by Dave “McSlow” Hull

CL building and racing is a gentleman’s thrill ride

Above: Bill Lee, past NCLRA president, congratulates the author on winning Super Slow Rat in 2007. Dave had to borrow two pitmen to get there: Bob Whitney (in red) during heat racing and Bob Oge (in gray) for the final. Also shown is Ashley Wilk (R), who finished second.

Right: Prototype ShyFox with hardware, including a 2007 Nats winner’s plaque. Built to plans, the model is fast enough for a team that has practiced to be a contender. It performs solidly overall and will stand up to hard racing.

The ShyFox

THE MOST ACCESSIBLE CL Racing events are Super Slow Rat (SSR) and its evil twin, Fox Race, which are often flown combined. The reasons are many, but at the top of the list are that the models fly well and that the pace is within many pilots’ physical abilities.

You don’t have to be in marathon condition to fly SSR/Fox safely and get a lot of enjoyment from it. That, in combination with the stock-engine restrictions and airframe-size minimums, means you are likely to experience some extremely close racing.

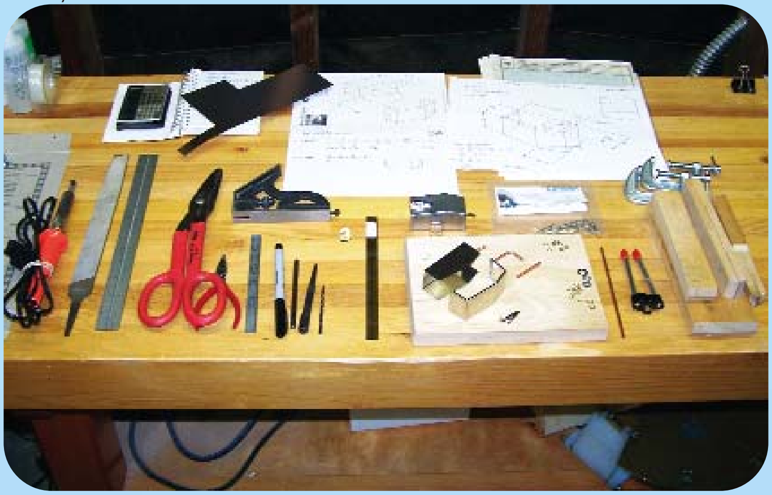
The airplanes can be made rugged and the systems are simple, so if three contestants start the race, it is a good bet that all of them will be in it until the end. Being able to compete against your buddies with a fair chance of beating them is a ton of fun. This event might have more bragging per mph than any other Racing class.

When I started Racing and was looking for another event to enter in local contests, I noticed that the organizers rotated the categories but that SSR/Fox was held more often than many of the others. That meant if I built an SSR/Fox racer, I could race more often. That was all the motivation I needed.

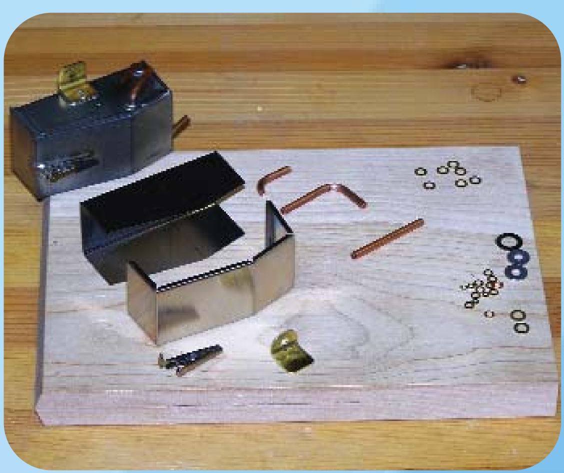
My local hobby shop had no eligible kits, so I started designing the ShyFox just three weeks before the 2005 Northern California Racing Championships. The contest was to be held in Napa, California.

