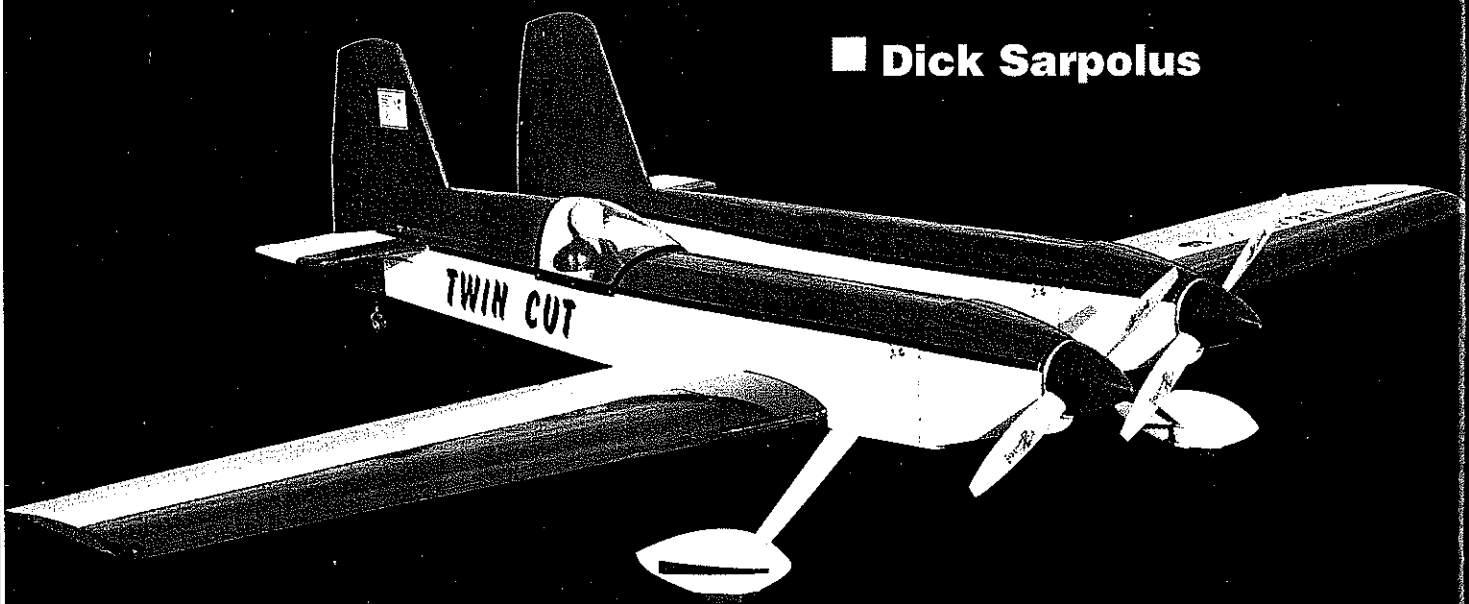
Twin Cut

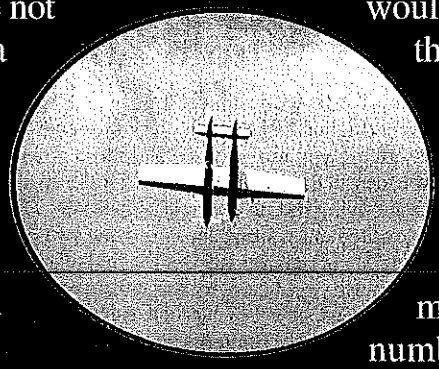
■ Dick Sarpolus



Not your ordinary twin-engined layout

TWIN CUT was begun because I like twin-engined aircraft and I like gasoline engines. I also wanted to try the new Cheetah 42 engine with its interesting C.H. Electronics Jump Start feature; easy starting engines would be an advantage in a twin.

My first design thoughts were not promising; I only wanted to do a twin if it would be a good aerobatic performer, not complex, and easy to build, but also not so large that it would be a storage and transportation problem. My one previous twin gas-engined project was a Nick Ziroli DC-3; it was impressive and flew great, but I didn't want another 43-pound aircraft that barely fit in my minivan. My new twin would have to be easier to move around.



In a smaller size, it's quite easy to put two engine nacelles on a wing, use a conventional fuselage with a rounded-off nose, and have a good twin. But when the engines are 42cc gas/ignition types with their weight and bulk, the nacelles get pretty big and heavy, and the wing center section has to be beefed up to support them. Then plug-in outer wing panels would be needed, further complicating the wing structure. For this project I didn't want to go with two nacelles on a 3-piece wing.

