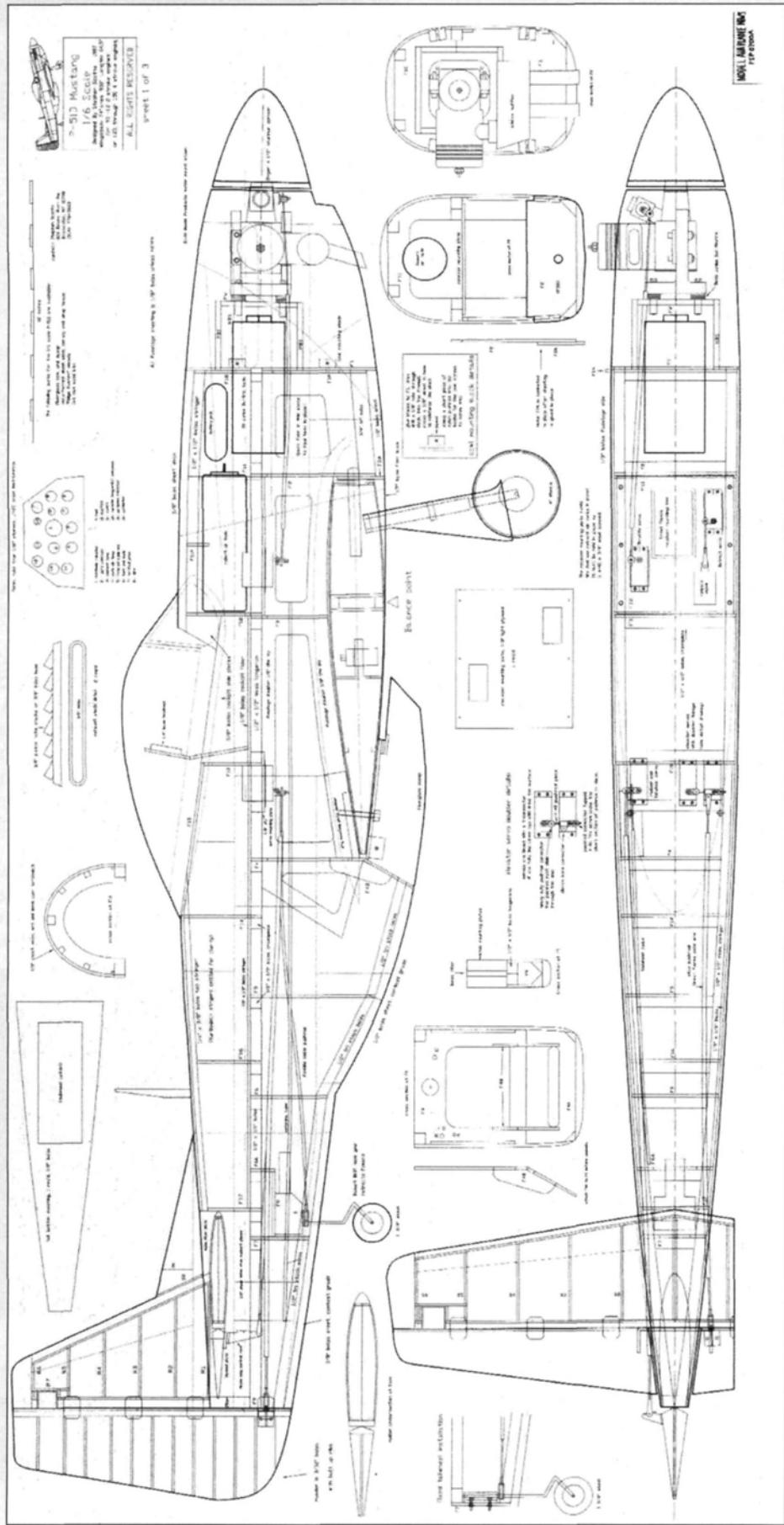
Cut and glue a $\frac{3}{16}$ -inch-square balsa spar into the notches at the trailing edge (TE) of ribs W2 through W7. Do the same with a $\frac{3}{32} \times \frac{3}{16}$ -inch stick between ribs W7



The Mustang is designed for retracts, but you can build it with fixed gear. Here, the Robart gear have been bolted into place. Access for maintenance is easy.

P-51D MUSTANG

FSP0700A P-51D MUSTANG SHEET 1 OF 3



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and W11 and the $\frac{1}{4} \times \frac{3}{8}$ -inch spars that support the bomb drop and form the edges of the aileron and flap servo-access hatches. Shape and sand the sub-LE and TE pieces to smoothly follow the contour of the ribs. Use medium Zap to attach the wing skins, and be careful not to distort the wing.

