Mustang!

A midsize Stunt model with the right combination of looks and performance

BY PAT JOHNSTON

It looks like the Mustang is ready to provide chase-airplane duties for its big brother B-25. The P-51D is a clean model!

MY PURPOSE IN designing this Mustang was to develop a midsize model that could be powered with engines in the .46 to .53 range so handling in the wind would not be a chore for a person my size. In stiff winds the larger 60-size airplanes pull my 140-pound frame around more than I prefer.

Perhaps filling my pockets with lead would help. Past that, a smaller model is the logical solution.

I wanted an airplane that would fly competitively and look the part of larger designs. This Mustang has a relatively deep fuselage along with dihedral to give it a more commanding, scalelike presentation.

The general observation is that it is a "normal"-size CL Precision Aerobatics (Stunt) model. It is not far off; the wing area is 626 square inches, compared with the customary 650-700 square inches of most typical-size Stunters. That is dimensionally close to 96% of a 680-square-inch wing.

The Mustang is fun to fly! It has the feel and flight characteristics of a serious competition Stunter and superior visual appeal. The scalelike appearance is half of the equation and the color and trim scheme are the other part.

An unplanned additional component was the Magnum .53 engine and a tongue muffler. The flight judges have commented that the sound just comes out "Mustang."

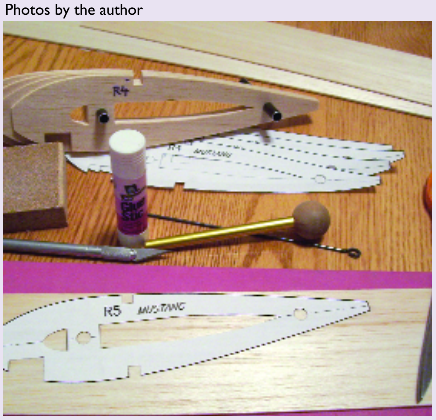
The .53 is a Leonard Neumann (of Stuka Stunt Works) modified engine swinging a wood 13 x 4.5 propeller at 8,500 rpm. The sound is pleasing and appropriate for the model. The Magnum .53 is out of production, and I have replaced it with a clone engine—the ASP .53—which Leonard still sells.

The genesis of the paint scheme were discussions my friend Jack Pitcher and I had while observing Paul Walker's colorful Mustang Stunter awhile back. Jack has a terrific-looking Stunter he has flown for years he calls the Centennial. The workmanship and finish are top-notch, but the model is painted mostly blue.

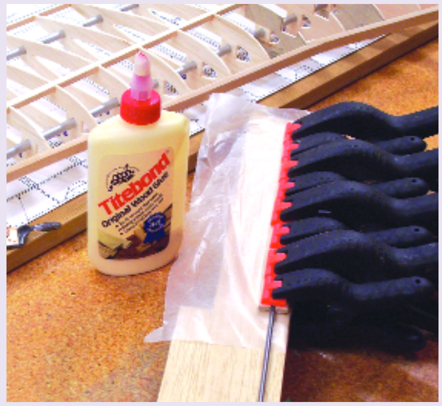
The result is that the Centennial earns fewer appearance points than a flashier aircraft. Jack asserts that the airplane needs to be "flashy" to score well, and blue is not.

As I looked at Paul's big Mustang I envisioned a similar paint scheme with the American eagle morphed onto the side. Al Rabe used an eagle on one of his Bearcats from the late 1960s, and it was a striking trim scheme.

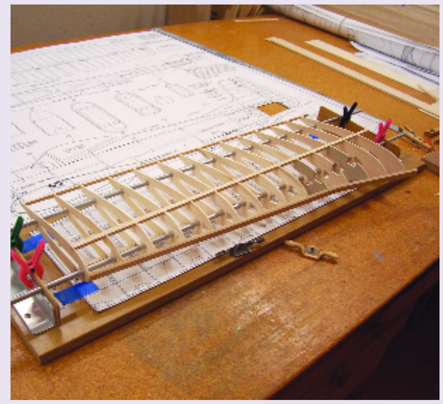
Photos by the author

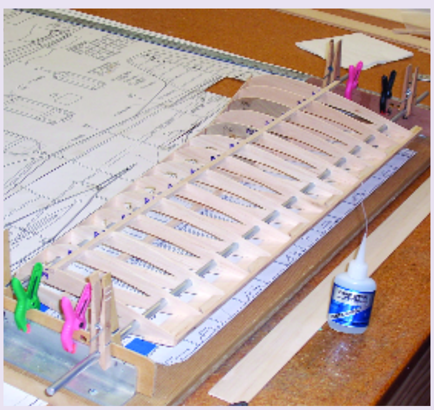


The wing rib patterns are glued to the balsa for cutting out ribs.