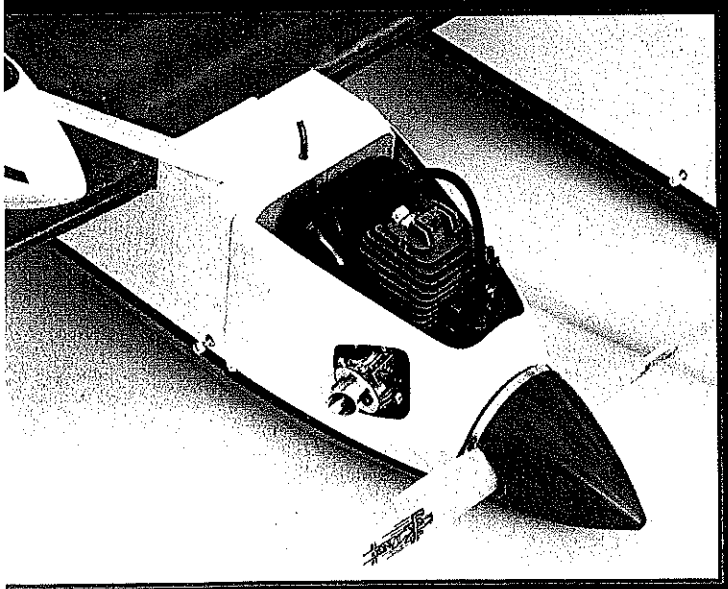
I considered a twin-fuselage layout like the P-82 Twin Mustang. Again, modelers have done this with a number of different aircraft and there is even a Twin Sukhoi kit on the market in a smaller size.

This was more promising; the next move was to see how close together the fuselages could be located, while providing clearance between the two propellers. First

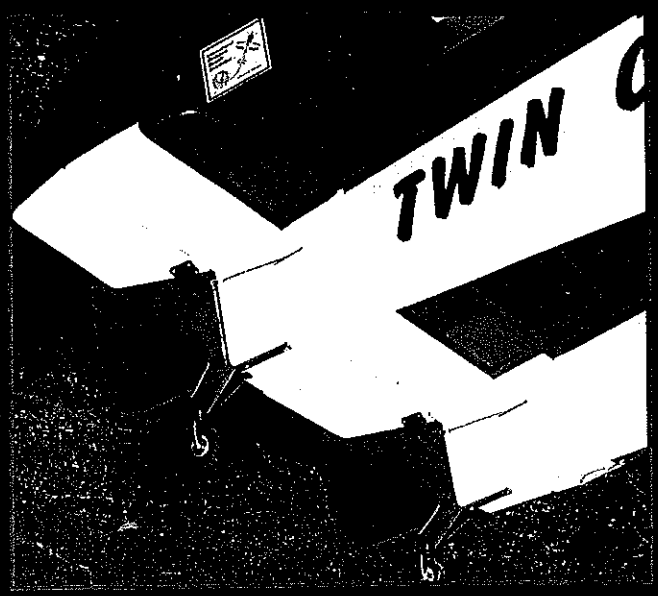
lculations showed the rcraft would still be rger than I wanted. But wait! What if he engine was cated behind the other, e fuselages moved closer gether, and the propellors ermitted to *overlap?* This as done years ago on an xperimental twin Cub, and utan has done something ke it on his new volutionary asymmetrical vin, the Boomerang. Another idea—Rutan has nown an aircraft layout oesn't have to be mmetrical, so why not ake the twin fuselages fferent? Only one needs a ockpit for the pilot. This ing could look like a fairly dical racing aircraft, or a y at a twin-engined erobatic aircraft.

Author is six feet, two inches tall, and Twin Cut still looks big—longer fuselage is 70 inches in length. Wing area 1,660 square inches on a 104-inch span.

Photos courtesy of the author Graphic Design by Carla Kunz



vo Cheetah 42 gasoline/ignition engines beneath fiberglass cowls. ops are 18 x 10s. C.H. Electronics Jump Start.



Each Twin Cut fuselage has a leaf-spring tail wheel assembly, coupled with springs to each of the twin rudders.

My layout work continued, to keep the wingspan as small as possible and still have sufficient wing area for a reasonable wing loading. The fuselage centerlines, if set at 16 inches, would let the usual 18-inch props overlap by two inches. Seemed reasonable. I've settled on six-inch-wide fuselages as about as narrow as practical when using the gas engines.

