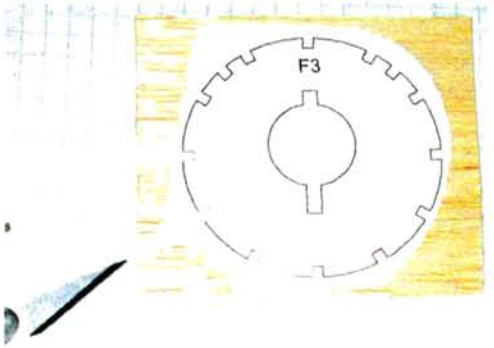
BY LE PHAN > PHOTOS BY MARC KLINGER

F-104 Starfighter

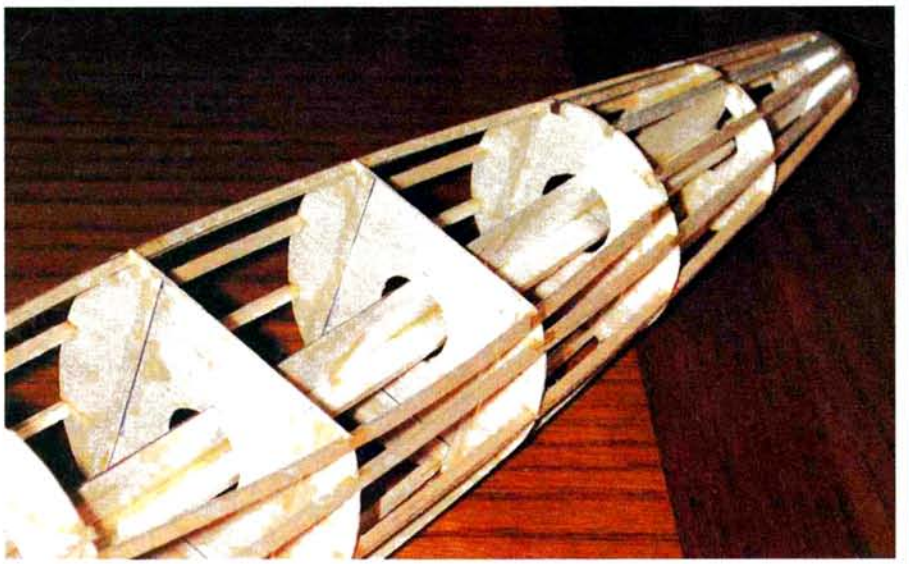
A Speed 400 pusher jet with performance

I HAVE BEEN FLYING SPEED 400 electric-powered models for years with great success and have gotten a lot out of these inexpensive, $9 motors. So, I thought "Why not see how far I can push a standard Speed 400?" When I took my F-104 Starfighter to the flying field, however, all I heard was, "It doesn't have enough wing on it!" For those who are not familiar with the Lockheed F-104 Starfighter, it was the U.S. Air Force's first Mach 2 jet interceptor and was first flown on March 4, 1954. It had very small anhedral wings and was very fast; in fact, many referred to it as "The missile with a man in it!"



Start by cutting out all the formers. To avoid tearing away the corners, cut the notches out first and then cut out the rest of the former.

To stiffen the formers, I glued support strips across the grain.



Here, the fuselage is taking shape, and several stringers have been installed. Notice the alignment crutch that runs through the formers. It will be removed later.

SPECIFICATIONS

MODEL: Lockheed F-104 Starfighter
TYPE: electric pusher-prop jet
WINGSPAN: 16.5 in.
LENGTH: 41 in.
WING AREA: 110 sq. in.
WEIGHT: 18.6 oz.
WING LOADING: 24.3 oz./ft.
MOTOR: Graupner Speed 400
PROPELLER: Kavan 6x4
SPEED CONTROL: Great Planes C-30
BATTERY: 8-cell, 600mAh AE Ni-Cd
RECEIVER: Hitec Electron 6 FM
SERVOS: 3 Hitec HS-55s

Because Speed 400 motors are able to handle wing areas as small as 100 square inches, I built the Starfighter in 1/16 scale so it has a wing area of about 110 square inches; it has a 16.5-inch wingspan and is 41 inches long. With a projected flying weight of about 17 ounces, its wing loading would be an attractive 22 ounces per square foot. To keep the airframe light, the entire plane is sheeted with 1/32-inch A-grain balsa.