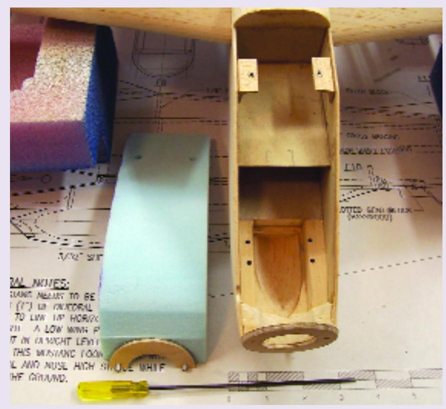


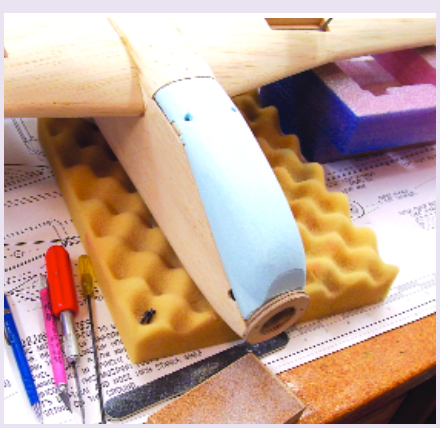
Landing-gear mounting blocks are laminated from 1/16 plywood and 1/8 plywood strips.

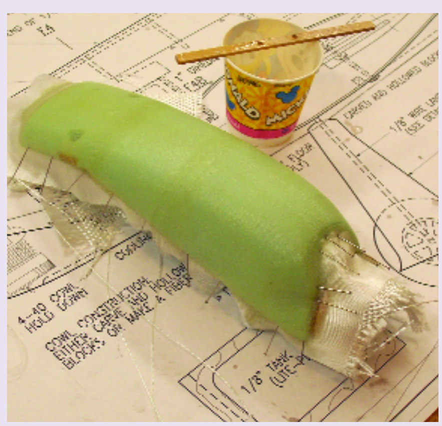

The wing halves are built on fixture rods to ensure correct alignment.


Hinge reinforcement blocks are installed before the top layer of TE sheeting is glued on.

Fully frame and box in the landing-gear blocks before installing the LE sheeting.


You can see the maple engine mounts, the tank-mount area, and the rear cowl hold-down.


Shape the foam cowl mold, which must be undercut 1/32 inch to allow for the thickness of the fiberglass.


The fiberglass is laid up with epoxy over the foam mold, and then the foam is removed.


The finished fiberglass cowl has adequate vents to allow hot air to exhaust from the cowl.

I also wanted to use a bright blue and red. Brodak Manufacturing sells a line of dope with a selection of colors that includes "Miss Ashley Red" and "Miami Blue." Both were just what I was looking to find.

The Mustang is my third model to use this scheme. The first was my big Bearcat II, followed by a classic Al Rabe Bearcat. Both received high appearance points, and the judges always gave them strong flight scores. With this experience I decided not to deviate from this established theme.

For anyone who wants to do this trim scheme, I have drawn it on AutoCAD and will be happy to send it out. I enlisted a sign shop to cut the myriad stars with a low-tack vinyl masking material. That worked out beautifully and saved many hours of cutting stars by hand from frisket paper and then dealing with removing that frisket paper. Making 36 stars is a lot of work, and the vinyl masking is worth every penny.

Windy Urtnowski provided his cast epoxy-resin exhaust stacks, which give the nose a nice touch of realism. He recommends hollowing out the stacks to create the appearance of actual exhaust openings. It does look very good that way.

I resisted the temptation to airbrush smoke residue out the exhaust stacks and down the side of the model. It looks great on warbirds, but this Mustang is representative of a Reno Air Racing airplane; the pit crew would not allow its jewel to show smudges down the sides. Constant cleaning and a fresh wax job would be more like the real thing.

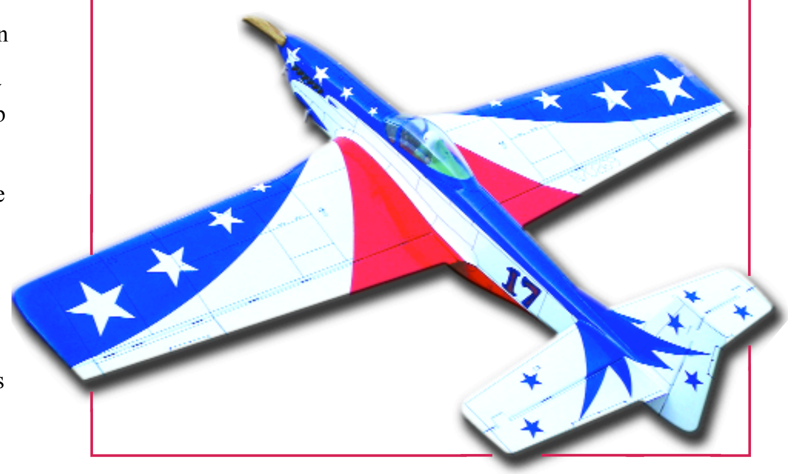
I made the ink lines with a 2.5-point-size Rapidograph ink pen. I prefer a slightly bolder line weight than from a pen in the 1-point-width category. As in Stand-Off Scale the panel lines need to be visible, and the 2.5-point-size pen is almost perfect.