Remove the wing from the building board, cut off the building tabs, sand off any overhanging wing sheeting, and cut the access holes for the aileron and flap servos. Pin the wing to the work table, right side up, and sand the sub-LE flush with the ribs. Drill a hole through the webbing between ribs W4 and W5 to pass the air lines from the retracts into the conduit.

Fit W14 into place next to rib 1. Glue scrap balsa into the TE between ribs W1 and W2, and sheet the top of the wing. Glue the LE into place, and sand it to shape. Add the $\frac{1}{4}$ -inch sheet TEs, and make sure that the flap hinge-support blocks are in place before you glue it to the wing. Add the wingtip block, and sand it to shape.

Build the other wing half in the same way, then laminate the four center-section brace pieces with medium Zap. Cut rib W1 to form a slot between the spars, and trial-fit the brace into place. Epoxy it into place in both wing halves with $2\frac{1}{8}$ inches under each wingtip. To ensure a straight wing, make sure that the TEs line up with each other.

Epoxy W17 in the wing center section, and make sure that the $\frac{1}{2}$ -inch hole lines up with the slot in rib W1. Reinforce the center section with 6-inch fiberglass or nylon tape. Drill a $\frac{1}{2}$ -inch hole at least 3 inches into the wing, keeping the drill bit as square to it as you can. Zap a $\frac{1}{2}$ -inch dowel into place, and leave about $\frac{1}{2}$ inch protruding.

Pin the $\frac{3}{32}$ -inch balsa flap skins over the plan, and mark the location of the ribs. Zap the $\frac{3}{16}$ -inch-square balsa spar on top of the sheeting at the LE, and then Zap the flap ribs into place. Glue the top spar into place, then glue the sub-LE into place. Add the hinge support blocks and, to provide a base for the flap control horn, make sure the oversize center block fits between ribs FL3 and FL4. Add the top sheeting, then mark the flap's sub-LE centerline and drill holes for the Great Planes* Pivot Point hinges. Add the $\frac{1}{2}$ -inch LE, leaving notches for the hinges, and sand the LE to shape (see detailed drawing on plan).

Using the hinges as a guide, mark the wing's TE centerline and drill $\frac{5}{32}$ -inch holes for the flap hinges. Epoxy a 1-inch-long piece of brass tube into each hole, and allow the tubes to protrude from the holes about $\frac{3}{16}$ inch.

FLIGHT PERFORMANCE

I looked at a lot of P-51s before I flew this bird. Mustangs are big and solid, and they fly with authority. They were designed to be stable, solid gun platforms. They fly straight and make big loops and rolls; fly this model the same way. Don't try to snap and spin it like an Extra; it will just look silly.

• TAKEOFF

This is one of the true delights of flying the model. It's stable,

and it tracks rock-solid when you treat it right. Be sure you know how to fly a tail-dragger before you attempt to fly this one. The nose is way up in the air when the

Mustang sits on its tall landing-gear struts, and this plane needs careful attention at the beginning of the takeoff roll.

Begin the takeoff roll with a small amount of right rudder and full up-elevator. To avoid nosing over, gently apply throttle, and ease off the up-elevator as the model gains speed. There shouldn't be any up-elevator left when the tailwheel lifts off. Let the plane fly off the ground using minimal elevator for liftoff. Hold right rudder to climb out, and allow the plane to accelerate as it climbs. To avoid distraction, pull up the landing gear after you have made your trims and leveled the plane out.



• GENERAL FLIGHT CHARACTERISTICS

Reduce power to about $\frac{3}{4}$ throttle for level flight. The big Webra pulls this plane with authority. Loops are a delight to watch, but remember to reduce power on the downside of the loop. Rolls are majestic; make sure you have plenty of speed on entry.

If you lose the engine in flight, get the nose down and get back to the runway.

Don't worry about the landing gear until you are sure you have made the field. It's better to scratch the bottom of the model than to lose it while you fiddle with the switch.

• LANDING

For your first landing, leave the flaps up. Remember to drop the gear then turn gently onto final and carry some power until you have the field made. Cut the throttle as you cross the runway threshold. The plane will run on the mains before settling down. Remember to steer with the rudder on the ground! As you gain more confidence with the plane, you can experiment with the flaps.

