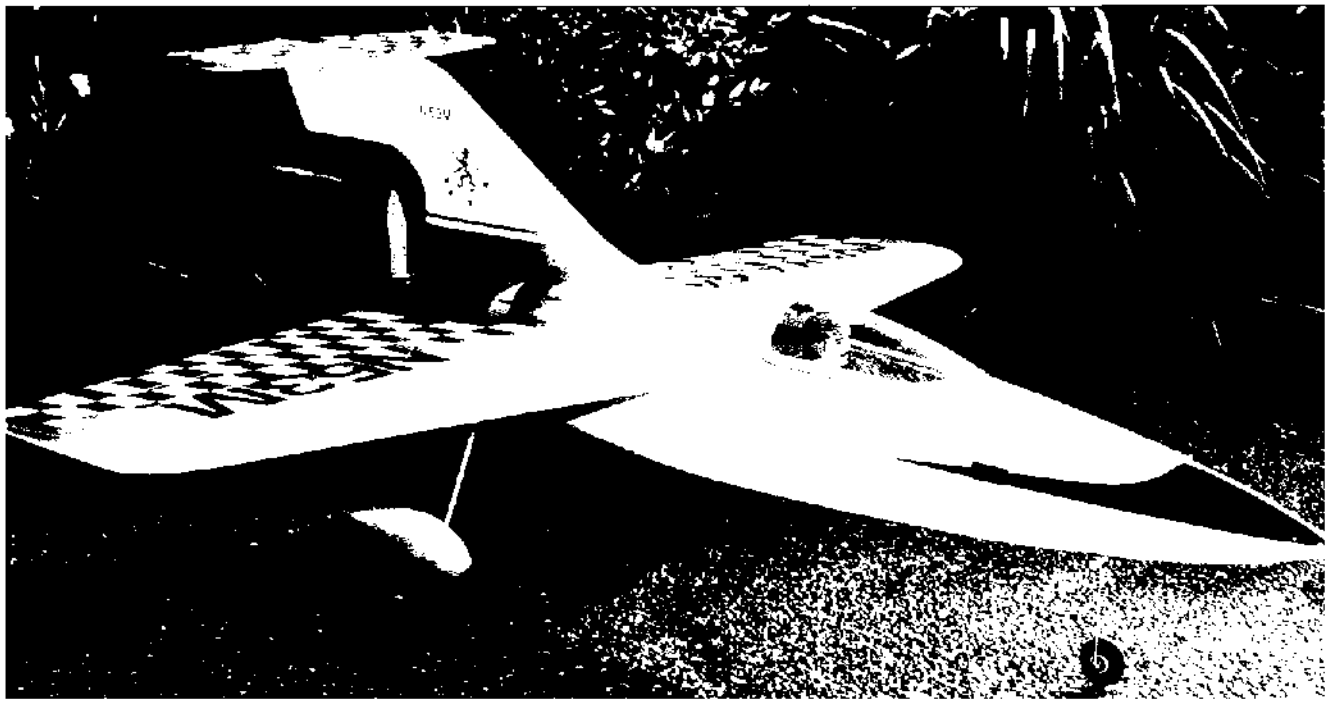


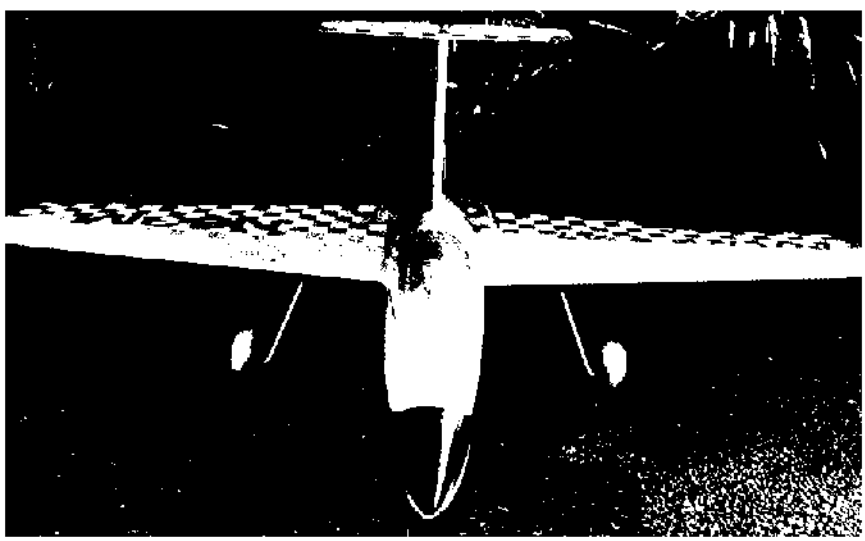
PUSHY CAT

An Unconventional 1/4 Size Pusher-Prop Racer

The need for speed! Radio control aircraft that thrill us with speed and beauty are appearing at flying fields and contests internationally. The screaming Reno style unlimited aircraft are both gorgeous and exhibit speed that make us gasp. Still faster are the paint blistering fan jets with clipped wings clocked at speeds Indy cars would be proud of. For the modeler without an unlimited budget, but who still wants the thrill of controlling a plane that's somewhat nerve racking at full throttle, there are sport models advertised as speed machines for the average "Sunday fun" kind of guy or gal. The Pushy Cat is the later of these heart pounding aircraft.

The full-scale Pushy Cat is a pusher-prop midget class Reno racer designed, built, and piloted by Jim Miller. The model in this article is a Quarter Scale rendition of Jim Miller's T-tailed racing machine. Being of a pusher configuration makes this plane unconventional for a Reno racer. Nonetheless, its graceful design and beauty warrant modeling this aircraft for radio control.

The Pushy Cat is not modeled to compete as a Formula I racer, however, it does exhibit enough speed to be exciting. In actuality, the shoulder mounted semi-symmetrical wing and tricycle landing gear make this plane easier to fly and land than many low wing airplanes. So while not for beginners, the intermediate pilot with average flying skills will handle this aircraft with ease.