The idea is to create the illusion and look of the Mustang and make people believe it is one, even though it's not scale. I am pleased by how well this design accomplishes that goal.

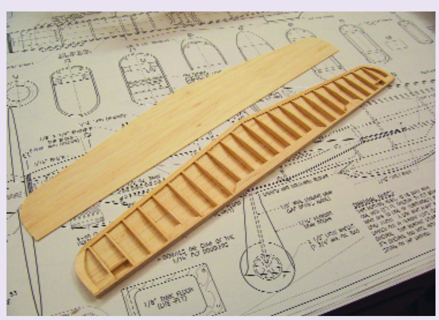
Construction Overview: The Mustang's construction methods are relatively normal with a few exceptions. The most obvious deviation is the double taper in the wing to make the center

Mustang!

Type: CL Stunt (Precision Aerobatics)
Wingspan: 56.38 inches
Flying weight: 52-57 ounces
Wing area: 626 square inches
Length: 42.5 inches
Engine: .46-.53 Stunt tuned two-stroke
Construction: Balsa, plywood, hardwood
Covering/finish: Heavyweight silkspan, dope
Other: 4-inch bellcrank, 2-inch spinner

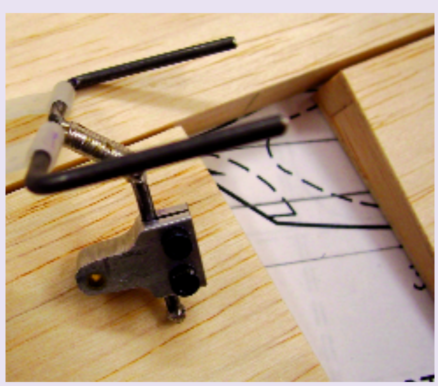


A second fiberglass cowl was made for an engine change to the Magnum .53 on the author's first Mustang.



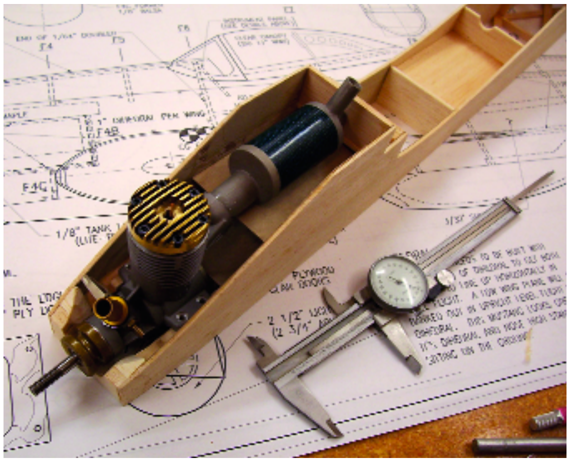
All internal stabilizer structure is built on the top sheeting piece.

The bottom stabilizer sheeting is epoxied on, and lead shot in baggies holds it down.

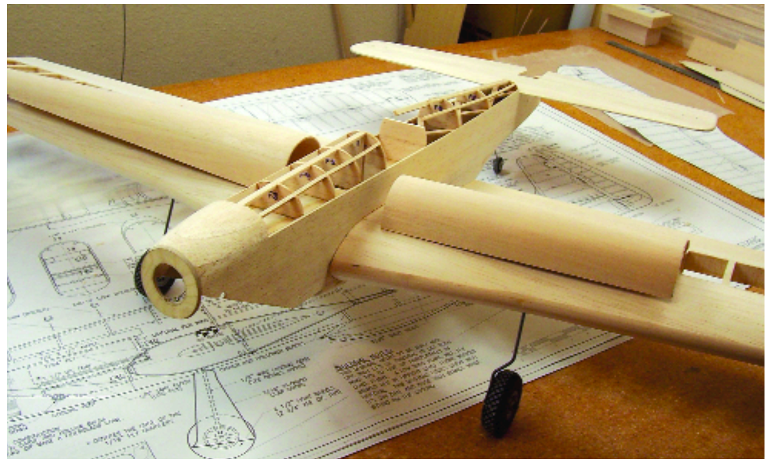


The author makes his own adjustable tail-horn hardware.

The completed tail reveals the balance tabs on the elevators and rudder. This adds realism.



The Stalker .51RE engine installation will demand a slightly different cowl shape than a side-exhaust engine.



The top fuselage sheeting is rough-molded and ready to install over formers and stringers. The stringers keep the sheeting from sagging between formers.

wing bays that define the P-51 "D" model wing. These are not tough to frame up, especially when using the double-sheet LE component made from 1/8 balsa.