The center wing section would be constant chord, with tapered tip panels. I wanted an easy to build one-piece wing. I checked the minivan and figured it would accommodate a 104-inch wing without too much trouble. The two fuselages and removable center stabilizer section wouldn't be a problem.

The longer fuselage would be about 70 inches overall, and the second fuselage would have a four-inch-shorter nose. Overall proportions, the airfoil, and the moments are about typical for a sport/aerobatic aircraft; I didn't think the design represented too much risk. My usual preferred construction: foam core wing, foam core fuselage top blocks, foam core tail surfaces.

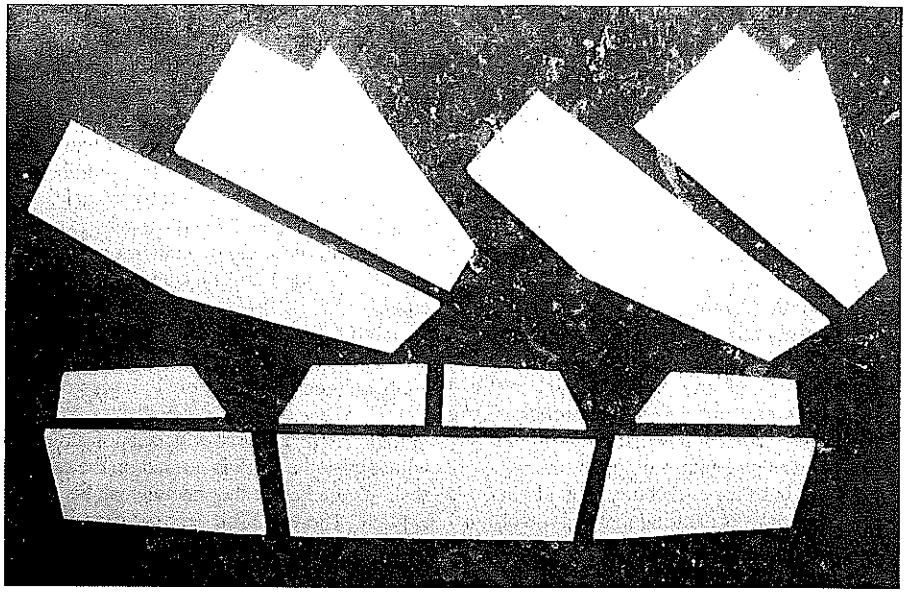
A sheet aluminum landing gear cut in two would be easy, along with two tailwheel assemblies. Suitable fiberglass cowls, wheel pants, and a plastic canopy are available from Fiberglass Specialties.

For the radio gear installation, there would be an aileron servo in each outer wing panel. Each fuselage would have a throttle servo, elevator servo, and rudder servo, linked by extended Y harnesses to the receiver in one fuselage. There would be a steerable tail wheel on each fuselage, linked to its rudder. For equal elevator loads, I planned to use a Y pushrod from each elevator servo to drive the two elevator sections from each fuselage. The removable center stab section would have its elevator in two pieces. This all worked out fine.

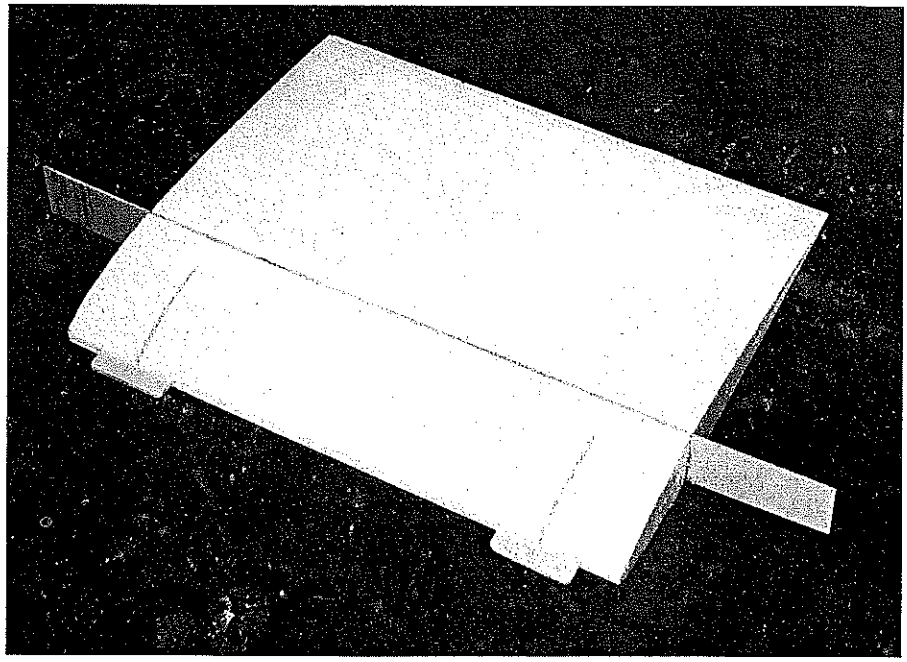
Construction of the prototype went fairly quickly, but after building two fuselages and tail sections, I was thinking that I could have had two complete aircraft by that time. I liked the appearance of the completed Twin Cut but had a few doubts about its flying qualities. Comments from club members who saw the airplane before it was finished were not all encouraging; some felt I'd lose a few fingers starting the engines and wouldn't be able to test fly it.