As my friends will confirm, I don’t do

Photos by the author

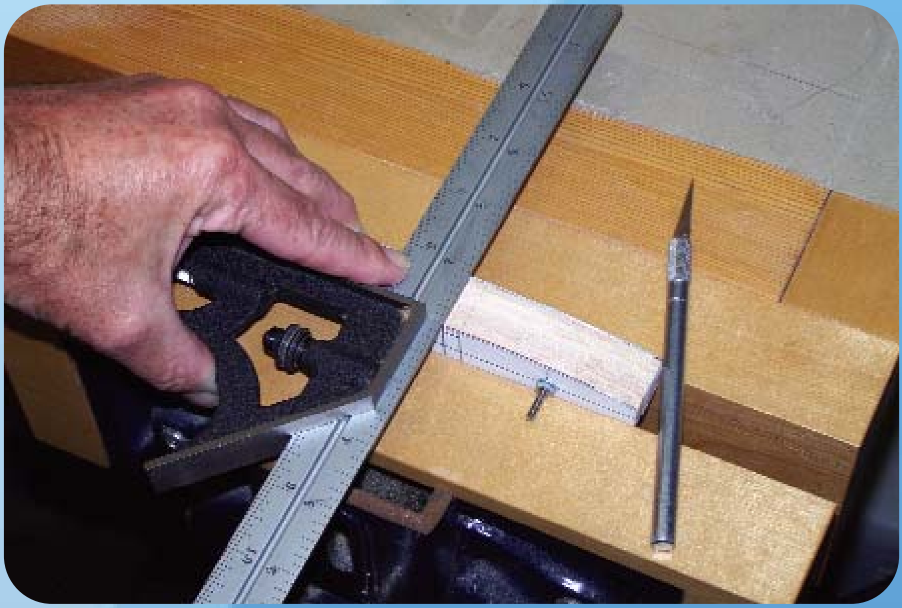


This complete set of tools will help you build a good tank. Wood blocks are bend-forming tools. One thing is missing: the small propane torch used to anneal the copper tubing before bending.

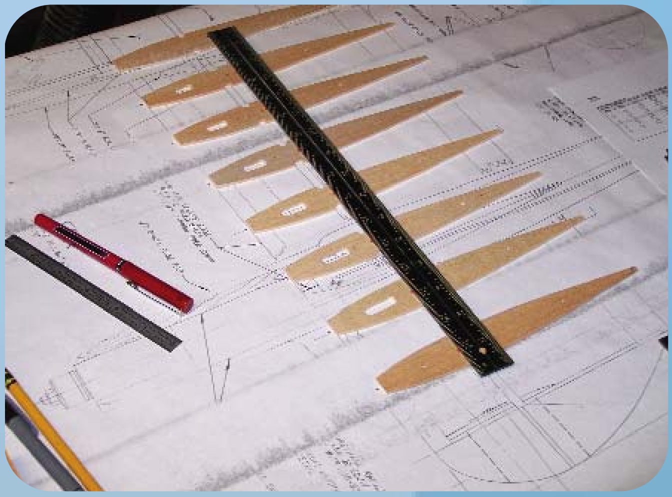


The tank body is formed from tin-plated steel sheet in two interlocking pieces. All seams overlap by 3/32 inch, for durable solder joints. Accurate work makes soldering much easier. A finished tank is in the upper left.

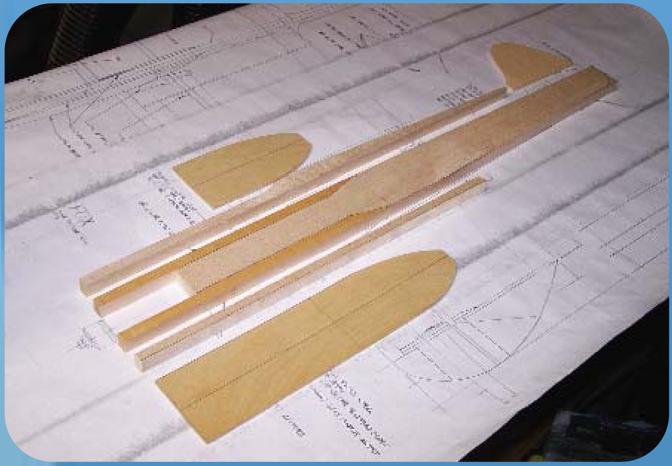
Modified "Dirty Dale" small shutoff. The left edge is screwed to the engine plate. The fuel line goes through the pinch aperture at the bottom, which has an adjustable spring force and can be used on soft 3/32-inch-diameter silicone tubing.



After ribs are shaped, cut spar notches. The template establishes the location and a square aligns the cut; a vise leaves one hand free to hold the knife.



Once the ribs are shaped and notched for spars, you can mark them for cutting leadout holes on the inboard rib set.



A solid front end is needed for durability in racing; you get it using 1/8 birch plywood doublers, extended maple engine bearers, and an inboard balsa cowling. Use firm balsa for the main fuselage plank.