The 1/8 LE strips are overlapped at the intersection to produce an integral joint with no discernable weaknesses. A double-layer LE is not subject to the angular demands of a piece of 1/4 square LE stock, allowing a more versatile LE shape.

Don't overlook installing shear webs, which connect both spars, and the webs at the front edge of the TE sheeting. It is amazing how much this does to stiffen a wing from warps. The shear webs must be installed with the wing in the fixture to ensure that the wing remains true.

The relatively short nose demands that the tank compartment be set back into the wing an inch. Don't forget to cut the fuselage sides with the tank setback tabs in place. I forgot this on my second model and had to splice the tabs on.

The nose plywood doublers are 1/64 plywood. I find that to be plenty strong.

Many times we partake in gross overkill when it comes to "normal" construction methods. My philosophy is that until we find an area that presents a noticeable weakness, the design is usually overbuilt. Building the model light to begin with demands less intense structure.

The tail surfaces are built up. The rudder is ribbed and covered with silkspan, which shows off the structure nicely. I usually do that to the elevator too, but the Mustang did not have fabric-covered elevators.

The ribs are placed at 1-inch intervals to prevent any noticeable sagging of the 1/16 balsa skins. This is working well; the tail surfaces have the look of being shaped from solid sheet stock but retain their lightweight qualities. The stabilizer is 1/2-inch thick at the center and tapers to less than 3/8 inch at the tip, which keeps the "look" from being too bulky.

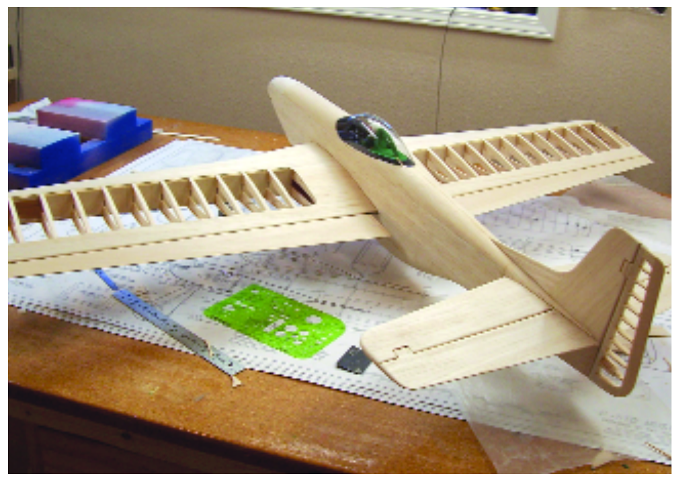
Construction

Start this project by procuring a good supply of light balsa. That is tough to do locally here in Idaho, so I order wood from Lone Star Balsa. Specify the 6-pound stock. Most of the sheets are in the 5- to 7-pound range.

If you do not have a good scale, buy one! Stationery stores carry "letter scales" that cost less than $2 and will weigh balsa as heavy as 3 ounces. These scales are calibrated in ounces and grams.

A good 16-ounce scale is handy for measuring the weight of all the individual components. Wal-Mart carries a nice 16-ounce scale with a dial face for a reasonable price. A quality modeler must watch every gram that goes into an airplane.

The first priority is to decide which engine to install. We are in an era in which the selection of world-class Stunt engines has never been better. My first Mustang has the Neumann-modified Magnum



With the cockpit detail installed and the canopy glued in place, the Mustang is ready for the cowl and then finish.

.53—an excellent engine. The all-up weight is 10.7 ounces, making it perfect for this model.

Other choices for power are the RO-Jett .51 SE (side exhaust), the O.S. .46 LA, the ever-popular SuperTigre .46 (if you still have one around), or the current SuperTigre .51. There are many others, but the preceding are all good choices.

I installed a Stalker .51 RE (rear exhaust) in my second Mustang. The rear exhaust gives the airplane's nose an extremely clean look with no exhaust system out the side and the bonus of less fuel residue on the model to clean up. The muffler is completely contained in the cowl. I am starting to love the concept of a rear-exhaust engine setup.

Wing: The wing construction is a standard "D-tube" design. Shown on the rib patterns are 5/16-inch-diameter holes for the wing fixture.

I have used two Easton 2013 arrow shafts on parallel supports as my homemade fixture. Any good archery shop will have appropriate shafts for a fixture. While you are there, think about buying a half dozen 2013 shafts; you can use the extras for pushrods.

The "20" designator is 20/64 inches in diameter, or 5/16 inch, and the "13" is .013 inch wall thickness. This ultra-light shaft (9.01 grains per inch) is the right size for fixture rods. The extra shafts will make two pushrods per shaft. The cost is typically less than $20 for a half dozen.

These aluminum shafts are as light as the carbon-fiber variety but cost considerably less. A local outlet sells extruded aluminum stock. I bought a length of 5/16-inch-diameter solid stock and that works fine for fixture rods too.