STIFF, LIGHT FORMERS

Cut the former patterns out of the plans, and use a glue stick to attach them to 1/32-inch C-grain balsa sheet; position the grain horizontally. Cut out the notches first to avoid tearing off the corners; then cut out the center and the outside portions. Peel off

FLIGHT PERFORMANCE

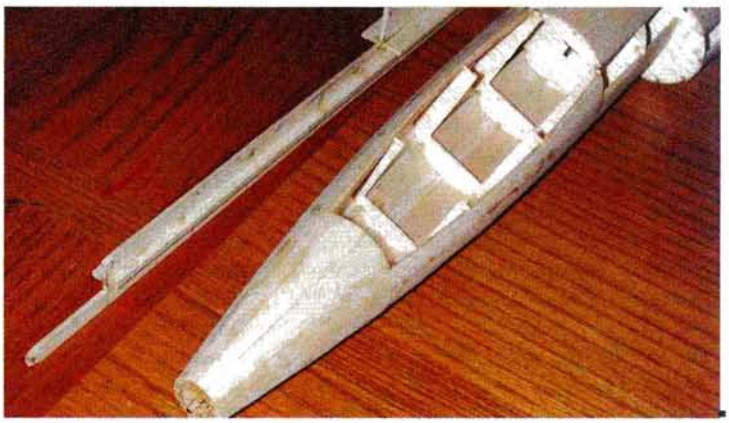
MY FIRST TEST FLIGHT WAS ACTUALLY A "glide" test; everything except the battery and motor was installed in the plane. I installed a small receiver battery pack to power the receiver and servos. It weighed 9 ounces all up for the glide test. I had installed the towhook underneath the canopy, and it worked well. After about eight bungee launches, I was able to determine the balance point; it was farther forward than I had calculated. (I had set the balance point at 25 percent of the wing chord for the "glide test," but because the long fuselage adds lift, the final balance point is 12 percent of the chord!) As the angle of attack increases, so does lift. The F-104 glides fast, and its roll rate is very touchy, so tone down your aileron dual rate to 75 percent for the powered flight.

For the powered test flight, the model weighed 18.6 ounces with the motor and battery installed. I stepped on the launch-release pedal, and the F-104 accelerated off the launch pad in a straight line. After the hook had been released from the plane, I applied full throttle. The F-104 climbed at a fast rate almost straight up. I pushed the stick down to level it and started a wide left turn, but the nose kept on going up. After applying full downtrim, I was able to fly the plane level.

The model has good pitch stability with elevator throws of 3/8 inch up and 1/8 inch down. Even with 75 percent dual rate on the ailerons (1/4 inch up and down), the plane was still roll-sensitive. I flew several low-level passes and then decided to land. I reduced the throttle to about 80 percent, and the plane started to descend. Just before it touched down, I flared it and turned off the motor. The entire flight lasted only 1.5 minutes. To see a video of the first test flight, take the "Click Trip."

After pondering the first flight and doing more testing, I realized that when I applied full power, the motor's thrust angle pushed the tail down. I corrected the thrust angle, and all subsequent flights were a joy.

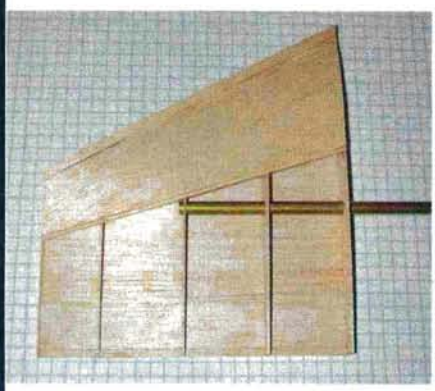
Attach the outer sheeting to the fuselage in sections, as shown here. When the fuselage is rigid enough to hold its shape, remove the internal crutch and add the rest of the sheeting.



The crutch has been removed from the fuselage.

The nose cone and foam canopy add the finishing touches to the fuselage.

The basic wing structure is very simple. The ribs are glued on top of the bottom sheeting.



The main wing spar is a brass tube that plugs into the fuselage.

the paper to save weight. Make sure that you have plenty of sharp hobby-knife blades on hand.