Elevators are ready to drill for the joiner wire. This method provides much control and accuracy. Use a 3/32-inch-diameter drill, but go only as deep as the joiner arms to avoid breaking through when shaping.

Elevators (top) are made as one piece and cut apart after shaping, before installation. Use accurate layout lines—especially centerlines. Basswood or spruce spars are glued and taped on until dry.

Cut these fuselage features before tapering it to improve accuracy. The tail skid is assembled from two pieces of music wire, wrapped with copper wire and soft-soldered.

Major airframe parts in the early assembly stage. Use accurate layout lines on all pieces, and make sure centerlines line up during each step. The Fox bellcrank is the way to go.

The ShyFox is fueled through a uniflow line via a fitting attached to the top engine lug; black tubing is the seal. The alligator clip is pressed during fueling, opening the overflow line. Since the clip has minimal spring force, thin-wall surgical tubing is used.

Fox Race Tips

If you are going to build the ShyFox as a Fox racer, increase the engine-mount spacing compared to the plain-bearing .25s. Also, you will probably need the full 2-ounce tank.

The nose will see more vibration and stress. Therefore, use firmer wood for the fuselage and cheek cowl, and apply at least one layer of 2-ounce-per-square-yard fiberglass on the front. Overlap it onto the wing center-section planking. Use generous epoxy fillets on the wing/fuselage joint.

Install the shutoff so you can shut down the model anytime it vibrates badly. If the airplane vibrates terribly on the ground or in the air, change propellers or engines until it moderates, or you will get cracks around the wing/fuselage joint.

Be aware that a Fox power plant uses different design features and materials from more modern engines. Be sure to use fuel with plenty of castor oil, but don't try to run a hot Fox with a lot of varnish on the piston or liner.

At local contests, we run all castor fuel in Fox Race, which helps. If you have starting problems and the engine fires but the propeller oscillates back and forth, reduce the voltage to your plug. This also reduces your risk of a pit fire.

If the engine starts fine cold but won't restart hot, work on priming, and even try dousing the cylinder with a water bottle during each pit stop. When the hot starts go away, you need to find an engine with a tighter piston/liner fit; that is what the competitors who are passing you have.

If the vibration is killing your airplane, soak the cracks with thin CA and then heated epoxy. Install an O.S. .25, and race it as a Super Slow Rat. ***MA***

—Dave "McSlow" Hull

Keep your engine covered to shut out inevitable blowing grit that will ruin your piston/sleeve fit. Ear protectors are a good idea. Any major problems would require you to open the toolbox—a sure sign that you didn't win.

anything quickly—especially building an airplane. However, I finished the calculations, penciled the shapes, and started construction. I soldered the fuel tank the day before I packed for the trip. I put a couple coats of dope on the fuselage in the motel room the night before the race and decided that my ShyFox and I were ready to give it a shot.

My racing partner, Dave Dawson, started breaking in the engine as soon as we arrived at the field. We got in a couple of test flights before the contest and declared the equipment to be ready.

From the first flight, it was obvious that the model performed smoothly and was simple to fly. We were competitive from the start, nabbing a second place among some tough competition.

In spring 2007, at the Cabin Fever contest in Tucson, Arizona, we were beaten by perhaps the fastest SSR design in North America in a phenomenal race. In July of that year, I took the ShyFox to the Nats and garnered first place.

Two characteristics made this possible. First, the airplane has a straightforward fuel system and starting procedure. I had to borrow one pitman for the heat races and then another for the final, and each had only five minutes to figure out how to fuel up, prime the engine (but avoid flooding), and get one-flip starts.

The other key feature is that this model flies so solidly that the winds at Muncie, Indiana, were never a factor. I could watch for traffic instead of worrying about my racer ballooning in the wind.

If you and your flying buddies want to have a bunch of fun, score some plans, shuffle through the stack of balsa at the hobby shop to find some racing wood, and spend a few evenings at the building board. *If you aren't having fun, you aren't racing*.

CONSTRUCTION

Because the ShyFox was to be built in fewer than three weeks, it had to be simple.

I like to use $^{1}/_{16}$ ribs with capstrips. But it takes me quite a bit of time to cut and fit so many pieces (I'm slow, remember?), so the drawing shows $^{3}/_{32}$ ribs without capstrips. And I used an aluminum engine-mounting plate with integral gear leg, similar to the one on my Quickie Rat racer.