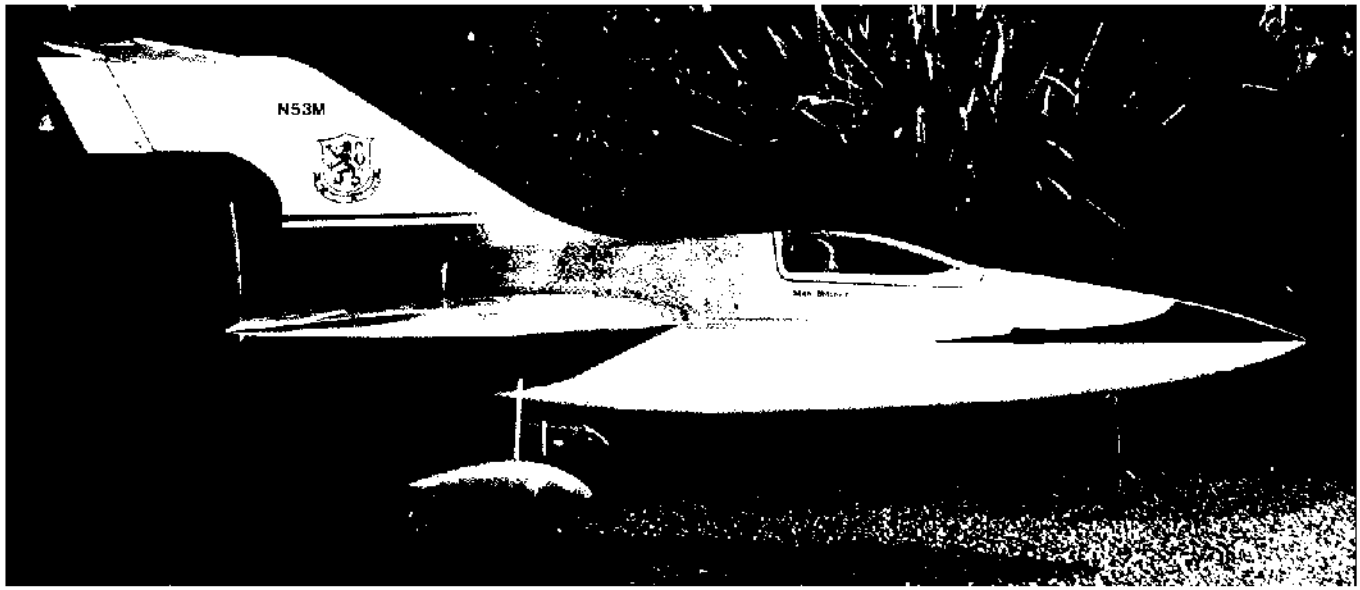
The design features are flexible with several configurations possible. It can be built with or without a functioning rudder, can be glassed and painted or MonoKoted, and a retractable nose wheel is also an option . . . decisions, decisions. Other items that make this plane especially pleasurable are:

(a) The radio compartment is easily accessible by removing the entire top and forward portion of the fuselage with the removal of two hidden machine screws. The top of the fuselage also hides the wing bolts giving the plane a clean appearance.

(b) The aileron, elevator, and rudder servos are all mounted in the wing so that the wing/tail assembly can be removed for transport by simply removing the two wing bolts and disconnecting the servo wires. Under the wing you will find full access to the engine and fuel system. A fuel pump of some sort is recommended.

(c) The fuel tank is over the Center of Gravity so there are no balance problems as fuel is consumed.

The prototype plane shown in this article is version 2. The first prototype was quite simple in comparison. It had no rudder, no retractable nose wheel, no pilot or cockpit, was MonoKoted, and used a stock engine muffler. My philosophy at the time was —



why spend bucks on something that may not be of sound design. My worries were unfounded. The first version of the Pushy Cat flew great and encouraged me to build a deluxe version, version 2.

CONSTRUCTION

The following construction sequence is not meant to be all inclusive and certain instructions may be quite vague at times. The author made every effort to ensure that the correct building sequence was maintained and that the most critical areas of the construction were included.

Fuselage:

Cut out the fuselage sides from the 3/16" balsa sheet stock. Pin or tape the sides together and sand the edges to ensure symmetry. **Caution** — the plans show the fuselage sides to be 36" in length. This was done to allow for a pattern to cut from. The assembled fuselage sides will be slightly less than 36" due to the curvature of the structure.

Mark the locations of all the bulkheads on the inside of the fuselage sides. Assemble the fuselage sides and bulkheads upside down over the plans using masking tape. Adjust the tape until the assembly is straight and true to the centerline on the plans and that each side is perpendicular to your building surface.

Using 1/4" balsa sheet, plank the bottom of the fuselage starting at the front and working towards the rear. Glue each plank in place, removing the masking tape as you go. Remove all tape, bulkheads, and bracing from the structure.

With fuselage in the upright position,

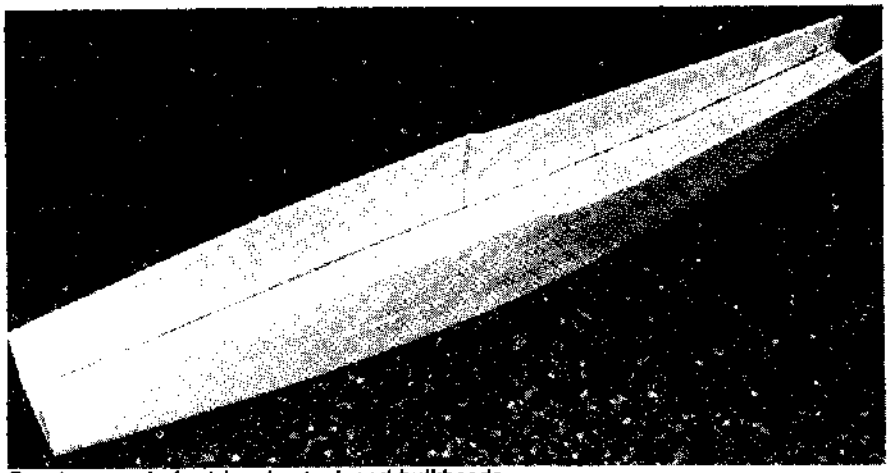
"The full-scale Pushy Cat is a pusher-prop midget class Reno racer designed, built, and piloted by Jim Miller. The model in this article is a Quarter Scale rendition of Jim Miller's T-tailed racing machine.