I feel that the engine starting is not particularly dangerous; extreme care is called for, as with any aircraft. I prime both engines, start up the rear engine first, and then the forward one. The Cheetah 42 engines are easy starting. When starting the forward engine with its prop positioned vertically against compression, my fingers are definitely not within the arc of the other prop and are also ahead of the other prop. An electric starter would of course make the procedure even safer.

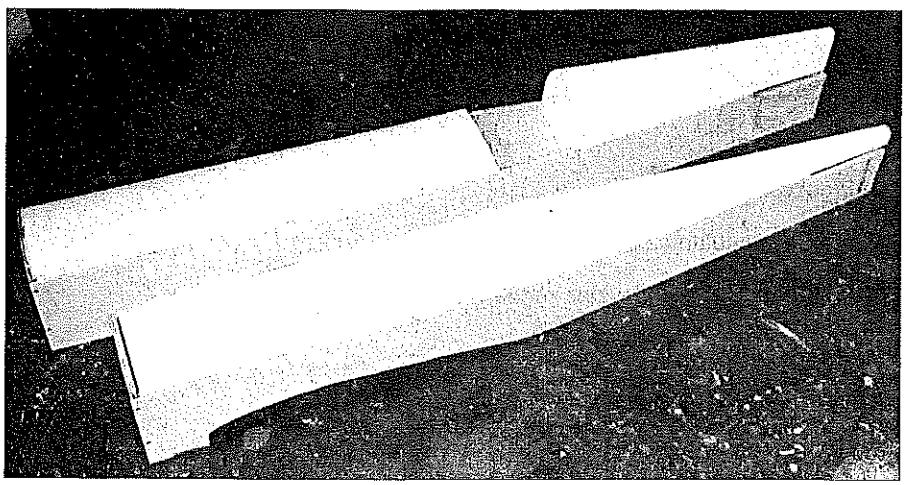
The model was completed in time for a January test flight; not very good planning. We lucked out with some unusually warm but breezy weather, and the test flights went



Foam core tail-surface parts are cut from ⅜ thick foam sheets.



Wing center section with full-depth plywood spar glued in place. Partial plywood ribs also glued in, and plywood wing mounting tongues are in place.



Fuselage assemblies with foam cores placed on top, prior to sheeting.

off smoothly. It was quickly apparent that the Twin Cut flew smooth and steady, with plenty of power from the two new Cheetahs. In rolls and loops it responded quickly and positively; the two-fuselage configuration didn't seem to hinder aerobatic performance.

During the first two flights, I put the airplane through about everything I could think of—loops, rolls, snaps, spins, stall turns, low inverted passes, etc. Now, I'm sure not doing competition-class maneuvers these days, but the airplane looked good to me. It did everything I wanted it to do, was very stable and groovy, and is as easy to fly as any equivalent single-engine aircraft.

But the Twin Cut has that twin-engine sound; it was just what I'd hoped for.

A twin isn't for everybody; but a twin-engined aircraft is exciting and fun—worth a bigger investment!

CONSTRUCTION

There's quite a bit of foam cutting to be done, with the wing cores in three sections, the top blocks for two fuselages, and the foam sheets for the tail surfaces. I receive quite a few requests for sources for foam core cutting, and while there are a number of custom cutters advertising in the model magazines, I encourage anyone who expects to be scratch-building to do their own foam cutting. I think it's a quick and easy way to build.

Patterns for the templates to be used for the cutting are shown on the plans; the templates can be made from thin plywood.