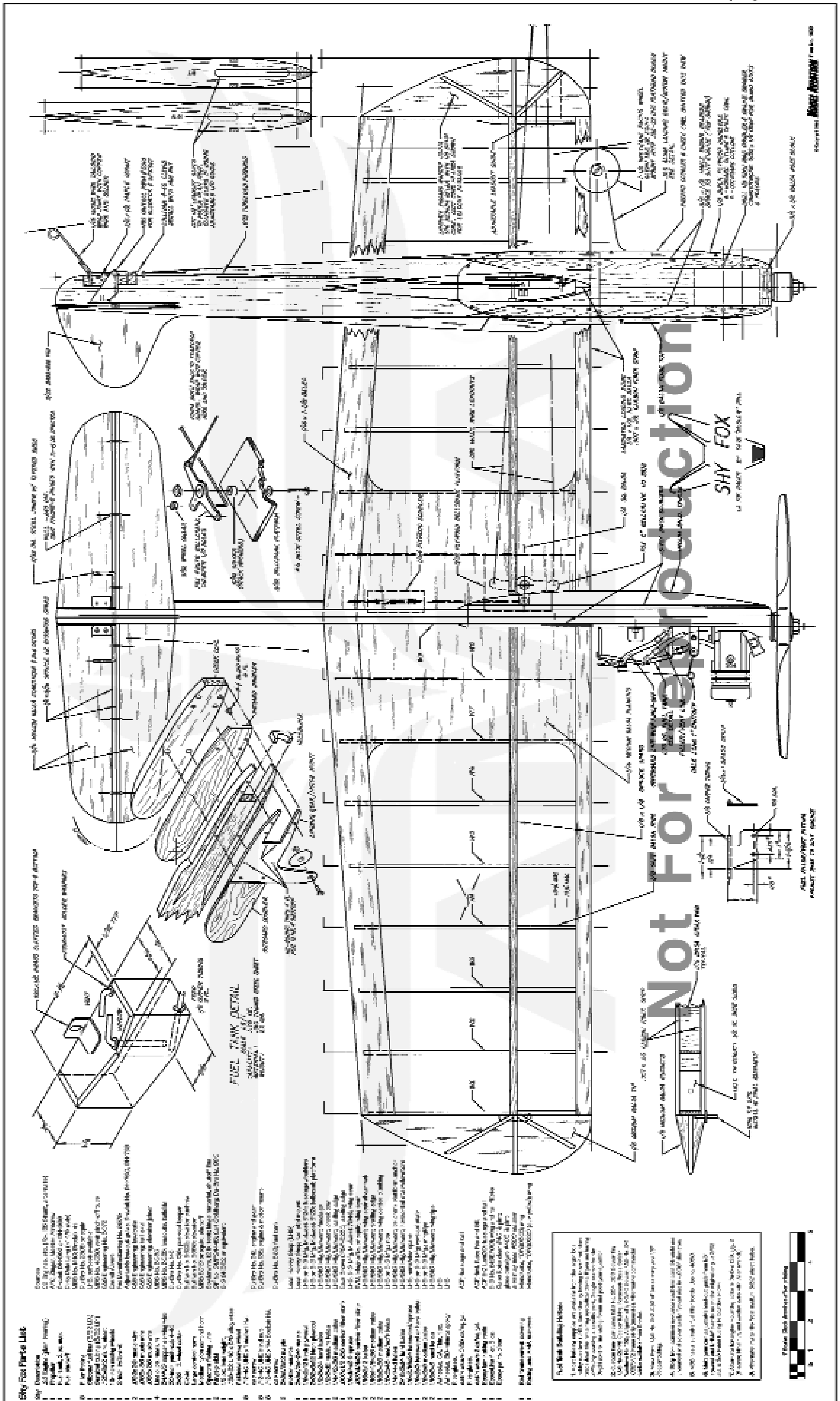
For someone who has not had much experience with engines, definitely go the SSR route. This is a stock-engine class, so the event directors might disassemble your power plant to see if you have "improved" things or installed nonstock parts. If you just can't stand running a stock engine, move up to Slow Rat; those rules allow fully modified engines.

There are many different fuel systems.