PUSHY CAT

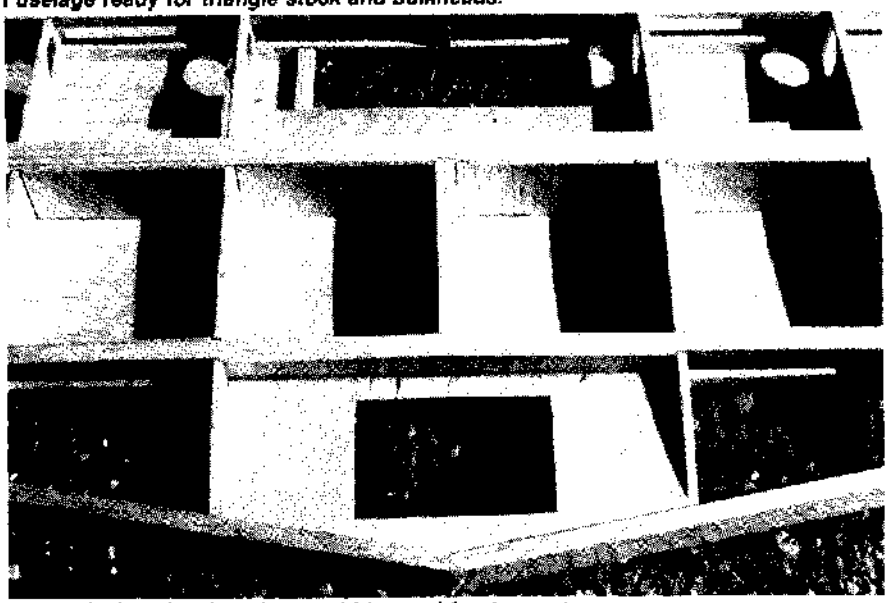
Designed By:
Stan D. Mitchell
TYPE AIRCRAFT
Sport Scale (Pusher)
WINGSPAN
49 Inches
WING CHORD
14 Inches (Avg.)
TOTAL WING AREA
680 Sq. In. (Approx.)
WING LOCATION
Mid-Wing
AIRFOIL
Semi-Symmetrical
WING PLANFORM
Double Taper
DIHEDRAL, EACH TIP
N/A
OVERALL FUSELAGE LENGTH
46½ Inches
RADIO COMPARTMENT SIZE
(L) 17½" x (W) 4" x (H) 3½"
STABILIZER SPAN
16 Inches
STABILIZER CHORD (incl. elev.)
5½ Inches (Avg.)
STABILIZER AREA
84 Sq. In.
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Top of Vertical Fin
VERTICAL FIN HEIGHT
9 Inches (Approx.)
VERTICAL FIN WIDTH (incl. rud.)
9 Inches (Avg.)
REC. ENGINE SIZE
.40-.50 2-stroke
FUEL TANK SIZE
10 Oz.
LANDING GEAR
Tricycle
REC. NO. OF CHANNELS
4-5
CONTROL FUNCTIONS
Rud., Elev., Throt., Ail.
(Retracts Optional)
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Balsa, Plywood, Foam
Wing ..... Balsa, Plywood, Spruce
Empennage ..... Balsa
Wt. Ready To Fly . 92 Ozs. (5 Lbs. 12 Ozs.)
Wing Loading ..... 19½ Oz./Sq. Ft.

Short Biography of Author

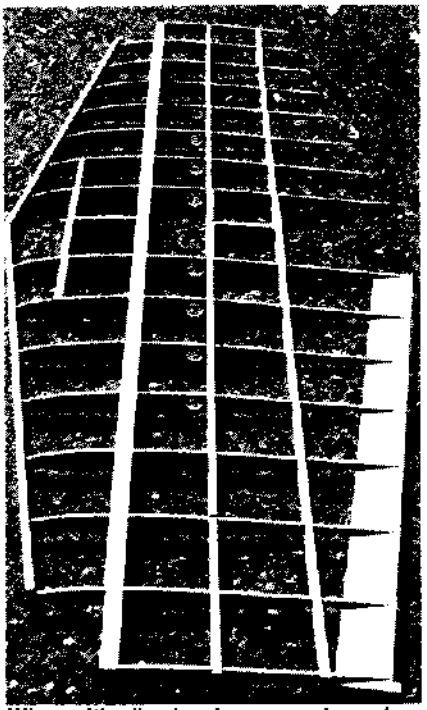
Stan Mitchell is a Certified Public Accountant by profession, but is a certified modeling junky in actuality limited only by financial reality. The 35 year old CPA's interest in radio control began as a child with many visits to the local hobby store. He spent a lot of time slobbering over R/C airplanes on display but had to settle for plastic or rubber powered models instead. Soon after graduating college he began pursuing his R/C dreams and has since converted large portions of his garage into hangar facilities. He lives in Tulare, in Central California (only 70 miles from Madera, home of the Reno style races) with his wife Becky and son David and enjoys flying with several other R/C fanatics at the Porterville airport.



Fuselage ready for triangle stock and bulkheads.



Front of wing showing shear webbing and front mount.



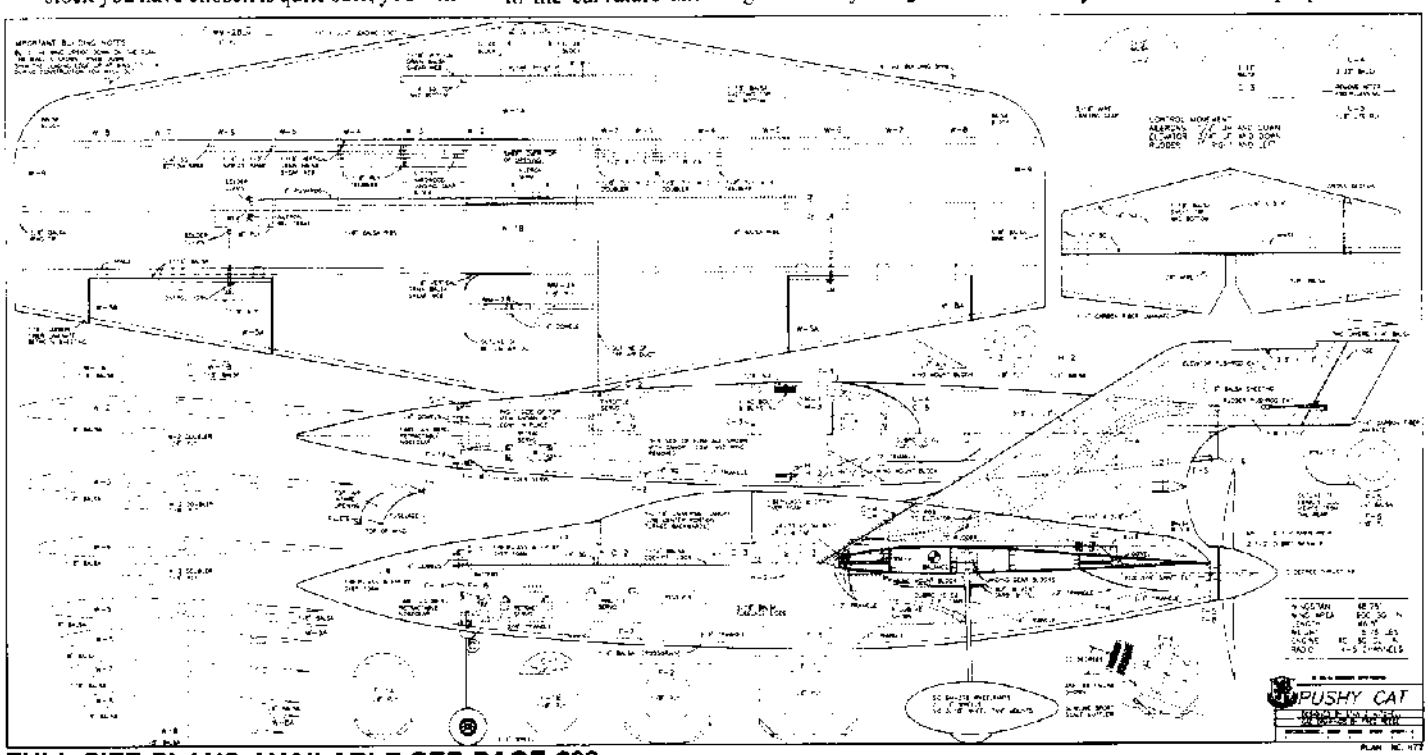
Wing with ribs in place — note carbon fiber laminate on trailing edge.