Pick higher-density balsa for the spars. Hard spars are cheap insurance for a strong wing. Carbon fiber could be applied to the spars, but I don't recommend it. Hard balsa is much less expensive and not nearly as hazardous with which to work.

As does balsa, carbon fiber works great in tension. Balsa is five times stronger in tension than compression, and carbon fiber is even stronger under tension. However, both are much weaker under compression, which is the area we need to improve in the equation.

The carbon fiber will buckle under compression unless supported with other substances such as resins, and those cost weight. Why not just size the balsa spar to resist the compressive loads and quit there?

If you want to get fancy, you could make the spar from 1/4 balsa that is 3/8 inch wide at the root and tapers to 1/8 inch at the tip. That weighs the same as a 1/4-inch square spar but provides more strength toward the center of the wing, where it is needed. No matter what method is chosen, this wing is 2 1/2 inches thick, which makes it inherently strong anyway.

This design lends itself well to experimenting with different methods and materials. Feel free to do your own thing, but *always* think about how much a different part may weigh and what effect it will have on the CG.

On my second Mustang I had a good supply of 5-pound stock, 3/32 balsa I used for the ribs. The weight difference was little, and after using this rib thickness I found it easier to work with than the customary 1/16-inch rib stock. You can choose whichever one you want to use.

Stack the ribs on the fixture over a copy of the plans to align and space the ribs accurately. I use small draftsman's triangles to square everything up. Install the spars, the 1/8-inch LE, and the TE assemblies.

The landing-gear mounts are shown built from 1/8 and 1/16 plywood supported with plywood rib doublers. I prefer this method to conventional hardwood landing-gear blocks, which are heavier. A 1/16 plywood gear cover laminated to a balsa block for shaping to the airfoil contour secures the 1/8-inch wire gear with 4-40 Allen-head screws.

As I mentioned in the overview, the wing LE is made from two layers of 1/8 balsa. The first layer holds the ribs in alignment and is trimmed to conform to the airfoil.

The 1/16 LE sheeting is installed, and the front of the wing is block-sanded flat to receive the front piece of the 1/8 inch LE layer. This construction "locks" the sheeting into the LE and allows a nice radius to be sanded into the LE.

I have drawn a wing-section view to show the components of the wing construction. Make sure the wing is still in the fixture when placing the vertical shear webs at the front of the TE and between the spars. The shear webs lock the wing into position and heavily resist twisting forces. The wing must be held straight in the fixture at this stage.

Each wing-panel tip is raised 1 inch at the centerline of the root and tip ribs to establish the necessary dihedral. Join the wing halves and install the 4-inch bellcrank.

I installed a flap-horn assembly I made from 3/32 music wire and brass stock. Don't worry about the dihedral. Just make sure the flap-horn wires are in line with the centerline of the flaps.

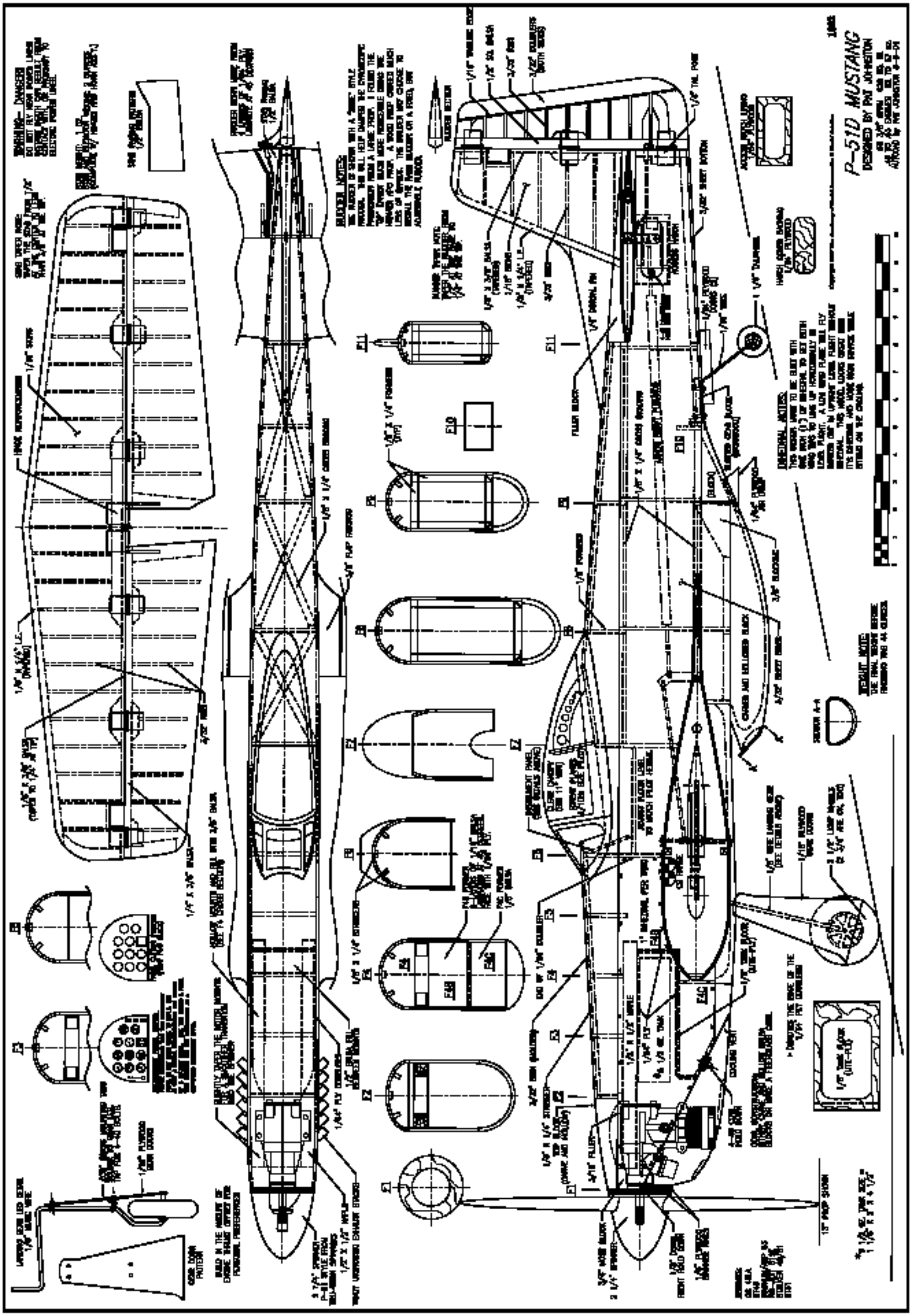
The flaps will have hard-point horn boxes to receive the 3/32-inch-diameter wire horns. These allow enough lateral movement to permit free controls. I have experienced no problems using a one-piece control horn and dihedral. The center-section sheeting, capstrips, and wingtips complete the wing at this stage.