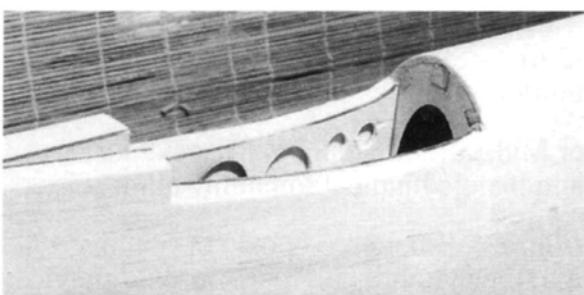
This model requires experience to fly but rewards careful technique. It looks and sounds realistic in the air, and it's a pleasure to fly.

place, and make sure that they operate properly.

FUSELAGE

The fuselage uses $\frac{1}{2}$ -inch-square longerons to provide mounting points for the formers, and the nose is shaped from $\frac{1}{2}$ -inch balsa sheet sanded to shape.

Edge-glue $\frac{1}{8} \times 48$ -inch-long balsa sheets together, and cut out the two sides as shown on the plans. Glue the lite-ply fuselage doublers to the fuselage sides, and be sure to make a left and a right side. Pin the $\frac{1}{2}$ -inch-square balsa longerons over the plan, making sure to follow the fuselage outline. Join the tail ends of the longerons with a small, triangular piece of balsa, then, starting from the front, cut and glue into place the balsa crosspieces. Make sure that the first crosspiece is recessed $\frac{1}{4}$ inch from the front edge. Laminate former F2A to F2 and glue F4A to F4 together, using the two F4B pieces



Aft of the turtle deck, the stabilizer support pieces have been added and sanded to blend into the fuselage sides.

Test-fit the flap and hinge parts before you epoxy everything into place. The tubes' extensions are necessary to stiffen the hinges. Add the $\frac{1}{4}$ -inch triangular fairing strip to the top of the TE, and sand smooth.

Cut the ailerons from $\frac{3}{4}$ -inch balsa stock, tack-glue each into place, and shape with a plane and sandpaper. If you install retracts, make a cardboard wheel-well template, and cut open the bottom of the wing to install them. Line the wheel wells with $\frac{1}{16}$ -inch balsa. Fit the retracts into

to brace them and to set the angle shown on the plan. Glue formers F2, F5, F6, F6A, F7 and F8 to the balsa crosspieces, and make certain that they are square to the longeron frame. Glue F9 to the top of the stringers at the tail.

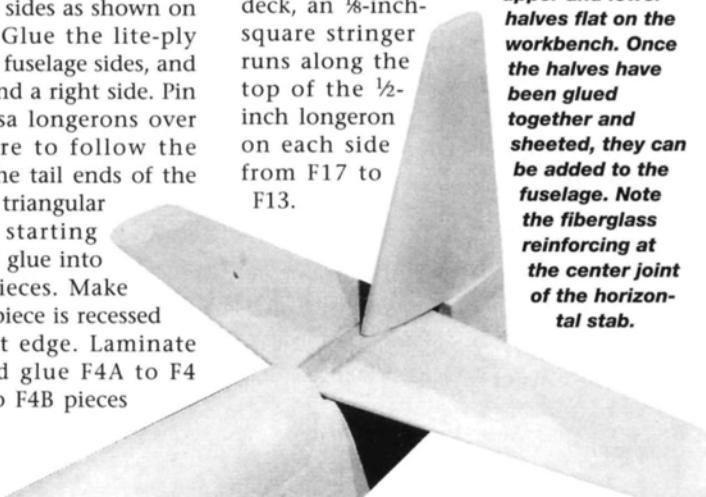
Using former F2 as a guide, pin (don't glue) both fuselage sides to the longerons. Make sure the tabs on F2 fit into the slots in the doubler. The balsa sides may have to be trimmed slightly so the ply doubler fits snugly on top of the longerons. Without gluing, put formers F1, F3 and F4 into place, and use the pins to hold the sides against the longerons. When you are satisfied with the fit of the formers to the fuselage sides and doublers, glue the sides into place with thin Zap. Use thick Zap to secure each former to the fuselage sides and to the balsa crosspieces. Remove most of the pins holding the longerons to your work table, then place the antenna tube and pushrod sleeves through the holes cut in the formers. Glue tailwheel plate F8 to former F7 and F6A. Use balsa tri-stock to brace the plate to the fuselage sides, and fit the tailwheel unit into place. It can be left in place for the rest of construction.