If you can't get C-grain balsa, you can use A-grain and add small, 1/8x1/32-inch-thick balsa cross-strips to stiffen the formers. This may seem tedious, but it will prevent the formers from splitting when you slide them onto the crutch, and it will prevent them from bulging when you apply the outer sheeting.

BIG FUSELAGE

I've found that the crutch method is a fast and easy way to build a straight fuselage. After you've completed the laborious task of cutting out all of the formers, the building process picks up speed. Make the crutch out of 1/8-inch balsa, and use the detailed drawings on the plans as a guide. The crutch must be built straight and true. To ensure that the formers remain vertical on the crutch, I drew lines on it as a visual aid. To help keep the formers square horizontally, I fitted half of an index card between them as a guide. When all 17 of the formers are lined up on the crutch, install the stringers. I added the first stringer at the 12 o'clock position and the next one at 6 o'clock. After confirming that the formers were vertical and square, I added a drop of CA at each stringer-to-former intersection, working from the nose to the tail. I then glued the 3 o'clock and 9 o'clock stringers into place. After I had glued all the stringers into place, I made sure that the crutch was not glued to any of the formers. If yours does stick, check at formers F1 and F2 (since they are the smallest, they're closer to the crutch).

I then applied some sections of fuselage sheeting in a checkered pattern. Once the fuselage was rigid enough to hold its shape, I used a hobby knife to carve out and remove the crutch so I'd be able to finish the sheeting. I then glued on the balsa nose block and the air inlets and carved and sanded them to shape. The air-inlet nose cones are made in the same way.

LITTLE WINGS

I cut out the bottom wing sheet and ribs first, and then I drew lines on top of the sheeting to help align the ribs and the rear spar. I glued the rear spar onto the wing sheet to help guide the ribs. Note that the R0 ribs are not glued to the wing sheeting but are reserved for the sides of the fuselage. The main wing spars are 1/4-inch-o.d. brass tubes that slide into the wing-spar root that's built into the fuselage structure. (See the plans for details.)

After you've applied the front and rear top sheeting, cut out the ailerons. Once I had finished the wings, I installed the servos. I used Hitec HS-55s for this project: one for each aileron and one for the elevator. I made my own control horns out of 1/16-inch plywood.

TAIL SURFACES

The elevator and vertical fin/rudder are made separately and then attached to the fuselage. The elevator was cut out of 1/8-inch-thick balsa. The fin/rudder is hollow. I used 1/8-inch-square strips for the spars and covered the sides with 1/32-inch sheeting. Because the elevator is an all-moving control surface, it requires a pivot tube. I simply soldered a 2-inch-long, 1/8-inch-o.d. brass tube to a perpendicular 1/8-inch brass C-channel. This makes it a T-hinge setup. The elevator axle is a 4-inch-long, 0.093-

o.d. brass tube, and it fits into the T-hinge. The axle tube fits in a slot cut in the elevator. I slid the elevator axle into the T-hinge and then glued the axle to the elevator. You may want to cover the elevator before you glue the axle in. For simplicity, I decided to install the elevator pushrod externally on the right side of the vertical fin. You can install the pushrod inside the fin if you want a cleaner appearance. There's plenty of room in it.

COVER AND FINISH

I chose a Canadian version of the F-104 and used silver UltraCote to cover the model. All the markings and numbers were cut out of UltraCote and ironed into place.

I carved the canopy out of a block of pink foam, sanded it and then covered it with ½-ounce fiberglass cloth. I used water-based polyurethane instead of epoxy resin. Two coats of polyurethane hardened the surface nicely.

The finished weight of the model is 18.6 ounces—a little heavier than I had hoped for but still plenty light.

BUNGEE LAUNCHER

Without getting into too much detail here, I used 17 feet of 5/16-inch-diameter standard rubber bungee material and two hooks from the hardware store. The anchor end of the bungee is a 2x6x14-inch block of wood and is 14 inches off the ground. Picture the top of a foot stool as the anchor point. This gives an upward pull on the plane of about 2 degrees when completely stretched out. The airplane end of the bungee has a 16-foot piece of nylon string tied to it with two rings attached to it 12 inches apart. One ring is hooked to a release pin that's part of the launch pad/model cradle, and the other ring is attached to the model's launch hook. I installed a Graupner GR627 glider towhook on the bottom of the fuselage right under the rear canopy section. I stretched the bungee by taking six normal paces, and that was enough tension to launch the model. Just make sure that you apply full elevator during the launch. You don't want your plane to crash into the anchor block (don't ask how I know this—ouch!).