glue the 3/4" triangle stock along the length of the structure. Unless the balsa triangle stock you have chosen is quite soft, you will probably need to cut the 3/4" stock into two or three sections to ease the installation due to the curvature and length of the joining surfaces. Test the flexibility of your wood first.

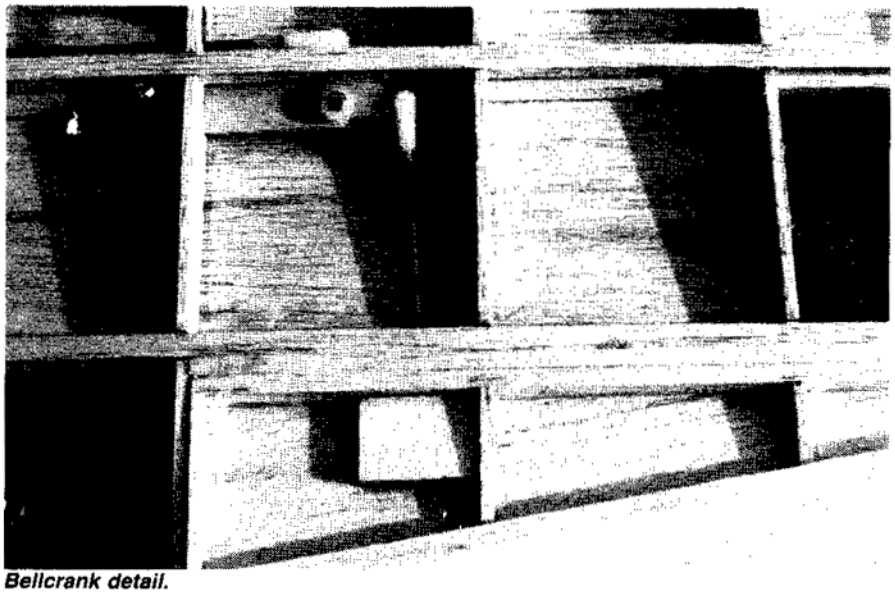
Laminate bulkhead F-1A and F-1B together with epoxy. Drill and install blind nuts for the nose wheel block on bulkhead F-1 and on the fire wall (F-4) for the engine mounts. Glue the bulkheads, wing mounts, fire wall, and all reinforcing stock to the fuselage using epoxy. The fire wall should be set at 0° incidence in relation to the top of the fuselage, and 0° thrust.

With the engine installed to ensure correct positioning, install the spinner ring laminates F-5A and F-5B. A Du-Bro 2½" spinner was used on the prototype.

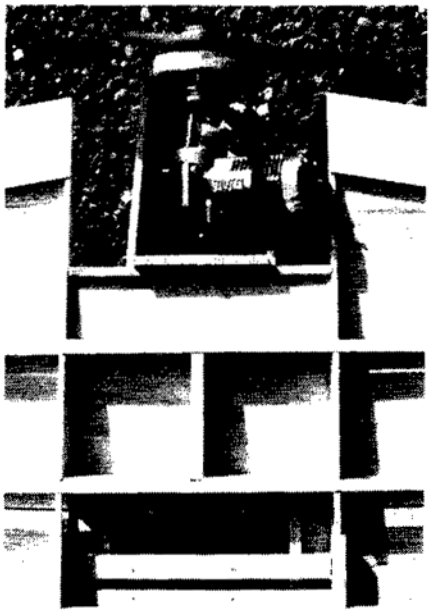
The Pushy Cat uses a 3/4" prop shaft



FULL SIZE PLANS AVAILABLE SEE PAGE 203



Bellcrank detail.



Rear wing mount detail and engine in place.

extension (available from Fox Mfg.) to allow the engine to be completely enclosed and to help in balancing by shifting some weight forward. If the extension is not used, be sure to install the fire wall (F-4) rearward 3/4" from what is shown on the plans.

You will need to trim the side of the fuselage to allow the engine to lay over on its side at the angle shown on the plans. Also carve an exit for the muffler. A Slimline sport scale muffler was used on the prototype.

Plan-out your steering (and retract) servo locations. Install the nose wheel hardware and throttle pushrod. Set the fuselage aside for now.

Wing:

The wing is built all in one piece, upside down, directly over the plans. Start by pinning the 48" x 1/2" x 1/4" spruce spar in place over the plans. Glue the wing rib doublers in place on ribs W-2, W-3, and W-4. These support the landing gear blocks. Set all of the ribs in place perpendicular to the building surface. Pin the leading edge in place as well as all the stringers. Note that some of the stringers change from 1/4" sq. balsa to 1/8" x 1/4" balsa as they near the wingtips. See the plans for detail.

To build in a little wash-out (remember, the wing is upside down) raise the front of each wingtip at rib W-8 approximately 1/4" with a scrap piece of wood. Make sure the center of the wing stays perpendicular to the building surface and doesn't rise up with the wingtips.

When you're satisfied that the wing is positioned and aligned correctly, CA glue all the joints in this skeletal structure.