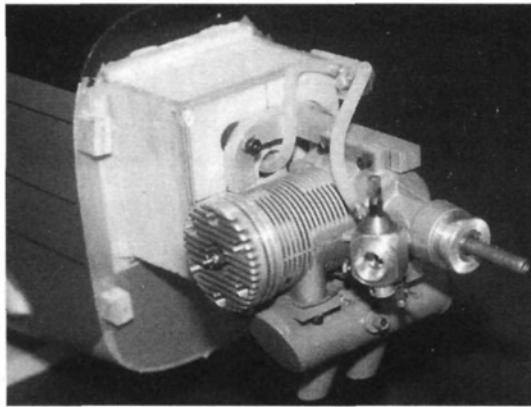
Cut and glue into place the $\frac{1}{2}$ -inch balsa tri-stock that runs along the bottom of the fuselage from F4 to F9. It should fit snugly against the notches in the formers and should bend to match the shape of the sides. Glue into place the $\frac{3}{8}$ -inch-sheet rear-fuselage bottom, and cut away the tailwheel opening. Do not round the corners of the fuselage yet. Glue into place the $\frac{3}{4}$ -inch balsa tri-stock that runs from F1 to F2A.

Turn the fuselage right side up and use a razor saw to cut away the crosspieces between formers F1 and F2. Use thick Zap to glue top formers F1B, F12, F13, F14, F16 and F17 to the crosspieces as shown on the plan. Making certain to leave about 1 inch extending forward of former F14, add the cockpit floor and glue the balsa stringer into the notch on the top of the rear fuselage. Glue in the remaining $\frac{1}{4}$ -inch stringers between F17 and F13.

To provide gluing area to support the turtle deck, an $\frac{1}{8}$ -inch-square stringer runs along the top of the $\frac{1}{2}$ -inch longeron on each side from F17 to F13.

The horizontal stab and the fin are airfoil-shaped and are built in upper and lower halves flat on the workbench. Once the halves have been glued together and sheeted, they can be added to the fuselage. Note the fiberglass reinforcing at the center joint of the horizontal stab.





The Webra 1.20 2-stroke engine has more than enough power to fly this fighter. A Slimline Pitts-style muffler easily fits inside the fiberglass engine cowl.

the $\frac{1}{2}$ -inch-square stringer into the notches on F12 and F1A, then cut two, $\frac{1}{2}$ -inch-square stringers $1\frac{1}{2}$ inches long. To make them easier to bend, make a series of cuts about halfway through each stringer and 1 inch apart, and with the cuts facing downward, Zap them into place between formers F12 and F1B. Use a razor plane to trim the stringers to follow the sides of the formers. Glue rear-cockpit deck F15 to the tops of former F14 and F13. The top turtle-deck stringer fits into the notch in F15.

TURTLE-DECK SHEETING

Cut two, $\frac{1}{8}$ -inch, contest-grade balsa pieces 22 inches long, and glue together. One end should be $3\frac{1}{4}$ inches wide, and the other end should be $5\frac{1}{2}$ inches wide. Soak one side of the sheeting in warm water for about 10 minutes; with gentle pressure, it should easily wrap around the formers. Wrap the fuselage with an Ace bandage to hold the sheeting in place while it dries (this takes about an hour). Remove the bandage, trim the turtle deck to fit, and glue it into place.

Glue the $\frac{1}{2}$ -inch balsa stab supports to the tail with a scrap of $\frac{1}{4}$ -inch balsa between them. Next, sheet the nose with $\frac{1}{8}$ -inch balsa sheet from formers F12 to F1B. Use 30-minute epoxy to laminate firewall F1 to F1A and F1B. Using the longerons as guides, align the motor-box opening with formers F1A and F1B. Clamp F1 into place, and allow the epoxy to cure thoroughly. Cut and glue into place the $\frac{1}{2}$ -inch, balsa-sheet chin pieces. They should fit between formers F1A and F2A.

Rough-shape the nose with a razor plane and coarse sandpaper. Leave some material for the final shaping with the cowl in place. Fit the $\frac{1}{2}$ -inch balsa cockpit side pieces into place, and bevel the edges to follow the curves of the fuselage. The motor box is built from $\frac{1}{4}$ -inch aircraft ply and is set up to fit your own engine/engine-mount combo. Measure your engine, and adjust the box accordingly. Assemble the box with thick Zap, and reinforce all the corners with $\frac{1}{2}$ -inch

tri-stock. Epoxy the engine box to F1 with 30-minute epoxy.

Glue the cowl-retaining blocks into place, and trial-fit the cowl. When you are satisfied with its fit, screw the cowl into place and finish shaping the fuselage. Trial-fit the engine and mount combo, and make the cutouts for the required cylinder head, exhaust, needle valve and cooling clearance.