So, yes; you can make an F-104 Starfighter fly with a cheap little Speed 400 motor, but it really does need more speed to live up to its reputation as a high-speed interceptor, so my next version will have a cobalt or brushless motor to really make it cook! ✈

See the Source Guide on page 151 for manufacturers' contact information.

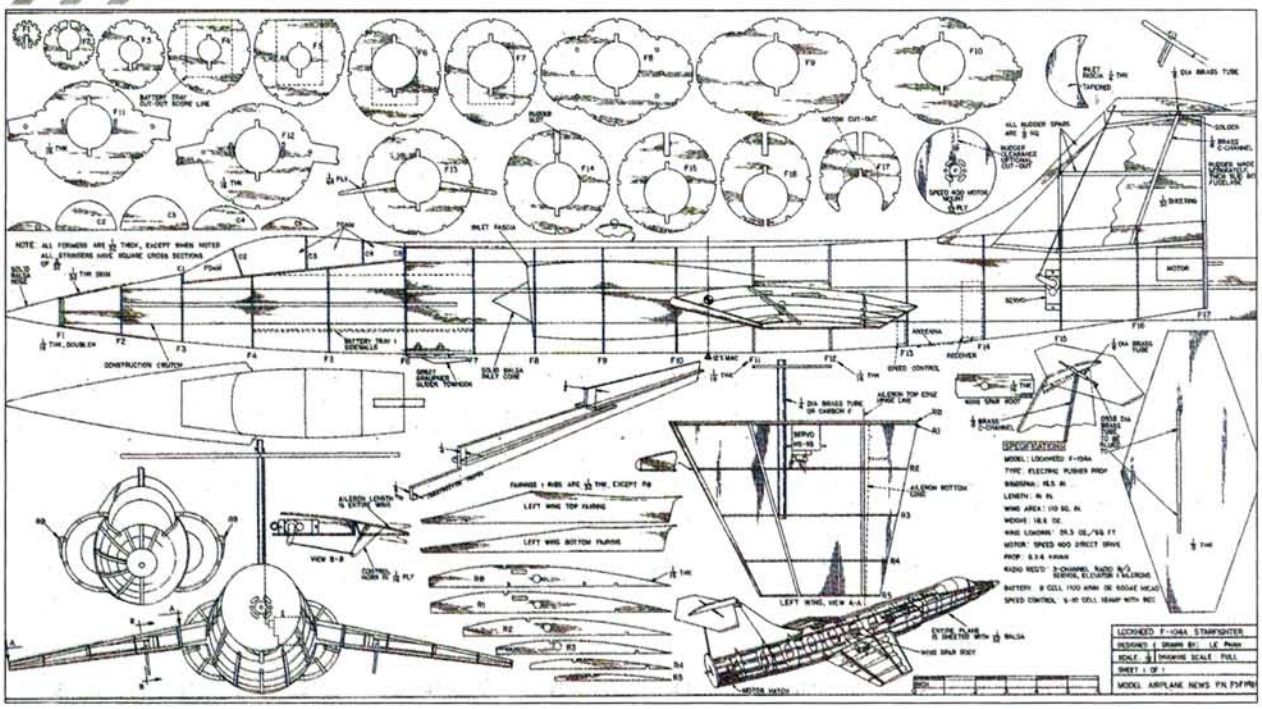
COMMENTS

Designed by Le Phan, this impressive F-104 Starfighter jet uses a Speed 400 motor and a pusher prop for thrust. It flies great and is built around a removable alignment crutch. The author launches the Starfighter with a bungee catapult.

The very simple, effective, all-moving elevator is easy to make and install.

click trip MODELAIRPLANENEWS.COM FOR FIRST-FLIGHT VIDEO

FSP0905A F-104 STARFIGHTER



TO ORDER THE FULL-SIZE PLAN, VISIT RCSTORE.COM ONLINE.