Unpin the wing and turn it over and finish installing the rest of the stringers. Install all of the shear webbing. The front and rear wing mount assembly can be installed at this time as well.

Make filler blocks from scrap and glue them between rib W-2 and the rudder/elevator servo opening on the bottom of the wing. Sand these to the shape of the wing. Sheet over the filler blocks when sheeting the bottom of the wing. They add strength to the wing mount and help keep the bottom of the wing from being damaged when the wing is tightened against the fuselage.

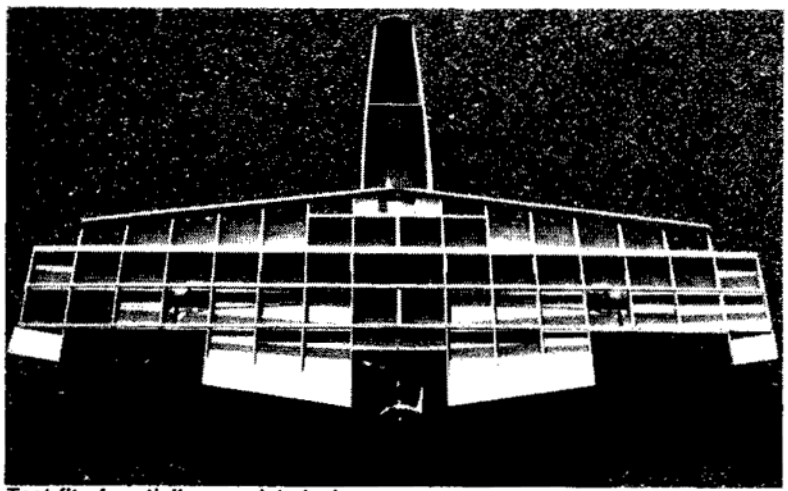
With the wing inverted again, install the trailing edge sheeting, making sure to allow the 1/16" sheeting to overlap 1/4" past the rear of the wing ribs as shown on the plans. Install the landing gear blocks.

With a razor saw carefully cut and remove the section of the trailing edge between ribs W-5 and W-8 and cut ribs W-6 and W-7 just behind the stringer. These pieces will be used later for construction of the ailerons.

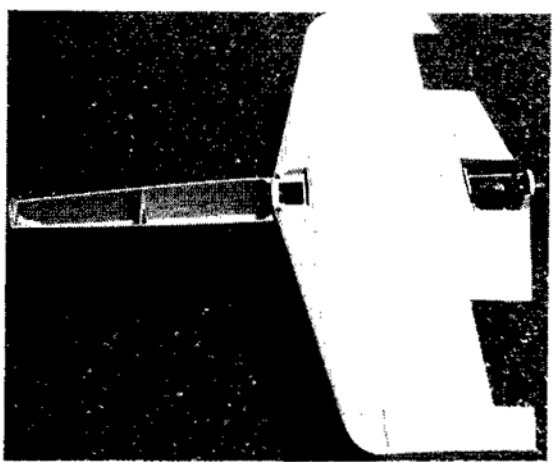
Using a scrap piece of the 3/16" balsa leftover from the fuselage side, trim and glue in place a piece to fit between ribs W-5 and W-8 on each side. These will be used as hinging surfaces for the ailerons.

Sheet the wing bottom starting at the main spar working forward to the leading edge and then from the main spar rearward to the trailing edge sheeting.

Position your aileron servo and install the aileron linkage. Sheet the top of the wing. Before installing the trailing edge sheet, glue a 1/4" wide strip of carbon fiber laminate to the rear edge of the bottom trailing edge sheet. The carbon fiber laminate will allow the trailing edge to be sanded to a very thin profile. The carbon fiber may be substituted by using other hard laminate materials. Glue on the wingtip blocks. Carve and sand the entire wing to

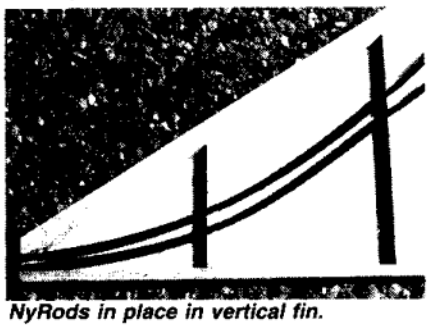


Test fit of partially completed wing.



Completed wing mounted to fuselage. Landing gear now installed.

Detail of front wing mounting block in fuselage.



NyRods in place in vertical fin.

shape as shown on the plans.

Position the wing on the fuselage with the dowels in the aft end of the wing inserted into the receiving holes in the fire wall. The wing should be at 0° incidence in relation to the top of the fuselage. Once square with the fuselage, drill through the front wing mount and the mount within the fuselage as well. Tap the wing mounts in the fuselage for the two 1/4" nylon wing bolts.

Ailerons:

The ailerons are built using the sections of material removed from the wing earlier. Cut the two aileron end ribs using wing ribs W-5 and W-8 as guides. Next cut a piece of scrap 3/16" balsa for the hinging surface of the aileron and glue in place. The existing ribs within the aileron will need to be trimmed some in order to join properly with the hinge mounting surface.

Main gear in place in hardwood block.

Sheet the bottom of each aileron. Glue the aileron horn mounting block to the inside of the aileron. The block should be placed against the rib and forward to the hinge mounting surface as shown on the plans. Install a 1/4" wide strip of carbon fiber laminate to the trailing edge just like on the wing assembly.

Sheet the top of each aileron. Bevel the leading edge of each aileron to allow for adequate hinge movement. Slot the ailerons and wing for hinges. See the plans for suggested locations.

Tail Assembly:

The vertical fin and horizontal stabilizer are built-up structures which are constructed directly over the plans. After one side of the vertical fin has been sheeted, notch the cross bracing to accept the NyRods that will be concealed within the vertical fin. Position the NyRods so that they exit approximately 1/4" on center from each other at the front of the vertical fin. Finish sheeting the fin after the NyRods have been glued in place.

The aft end of the vertical fin, or rudder if used, is made from two pieces of 1/4" sheet balsa laminated together with CA glue. Once in place, it is then carved and shaped to a thin trailing edge profile.

Assembling the horizontal stabilizer is straightforward. Just follow the pattern on the plans and use the materials called out.