The ShyFox

Type: Profile CL Racing
Skill: Beginner builder and pilot
Wingspan: 38.06 inches
Wing area: 306 square inches
Length: 22.5 inches
Weight: 27 ounces
Engine: O.S. 25LA Stunt or Fox .35 Stunt
Construction: Balsa and plywood
Covering/finish: MonoKote wings and tail, fiberglass fuselage and vertical tail
Other: 1.5- to 2.0-ounce fuel tank, propeller, 2-inch bellcrank

Full-Size Plans Available—see page 159



Numerous types work well, but some are more difficult to tune. To achieve the correct number of laps, the tank must be built to match your engine. The rules permit a tank that is a large as 2 ounces, but most .25 engines will overrun on this much fuel and you will be disqualified for not completing the required two pit stops.

I suggest that you run your engine on the bench to determine how much fuel is required to last 105-120 seconds when set slightly rich of peak; that should be good for 35-40 laps at typical ShyFox speeds. This should be somewhere near 1.5 ounces.

Scale the length of the tank shown on the plans to this volume. If building a custom tank is all that is holding you back from racing, try one from Brodak, such as item BH-582 or BH-566.

The fuel shutoff is an integral part of your fuel system and is considered a safety item in SSR/Fox; you can't use it during the race. But being able to shut down during a competition can rescue a pilot from his or her mistakes or from a pitman or the other teams.

My model is fitted with the spring-loaded, drawbar-type (the wire is "J" shaped) shutoff, with a pull-to-actuate trip wire. I used the small size from Dirty Dale Long. In addition to being a safety feature, the shutoff permits a team to put up a series of quick needle-adjustment flights immediately before the race.

The aluminum monowheel gear shown is actually easy to make. Be sure to use a heat-treated alloy such as 6061-T6 or 2024-T4. Lay the pattern on the aluminum and you are ready to cut. I like to drill holes at each inside corner and then saw into each hole.

I used a urethane wheel from Darrell Albert, with a threaded (fixed) brass hub. Other possible sources are Glenn Lee (urethane) and Marc Warwashana (who has replicas of Don's Wheels in rubber or urethane).

This gear design has virtually no give. A rubber wheel is an advantage if your pilot can't make consistent soft landings.

Wing: The wing has a constant thickness of 1 inch (minimum) from root to tip, so it can easily be constructed flat on the building board. Place a 3/8-inch strip of balsa under the TE and move it fore/aft until its center is exactly 1/2 inch above the building surface along the span. If you get this right, you will have no washin, washout, or warps.

The best way to make the ribs is to cut an aluminum root and tip template. Drill matching holes in the templates, and then drill a set of rectangular balsa rib blanks to match. Sandwich the whole thing and start shaping.

I like to use a block of 80-grit sandpaper to rough down one side and then the other. Finish shaping with 120-grit paper.

Take your stack of ribs and lay the spar stock in the correct location. Score the spar notches with a new razor blade or hobby knife. Do this carefully and you will get a straighter, stronger wing, because the spars won't be twisted and the fit will be nice and snug. Cut leadout holes in the inboard ribs using a piece of sharpened 1/4-inch brass tubing.

It is probably overkill, but the ShyFox's spars and LE are reinforced with carbon-fiber (CF) strips. A .007 x 1/4-inch strip is laminated to the inside of each spruce spar.

Make sure that the spar stock is straight to begin with and that they are laying on a flat bench when you glue the CF. If you want the most reliable joint, solvent-wipe the carbon and use epoxy. The LE is laminated from two pieces of 1/4 x 1/2 stock, with .007 x 1/2 CF in between.

Remember that the event rules require a 1-inch-thick wing. If you cut the spar notches too deep, push the top spar into them, and sand the ribs flush, your wing will be illegal.

Add the lower TE piece and then the upper. You might want to taper the insides of each a bit at the TE, to get a slightly better fit with your ribs and to make the finished TE a bit thinner.

The inboard tip is laminated so that the leadouts pass through the center slot, which is long enough to allow the leadouts to be moved forward or aft for trimming. Set your guide at the location shown on the plans for first flights, or you can forgo the adjustable guide and glue in brass guides at this location. Install the bellcrank platform and fit-check the controls.

Notice the 1/64 plywood reinforcement on the inside of the planking, around the pushrod hole. Add the spar shear webs, noting the direction of the grain.

The leadouts in the inboard wing preclude the use of shear webs in every bay. Don't worry about it; the wing is plenty strong.

Plank the top center-section and carefully sand everything. Do not ruin the airfoil or make the wing too thin.

My airplane has MonoKote iron-on covering. I like to apply this material to the wing before installation in the fuselage, so planning is in order.