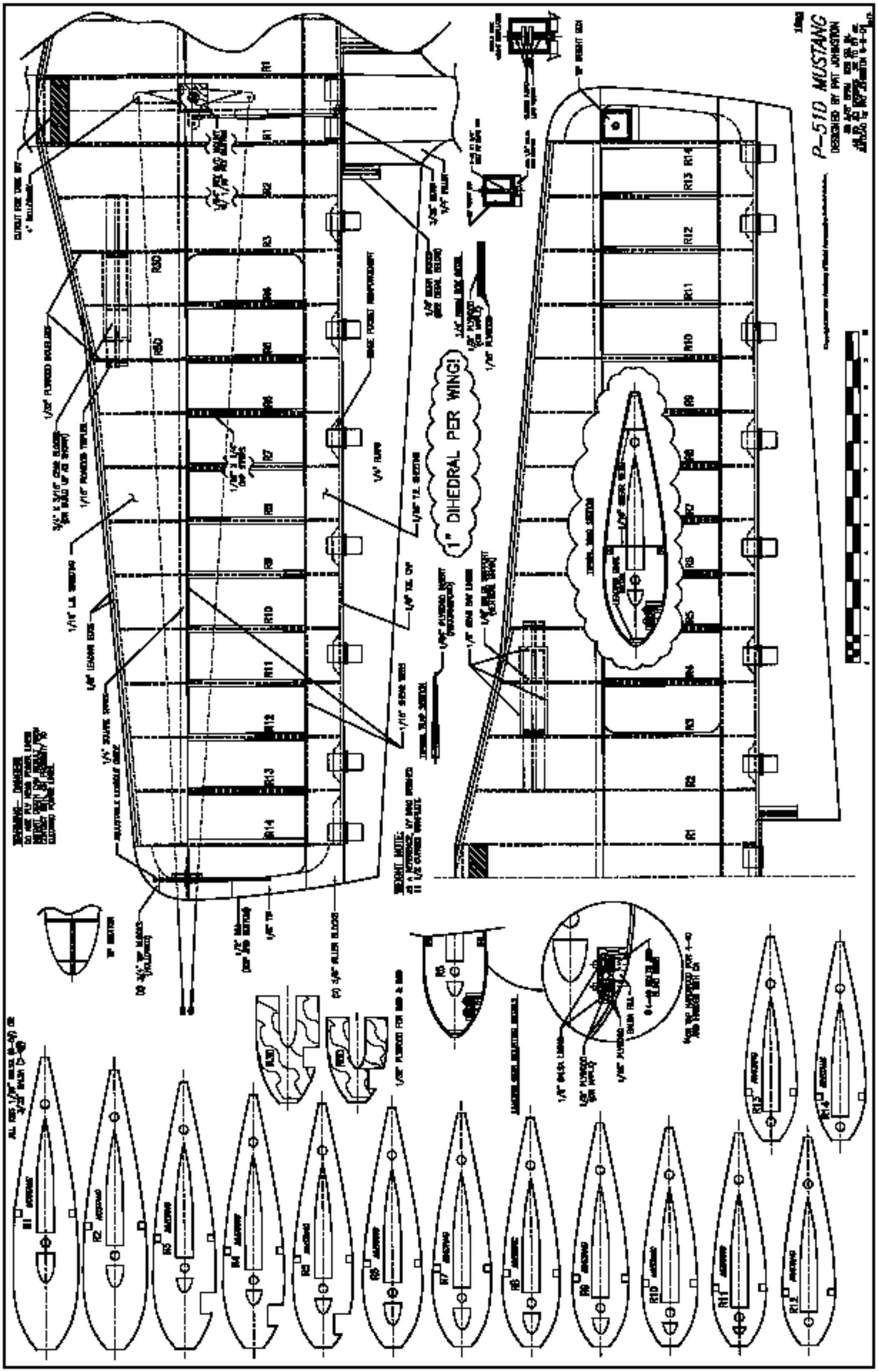
Install an adjustable leadout guide of your choice. I like the Paul Walker/Bill Werwage-type unit, which is 1/4 basswood with 1/8-inch-diameter holes drilled at 3/16-inch increments and a slot connecting all the holes. An eyelet may be pulled out, the leadout wire slid to the desired position, and then the eyelet pushed back in. This simple unit weighs roughly 4 grams.