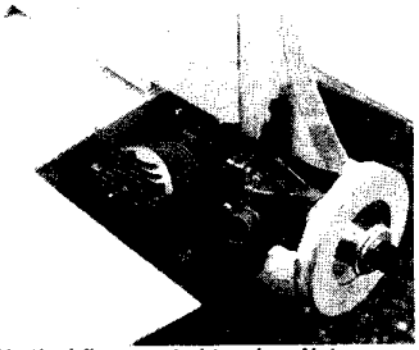
Detail of canopy formers and canopy mounting tabs.

After the horizontal stabilizer has been assembled, notch a groove in the rear center section to cradle the length of 1/8" wire bent in a "U" shape to connect the elevator halves. Glue the vertical fin and horizontal stabilizer together at this time being sure to install the elevator connector at the same time.

Because the joint between the fin and stabilizer is somewhat minimal, CA glue a 1/2" wide strip of 3/4 oz. fiberglass cloth onto each side of the joint for reinforcement. Carve and sand the entire tail assembly to shape.

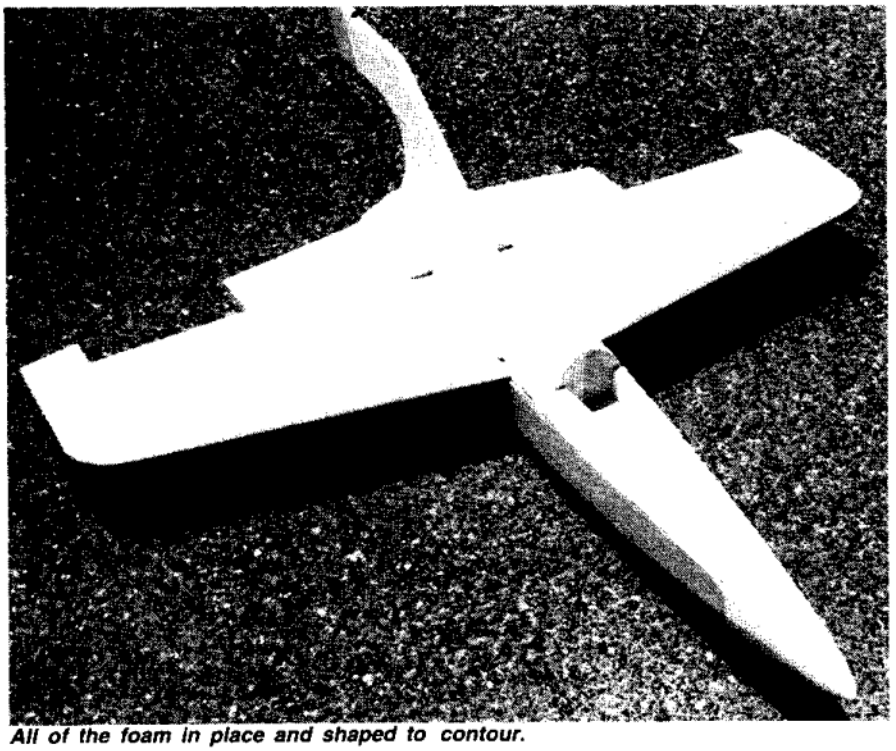
The elevator halves and the rudder are shaped from solid pieces of balsa. The elevator halves are cut from 3/8" balsa sheet and the rudder from two 1/4" thick balsa pieces laminated together in the same manner as the aft end of the vertical fin/rudder.

After each piece is cut out, use an X-Acto knife to cut a 1/4" deep slot in the trailing edge of each piece. Then place a 1/4" wide strip of carbon fiber laminate in the slot and glue using a thin CA. Shape the elevator halves and rudder to a finely tapered edge. The laminate in the trailing edge will provide strength to the edge and keep it from chipping. Slot the tail assembly for hinges referring to the plans for suggested



Vertical fin mounted to wing. Note scrap balsa to help set stabilizer incidence.

Slimline muffler exiting fuselage bottom.



All of the foam in place and shaped to contour.

Wing, vertical fin, and air scoop detail — note balsa filler fillets.

Detail of canopy and wing joint — note how vertical fin transitions to canopy assembly.

locations.

To attach the tail assembly to the wing, first sand the bottom edge of C-5 to a 45° angle, then bolt the wing to the fuselage. Using canopy former C-5 as a guide, position the tail assembly on the center of the wing forward to C-5's location. Put a piece of scrap balsa under the aft end of the tail assembly to raise it to the proper incidence. Use an incidence meter to align the horizontal stabilizer with the top of the fuselage body and set to 0°. At the same time, square the tail assembly with the wing and secure it to the wing with either scrap or 1/2" triangle balsa.

Glue former C-5 to the vertical fin and to the leading edge of the wing. Former C-5 should be positioned to meet the top of the fuselage. (Note: Cut C-5 from lite ply.) There will be a small triangular shaped gap between C-5, the wing, and the fuselage. Fill the gap with scrap balsa.

At this point the tail assembly is only held on with a minimum of support; however, once the decking and air scoops have been fiberglassed, the tail assembly will be secured in place for good and have plenty of fortitude.

Canopy Assembly:

The canopy assembly attaches to the fuselage with the use of 1/4" dowels at the front end and machine screws at the aft end. If you don't like working with pilot figures and clear plastic canopies, formers C-2 and C-3 can be omitted and the shape of the canopy assembly can be achieved from shaped foam only. The first Pushy Cat prototype was built this way and a simulated wind screen was painted on the canopy assembly instead.