If you cover using four pieces and leave a gap along the middle of the wing, you won't have to try to peel this off before attaching the wing to the fuselage. Don't forget to include the fillets when you calculate these dimensions.

Tail and Fuselage: Use firm to hard balsa for the fuselage and good five-ply birch plywood. Cut the blank for the maple (or birch) engine mounts, establishing the spacing to fit your selected engine. Cut the plywood doublers to outline but do not cut the wing slot yet.

Taper the TE of the doublers; it is much easier to do so before they are installed. Glue the engine mounts and inboard doubler to the fuselage with 30-minute epoxy. When cured, glue on the inboard doubler with the front edge lined up with the front of the wing.

Use the wing rib template to carefully trace the cutout over the fuselage centerline. Drill a 3/16-inch hole at the LE. Using a scroll saw or a coping saw, cautiously cut down the center of the line.

This will give a close fit during assembly and results in a stronger, lighter wing joint that is properly aligned. Straight is great; slanted is planted.

Use your engine to mark the bolt pattern, and then mark the two holes at the rear above the gear leg. Drill 1/8 inch in diameter through, and then counterbore the inboard side 5/32 inch in diameter and 1/8 inch deep.

Press the Du-Bro blind nuts into the holes. These are the best-quality blind nuts I have found.

Cut a piece of 3/8 x 1/2 balsa for the nose block. This adds strength but really serves to reduce drag.

It is easier to cut the engine-clearance radius in this block before you cut it to length. Epoxy in place and final-shape your engine case using sandpaper wrapped around a dowel.

Cut the cheek cowling block (inboard tripler) from medium balsa. Relieve the areas over the blind nuts, and coat with epoxy for fuel-proofing. Install using epoxy or carpenter's glue.

Clamp or weight the assembly until dry, and cut the wing hole in the tripler. Trim and sand to final shape, blending with the tapered plywood doublers.

Cut, drill, and install the maple tail skid block. Epoxy the block in place. A good way to ensure that the removable tail skid will fit is to make two blocks with identical hole spacing and use one as a soldering fixture.

Drill a hole in the fuselage where the elevator joiner goes through, and cut the horizontal stabilizer slot. The tail is set with zero incidence to the wing. Slot the top of the fuselage for the rudder.

An odd thing happened when I made the tail. As usual, I went to the scrap box before chopping up a new sheet. There was a piece quite a bit bigger than I needed—16 inches long.

Instead of cutting it to the plans pattern, I cut a stabilizer/elevator set that was as long as the piece of wood that I found. I ended up using this larger structure and have been pleased with it.

The model grooves well, and this stabilizer/elevator might be one reason why. Plans show the original size, which should work fine, so pick the one that suits you.

I fiberglassed the prototype ShyFox fuselage and tail for strength and durability. Use an extremely lightweight fiberglass, especially on the tail. I employed a 0.58-ounce-per-square-yard plain-weave cloth. Use an epoxy resin system that has low viscosity. Try not to thin it, but use lacquer thinner if you do.

This design's rudder is present because I like airplanes that look real. It also protects the shutoff horn if the model flips over, if it's fiberglassed or made from basswood.

You can use plywood if you think you can install and seal it before it warps. There should be no rudder offset.

Once you have glued the rudder to the fuselage and added the fillets, do the final shaping and sanding. If you are considering skipping the fiberglass reinforcement, you should know that the most vulnerable part of a racer's fuselage is aft of the wing.

If the pitman is forced to attempt a wing catch, the tail will whip. This can cause the fuselage to crack at the wing TE or farther aft.

So either don't make flying and pitting mistakes or build in ruggedness. Light is fast; broken is last.

Airframe: Insert the wing and horizontal stabilizer into the fuselage. Set this on a large, flat surface and clamp the fuselage to a 90° block at the nose. I use a large secondhand machinist's knee.

When everything is correct, you should be able to sight along the horizontal stabilizer from the rear and see if it is parallel to the wing. Take your time. A fast airplane exaggerates trim problems, and a crooked model is a slow model.

I have used KlassKote epoxy to seal and fuel-proof the wing/fuselage joint, and I like its durability and relative ease of use. You can mask over the MonoKote and paint directly over the seam for a good look. Scuff the covering where you will paint after you mask it, and then wipe off thoroughly with alcohol.

I like to use sewn hinges. Insert the joiner wire through the fuselage and install the elevators. Align and tape the assembly to the stabilizer.