The flaps are solid 1/4 sheet stock, shaped to a taper. I also prefer to install a 1/64 x 1/4 plywood piece in the TE to establish a taper line, which also makes a hard TE that resists dents. A Dremel tool saw blade held in the Dremel router table is used to make a perfect slot for the plywood.

As I mentioned, "lucky boxes" are installed in the flaps. These are plywood

Full-Size Plans Available—See Page 199




P–51D MUSTANG
DESIGNED BY PAT JOHNSTON
1° DIHEDRAL PER WING!
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14

boxes with a slot built in to receive the flap horn. They allow the flaps to be "tweaked" for trim purposes without risking damaging them.

The composite weight of the flaps should be less than 1.5 ounces. The wing (complete) at this stage should weigh approximately 11.5 ounces.

Tail: The stabilizer is shown built up with the airfoil section shown on the plans. The overall thickness is $^1/_2$ inch at the root and tapers to $^3/_8$ inch at the tip.

The elevators are built similarly, with a straight, tapered section. I glue all the internal components to the top skin and use thin epoxy to glue on the bottom sheeting. For this operation I put lead #8 birdshot in Ziploc-type sandwich baggies in 1-pound increments. I place the shot bags over the bottom sheeting to hold it down evenly while the epoxy is setting.

You can buy an inexpensive 25-pound bag of birdshot at firearms stores that carry reloading components. This shot-bag method works well for applying even weight to components that are being laminated.

The rudder is built up with ribs and is covered with silkspan. It is the only control surface that has fabric covering. This little feature adds a nice touch of realism, along with the balance tabs on the elevators and rudder.

An Al Rabe rudder is shown. If you have not tried one, do so on this model. It helps counter gyroscopic precession caused by large propellers. The Rabe rudder helps maintain line tension on the top portions of outside square maneuvers.

Keep the rudder assembly as light as possible. Excessive weight in the tail will have to be made up with lead or some form of heavier components in the nose.

Fuselage: Start by building the motor crutch assembly. Epoxy $^1/_2$ cross-grain balsa between the $^1/_2$ square maple motor mounts. This ties the nose components together, clamping the vibration from the engine.

The front firewall is built from five layers of balsa laminated at 45° to each other. The first and last layers have horizontal grains.

Cut the $^3/_{32}$-inch fuselage sides, and epoxy the $^1/_{64}$ plywood doublers to them. Glue the completed sides to the crutch assembly. Make fuselage formers from $^1/_8$ x $^1/_4$ balsa strips capped with the top sections of each former.

The top view of the fuselage shows the crossbracing between the formers. This adds considerably to the torsional stability for little weight. Shape, hollow, and install the bottom air-scoop blocks that transition into the rear of the fuselage.

Install the removable tail-wheel-assembly mounting bracket. This is a nice feature when it comes to finishing or even to alter the weight of the tail-wheel assembly for the CG adjustment. Pushrods will be installed at the appropriate stage.

The top sheeting is premolded over available forms. I use a 3-inch-diameter piece of PVC irrigation pipe to form the front sheeting. When wetted on the outside curve with hot water, the $^3/_{32}$ sheeting will be easy to wrap around a form. Tape it to the form and allow it to dry.

Hardware stores sell PVC in short lengths. A baseball bat is a good source with which to form the rear fuselage tapered sheeting. Borrow the bat from your neighborhood teenager, and then teach the kids how to fly as payback.