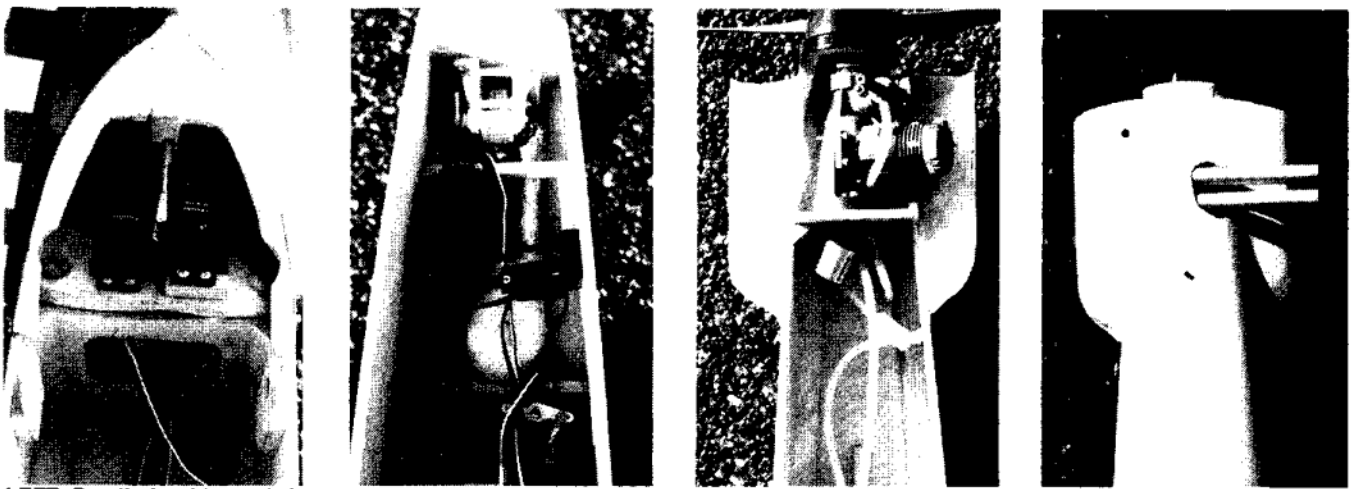
With the wing still attached to the fuselage, pin the canopy floor to the fuselage top and against C-1. The 1/4" doweling should be glued to C-1 and protrude approximately 1/4". Install canopy formers C-2 through C-4. Glue in the reinforcement blocks behind formers C-1, C-2, and C-3. Next remove the canopy assembly and install the canopy hold-down tabs H-1 and H-2 to the fuselage sides. Slot the canopy floor to accept the hold-down tabs and glue H-3 to each side of the canopy floor with 1/4" sq. balsa reinforcements behind each H-3.

Before starting the foam work disassemble the plane and carve the fuselage to shape. To give the Pushy Cat its very rounded bottom, carve the corners off well past the fuselage side and flooring pieces exposing the 3/4" triangle stock.

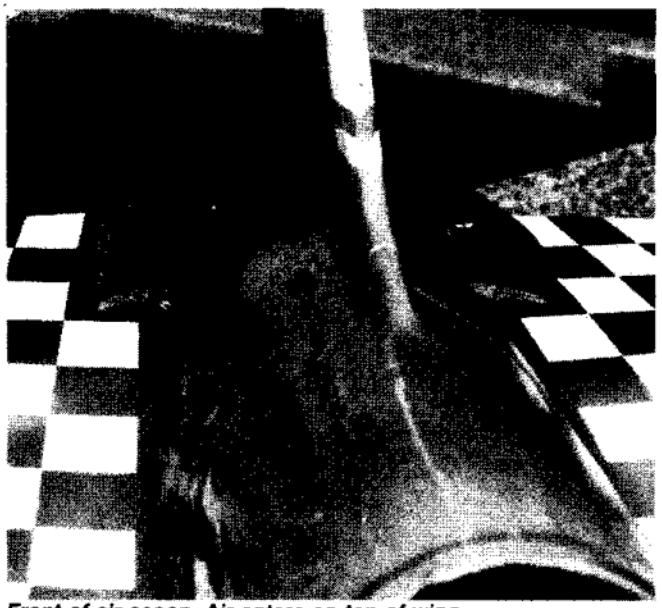
Foam Work:

With the plane assembled again it's time to attach the foam and give the plane its nose, decking, and air scoop ducting. The pieces of foam you will need are mostly small and will be removed later. So for cost savings I used foam blocks that came from packing crates and other sources rather than the somewhat expensive foam sold for making wing cores. Try to carve and sand each block of foam to near its final shape before gluing in place. This is especially helpful when working in the area where the wing joins the vertical fin. After gluing in place with Elmer's wood glue (or similar), sand the foam to its final contours.

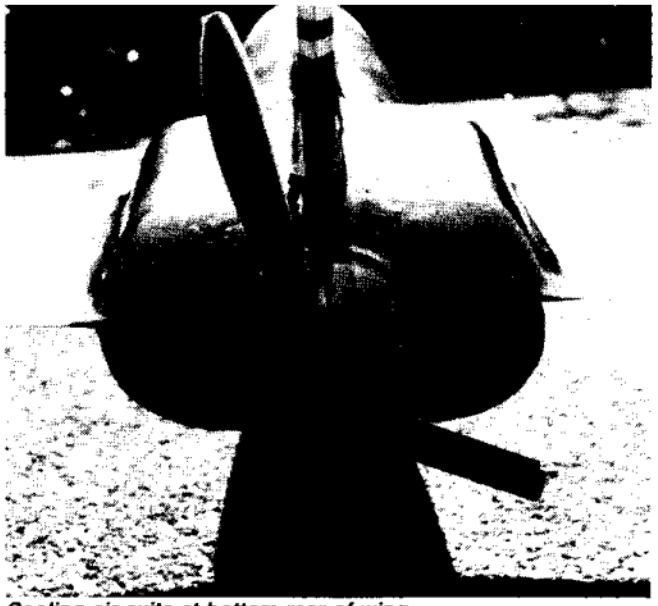
Cut and glue a piece of scrap balsa to the



LEFT: Detail of rudder and elevator servos — note throttle pushrod and position of canopy mounts H1 and H2. LEFT CENTER: Retract and throttle servo — receiving pod for nose wheel shaped from foam and then fiberglassed — note Du-Bro radio receiver switch and charging jack outlet. RIGHT CENTER: Fuselage with wing removed showing fuel system — note fuel pump and air ducting. RIGHT: Bottom of air ducting — note hole for carb adjustment and fuel tank breather tube exit just in front of pipes.



Front of air scoop. Air enters on top of wing.



Cooling air exits at bottom rear of wing.

front of the vertical fin and the top of the canopy as shown on the plans. Shape this piece to blend the vertical fin into the canopy top. With a razor saw cut through this piece to allow for the removal of the canopy.

Use balsa filler to make fillets where the foam pieces meet the wing and the vertical fin, except in front of the air scoop intakes. With the balsa filler still in hand, fill in any imperfections in the foam and sand to a smooth surface.

Fiberglassing:

The foam parts of the plane should be glassed first. I used 30 minute epoxy diluted with 99% isopropyl alcohol (3 parts epoxy to 1 part alcohol). Thinning the epoxy will allow the resin to be applied with a brush. Apply a layer of 6 oz. glass cloth to all the parts built-up with foam. Once the epoxy has cured, sand lightly and apply a second layer of cloth to these areas using 3/4 oz. or lighter fiberglass.

The ducting over the bottom of the engine compartment is only attached to the fuselage. Use wax paper to avoid fiberglassing the ducting to the wing.