Using 12-pound-test Spectra fishing line, start sewing the holes nearest to the fuselage and work your way out. Stitch a figure-eight pattern through each set of holes, using four passes through each hole.

Snug everything tight, but do not pull too hard on the line when tying the knot. It could cut you, or your wood, if you didn't use hardwood spars.

Sullivan Products' Gold-N-Clevises are strong; don't use a lesser-quality part. Install a jam nut against the clevis once you have the elevator adjusted to neutral, when the bellcrank is at midtravel. Do you feel catching or roughness? If so, fix it now.

Install the wheel on the landing gear plate and install the engine and plate together. The upper engine bolts also hold on the tank vent line and fueling port, so make this up now.

Fit the tank and shutoff in the space between the wing and the engine as far forward as you can, to improve fuel draw. Install the shutoff, and connect the fuel lines and shutoff trip wire. Adjust the wire so that full down-elevator trips the shutoff.

I am still trying to design a long-lasting tail skid. In the meantime, the ShyFox uses my standard replaceable wire skid. These are sort of spring-loaded into the mount.

Over asphalt, the standard skids wear down after a year of racing and the loop breaks off. Simply make a spare while you are bending and soldering, and don't worry about it.

The prototype ShyFox weighs 27 ounces, which is fairly heavy, but there is a relationship between weight and durability. You don't want your airplane falling apart near the time you get it trimmed and going fast in practice.

Make sure the CG is within 1/8 inch of the location shown on the plans. You can trim the CG within a certain range to suit your skills, but a racer should fly level without the pilot constantly watching it.

Be sure that your adjustable leadout guide is locked down tight, and then hang the model with the two leadouts held together. It should hang a bit nose-down.

Test-Flying and Racing! When you get your racer out to the field, check it one more time. Connect the lines and handle. Are the lines .015-inch stranded steel and between 59 feet, 6 inches and 60 feet, 6 inches long when measured between the handle and the fuselage centerline?

Is up really up? Is your handle marked? For the control setup shown, you should start with a handle spacing of approximately 2 inches.

Try the shutoff in flight and set the sensitivity to suit the pilot. You will know it is too sensitive if he or she accidentally shuts it off when taking off into the wind and applies a great deal of down to keep from ballooning into the racing zone.

This seems to be the most down-control I ever need, so we use this maneuver to set up each new model. If you shorten the tail skid and are slightly slow on the handle, you need more down-control.

The engine should speed up slightly on the last lap, although the tank shown runs evenly to the end. The downside of this is that the pilot won't get much warning of the impending pit stop, and the team should keep track of laps during each tank. Passing with a nearly empty tank is a risky maneuver.

I hope you enjoy building and racing your ShyFox. For more information about Racing, check out the National Control Line Racing Association AMA SIG. The dues are low and the information contained in the newsletter, *Torque Roll*, will help you become a competitive racer.

If you have the itch and want to learn how to race, one of the best articles to read is "The Race … and how to fly it" by John Kilsdonk, which was published in the May 1977 *MA*. AMA members can access this issue via the Academy's Web site, in the "Members Only" section. ***MA***

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Sources:

Brodak Manufacturing
(724) 966-2726
www.brodak.com

Dale Long
(951) 784-4328
dirtydshutoffs@dslextreme.com

Racing wheels and other specialty items:
Darrell Albert
(760) 741-2505
Scar4641@aol.com

Marc Warwashana
11577 North Shore Dr.
Whitmore Lake MI 48189
whellieman@gmail.com

Du-Bro Products, Inc.
(800) 848-9411
www.dubro.com

KlassKote
(612) 243-1234
www.klasskote.com
Sullivan Products (control horns are item 556)
(410) 732-3500
www.sullivanproducts.com

National Control Line Racing Association
www.nclra.org

Stock .35 Stunt engine, 2-inch bellcrank, glow plugs:
Fox Manufacturing
(479) 646-1656
www.foxmanufacturing.com

Stock 25LA CL engine:
O.S. Engines
(217) 398-8970
www.osengines.com

Lines, line-making supplies, clips, fueling bottles, horns, etc.:
MBS Model Supplies (Melvin Schuette)
(785) 256-2583
www.mbsmodelsupply.com

Tin-plated steel, 1/8-inch-diameter copper tubing; 1/8-inch-diameter aluminum plate for gear:
K&S Engineering
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www.ksmetals.com

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