Once preformed, install the sheeting over the formers. I prefer to split the molds down the center and install them a half at a time. This makes an extra joint on the top of the fuselage but is easier to do.

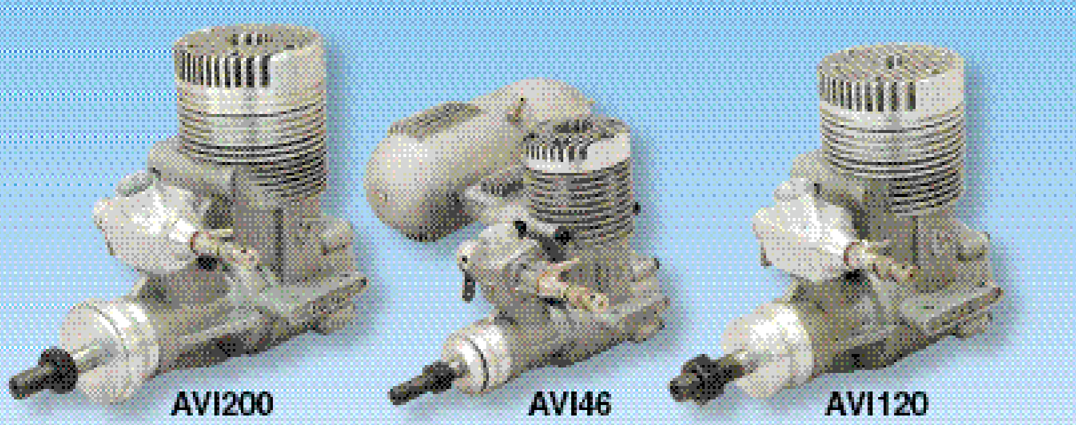
Notice the strip of $^1/_8$ x $^1/_4$ balsa on the top of the formers, to facilitate the sheeting installation and provide a glue ledge for the sheeting. A front top nose block is carved to shape and hollowed.

You can carve and hollow the cowling from balsa or form a fiberglass unit. I use blue construction foam as a cowl mold and lay up fiberglass over the top to make an epoxy-fiberglass cowl. Then I remove the foam and install all necessary mounting parts in the cowl.

I use a Sig 11-inch canopy and a Hangar 9 $^1/_{10}$-scale pilot. The pilot figure has nice detail and is painted with water-based acrylic paints.

The plans have a detail for the instrument panel. It is applied to the back of a flat-black painted panel for the instrument cutouts. All this is well laid out on the plans.

Finishing: I recommend a dope finish; I use the Brodak brand throughout the



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finishing process. I won't go into details of the finish since it is redundant in many construction articles.

Just remember that nothing but elbow grease can create a beautiful, light finish. The nice thing about elbow grease is that it doesn't fish-eye the color coats.

Apply the color scheme of your choice, ink lines, or whatever else with a clear coat sprayed overall. I rub out my clear with a regular automotive rubbing compound followed by progressively finer polishes. Wax the whole airplane after the dope has had time to cure.

Consult Windy Urtnowski for a complete line of videotapes and DVDs that cover finishing, building, trimming, etc.

Trimming and Flying: The fuel tank is wedged in with foam to resist vibration. Fuel vents are permanently mounted in the fuselage, and silicone fuel lines connect them to the tank. This provides great isolation between the tank and the vents.

Mount the engine on aluminum pads. Position the CG as indicated on the plans. It is approximately a 20% CG, which is a good starting point.

Balance the model laterally by supporting it on the tail wheel and glow plug. The right wing should measure 1.5 ounces heavy. Install enough lead in the tip box to achieve this figure.

The leadout wires are swept back 1 inch behind the CG as projected to the tip. My handle is adjusted for roughly 3 inches of line spacing. This controls the turn rate and makes the exits on the square corners easier to control, helping to eliminate the usual bobble.

Many people may want to start with 4-inch spacing on their first flights. If clean squares are difficult, reduce the spacing until the squares exit flat and smooth. Use a propeller that provides 5.0- to 5.2-second lap times.

I set up my Mustang with lightweight $2\frac{3}{4}$-inch-diameter wheels to handle the sometimes poor grass fields, but many people will install lightweight $2\frac{1}{2}$-inch-diameter wheels. I think the larger wheels give more consistent landings on pavement.

All the preceding adjustments are safe starting points. I expect that all builders will make adjustments to suit their flying styles.

I hope you enjoy this airplane as much as I do. It is fun to fly and competitive. I feel that the Mustang can fly with the best of them in the hands of top competitors. The bonus is its scalelike presence.

I thank Al Rabe for providing lots of inspiration from my youth onward. Dee Rice has been a great friend to bounce ideas off of and a good source of ideas and improvements to the design approach.

The Stunt community has a bunch of terrific guys who are ready and willing to help out whenever they are asked. Thanks, all! *MA*

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Sources:

Brodak Distribution
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PAMPA (Precision Aerobatics Model Pilots Association)
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