At this point, the rest of the prototype plane was covered with .58 oz. glass cloth. I like the wrinkle-free surface fiberglass provides plus it allows for unique paint applications. If MonoKote is your forte, feel free to use it when the time comes.

Back To The Canopy Assembly:

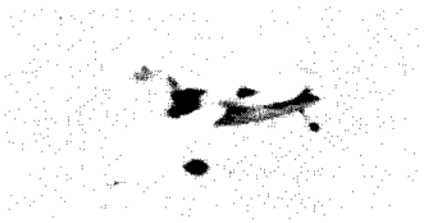
With the canopy assembly taped down firmly against the fuselage, drill through the fiberglass canopy assembly sides and hold-down tabs H-1 and H-3. Install 4-40 blind nuts in H-1 and enlarge the hole in the fiberglass just large enough to accept a machine screw. Slotted screws are not recommended because they tend to fall off the end of your screwdriver. A hex-head machine screw works well in this application.

Aileron linkage with hooded pushrod exit.

Foam Removal:

After the plane has either been painted or MonoKoted, the foam can be removed. The foam in the vertical fin/wing area can be removed with a long screwdriver by carefully picking away at the foam, being careful not to gouge the surrounding fiberglass structure.

On the underneath side of the canopy assembly, remove the balsa in front of, and behind the cockpit leaving 1/4" to 1/2" all the way around the edge for strength. Then with your screwdriver, remove the foam in these areas as well. This will increase the size of your radio compartment and remove some unneeded weight.



Pushy Cat .40-.50 PUSHER
(Sport Scale Pylon Racer)
Material List

Balsa Sheet:
2 — 3/16" x 4" x 36" (fuselage sides, misc.)
2 — 1/4" x 3" x 36" (fuselage bottom, rudder, wingtip blocks)
1 — 3/8" x 3" x 36" (elevator halves, wingtips)
14 — 1/16" x 3" x 36" (wing and stabilizer sheeting)
1 — 3/32" x 4" x 36" (canopy decking and formers)
2 — 1/8" x 4" x 36" (wing ribs)

Balsa Sticks:
2 — 3/4" x 36" triangle stock (fuselage)
1 — 1/2" x 36" triangle stock (fuselage, misc.)
1 — 1/4" x 3/8" x 36" (vertical stabilizer)
1 — 1/2" x 3/8" x 36" (vertical stabilizer)
2 — 1/4" x 3/4" x 36" (wing leading edge)
7 — 1/4" x 1/4" x 36" (wing spars, horizontal stabilizer)
2 — 1/8" x 1/4" x 36" (wing spars)

Spruce/Hardwood:
1 — 1/4" x 1/2" x 48" spruce (wing spar)
2 — 1/2" x 1" x 6" hardwood landing gear blocks
1 — 3" x 1/4" dia. dowel (wing and canopy)

Plywood:
1 — 1/8" x 12" x 12" aircraft ply (bulkheads, wing mounts, rib doublers)
1 — 1/4" x 6" x 12" aircraft ply (fire wall, wing mounts)

Servos:

The rudder servo is mounted directly to the front mount in the wing. The arm of the servo should be in line with the lower pushrod exit in the vertical fin.

The elevator servo needs two pieces of 1/4" thick spruce or scrap 1/4" ply to rest upon. This will place it in line with the upper pushrod exit.

Flying:

Check the airplane's balance front to back **and** side to side. If a retract servo has been installed, you will probably need very little added weight at the nose, if any. Due to the large radio compartment the battery pack can be moved far forward to help with

Miscellaneous:
1 — .40-.50 engine and mount
1 — Perry regulator pump
1 — Fox 3/4" prop shaft extension
1 — Du-Bro 2½" spinner
1 — Slimline sport scale muffler
1 — 10 oz. fuel tank
1 — 3 ft. fuel tubing
1 — 36" blue NyRod (throttle pushrod)
2 — 36" red NyRod (elevator and rudder pushrods)
2 — 1/4" dia. nylon wing bolts
12 — medium size hinges
1 — 3/16" x 36" music wire (main landing gear)
4 — Nylon landing gear straps
2 — 2½" wheels (main gear)
1 — 1¾" wheels (nose wheel)
1 — Nose wheel strut and mount
4 — Control horns
1 — Sig 16" canopy
1 — 1/5 scale pilot figure
1 — Set of aileron linkage (music wire or NyRod)
1 — Dual ball link (at aileron servo)
2 — Aileron bellcranks
1 — 1/4" wide x 60" carbon fiber laminate
1/2 — Square yard heavyweight fiberglass (6 oz.)
2 — Square yard lightweight fiberglass (.58-.75 oz.)
CA glue
Wood glue
5-minute epoxy
Laminating or 30 minute epoxy
Construction foam
Caveat — This list is not meant to be all inclusive. Other miscellaneous items will be needed, e.g., blind nuts, machine screws, radio equipment, paint or MonoKote, etc.

balancing. Otherwise add weight where needed.

Make sure that your engine is running properly. There is nothing fun about a dead-stick on the initial flight of any plane.

With the plane properly balanced and the engine properly tuned, there shouldn't be any surprises on your first flight other than minor trim adjustments. Remember, this is a fairly easy plane to fly — just a little faster than what you may be used to.

Landing is usually the biggest challenge to flying any plane. The Pushy Cat will not float like a trainer on final approach — so keep a fair amount of airspeed and keep the nose up when landing.

At high speed the Pushy Cat is nothing but a thrill. The relatively large amount of fuselage side area lets this plane do wide knife-edge turns with very little loss of altitude. And at a distance the Pushy Cat looks very much like a jet in flight. While not highly acrobatic, rolls, loops, and inverted flight are no problem.

Bad things can happen to good planes though. During the construction of version 2, version 1 had a mishap on its 15th flight. But, not because the plane was tricky to fly. It was my fault. My plane had a flame-out on a high speed, knife-edge turn, about eight feet above the ground. I had gotten performance greedy and tuned the engine a little too lean. Ah, another lesson learned the hard way.

What Else?

While flying the Pushy Cat, I have had visions of a .60 size engine crammed into the engine compartment for even more thrills. Now I haven't tried this so beware. The airframe is not built to handle quite that much engine. But with some carbon fiber on the main wing spar and a beefed-up fire wall . . . I think it could be done! Why not? Hey, this sport is supposed to be a challenge, right? And if you think about it, every plane we build is experimental prior to its first flight. Good luck and have fun building.

P.S. — Special thanks to Robert Gordon for his expert test pilot skills for the first flight of Pushy Cat versions 1 and 2. □

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