FINAL ASSEMBLY

Zap the wing-mounting plate doublers forward of former F4, and epoxy the $\frac{1}{4}$ -inch-ply wing-mounting plates into place. Reinforce them with $\frac{3}{4}$ -inch tri-stock. Secure the fuselage upside-down, and fit the wing into place. Measure to ensure that the wing is square to the fuselage, and tack-glue it into place. The wing scoop is held in place by a hook that's built up from plywood. Glue both SC1 pieces into place at the wing TE centered on the fuselage. Drill a $\frac{3}{16}$ -inch hole at each mark into the $\frac{1}{4}$ -inch-ply mounting plate. Pop the wing off, tap the mounting plates with a $\frac{1}{4} \times 20$ tap, and enlarge the hole in the wing to $\frac{1}{4}$ -inch diameter.

The fiberglass air scoop is latched onto a small hook formed by the SC2 and SC4 pieces at the LE of SC1. The air scoop hides the wing hold-down bolts and the radio charging plugs, which are installed in former F4A. With the scoop in place, sand the bottom of the fuselage to match. Fit scrap balsa between the wing LE and the fuselage, and sand to shape.

With the wing in place, epoxy the stab and vertical fin into place. Saw, carve and sand two filler blocks to blend in the stab/fin joint. Cut and rough-carve the wing fillets to shape, then fit and glue them into place. Attach the dorsal fin and smooth it out with filler. Tack-glue the rudder into place, and sand it to shape. Detach it, and bevel the rudder's LE.

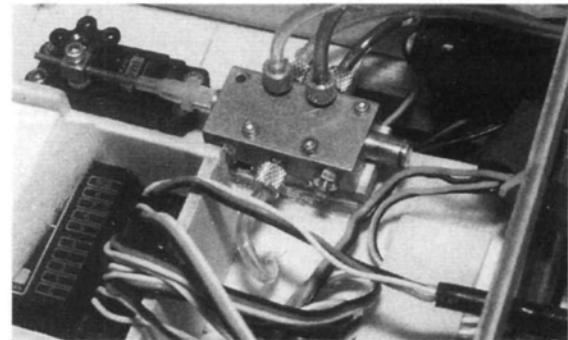
COVERING AND FINISHING

There are hundreds of well-documented paint schemes for the P-51D. I chose a scheme that I felt was attractive and practical. I got the photos of the "Ridge Runner III" from Scale Model Research*. I used silver MonoKote* for most of the model, with white and dark red trim. I sprayed parts that needed to be painted with Top Flite* LustreKote to match the MonoKote. The photos of the nose art, kill markings and spec plate were scanned into a computer art program, cleaned up and sent to a commercial vinyl shop, which produced the marking shown here—expensive, but

worth twice the price when you realize how much work they save you.

Before applying the markings, I scuffed all the MonoKote with a Scotch-Brite pad to give it a weathered appearance. The panel lines are made from $\frac{1}{2}$ -inch draftsman's tape. I sprayed flat, clear LustreKote over everything to seal the tape and enhance the weathered appearance. Since very few Mustangs were polished like mirrors during WW II, the Ridge Runner III is quite realistic. You can make the cockpit as fancy as you want; the plan shows a scale layout for the instrument panel. I used $\frac{1}{8}$ -scale instruments from J'Tec* and a $\frac{1}{8}$ -scale, Hangar 9* pilot figure.

There's nothing fancy about the radio installation, but it is a big job; work neatly. One of the flap servos needed to be reversed, so I used an ElectroDynamics* EDR-106 Pro Servo Reverser. I used a simple, homebuilt servo doubler for the elevators so if one servo fails, the other can still move both elevator halves equally. The



There is plenty of room for the radio gear in the fuselage. The RX is secured in a padded plywood box built on top of the removable servo tray.

doubler is shown on the plan. The 1200mAh battery is packed in foam and placed under the fuel tank. The receiver is secured in a Great Planes Receiver Guard mount box for security.

Installation of the Robart 622 retracts is straightforward. The air tank fits under the radio tray, while the servo and control valve sit on top. I used a UP-1 control valve from Ultra Precision*, which gives slow, realistic landing-gear motion.

When I installed the engine, I used a heavy-duty Davis Model Products* Iso Mount to secure it. I fitted the engine with a Slimline* Pitts-style muffler. After the first few flights, I added an on-board GlowLite glow igniter to provide a little extra security at low throttle settings. The Spinner is a 4.5-inch-diameter unit from Zinger*.

That's it for the building. I know you'll love this Mustang, as it is an honest and good performing model. If you've always said you want to build a P-51D, now is your chance; go for it.

*Addresses are listed alphabetically in "Featured Manufacturers" on page 134. *