Wing: There are three wing sections to deal with, and some work is needed on the center section core before the sheeting can be applied. There is a full depth ⅛ plywood spar in the center section to strengthen it and reinforce the two dihedral joints. The plywood piece is epoxied between the front and rear parts of the core; the two outer sections will be epoxied to the center section after all are sheeted.

There are two slots cut into the leading edge of the center section for the ⅛ plywood partial ribs used to support the ¼ plywood wing mounting tongues. Epoxy the plywood partial ribs in place and cut the slots for the mounting tongues; they will be glued in place after the wing sheeting and leading edges have been added to the core.

On the two outer sections, cut slots into their root ends for the plywood spar and sand the ends to accommodate the dihedral angle where the cores are joined; it's easier to sand that angle before the sheeting is on. The tips should be cut off at an angle before sheeting so they can be easily trimmed later to add the tip sheeting.

Before sheeting, the holes through the cores for the aileron servo leads and the servo connection leads between the two fuselages must be put in. To make those tunnels, I heat the end of a piece of ¼ wire and push the heated end through the foam core. The tunnel through the wing center section should be enlarged to accept the servo leads going between the fuselages.

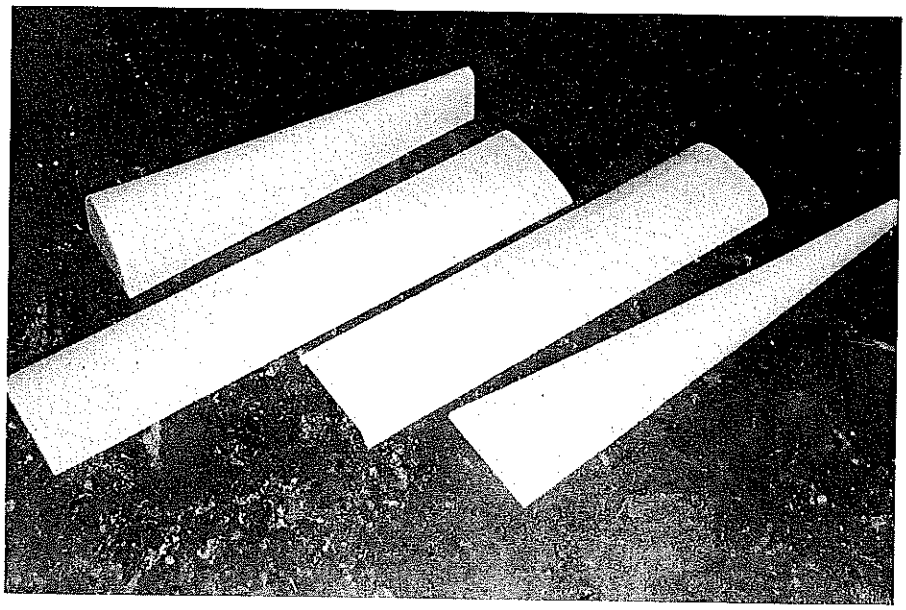
The wing panels are sheeted with medium 3/32 balsa, edge-glued as necessary for the width. I prefer the aliphatic-resin type woodworking glues for the joining; I think they are easier to sand for a smooth joint.

I sand the inside surface of the sheeting with rough sandpaper to speed up the work, and use fine sandpaper to finish off the outer surface. I strongly recommend Dave Brown's Southern Sorghum contact cement to apply the sheeting to the cores.

With the cores sheeted top and bottom, trim off the leading edge overhang and block-sand it square. Add an oversized balsa leading edge strip. I use five-minute epoxy to speed up the work, and plane and sand it to shape. Trim and sand the sheeting to match the cut off tip angle, and add the tip sheeting; round the edges slightly.

The ailerons are cut from the sheeting wing panels and trimmed down to allow for the balsa edging, which is glued in place and sanded to shape. Hinge the ailerons along the centerline, using large, sturdy, freely moving hinges of the type you prefer. Keep the gap between the aileron and wing as tight as possible while still permitting full movement of the aileron. Don't glue the hinges in place now; that will be done after the covering has been applied.

Recesses are cut into the bottom wing surface for the aileron servo mounting. Epoxy plywood mounting pieces into position in the wing to suit your servos, having the servos protrude from the wing surface just far enough for hookup of the aileron pushrods. A hole is needed through the foam core from the root to the aileron servo location, for the servo



Fuselage top pieces are cut to shape with hot wire over templates at block ends.

Twin Cut

Type: RC Sport

Wingspan: 104 inches

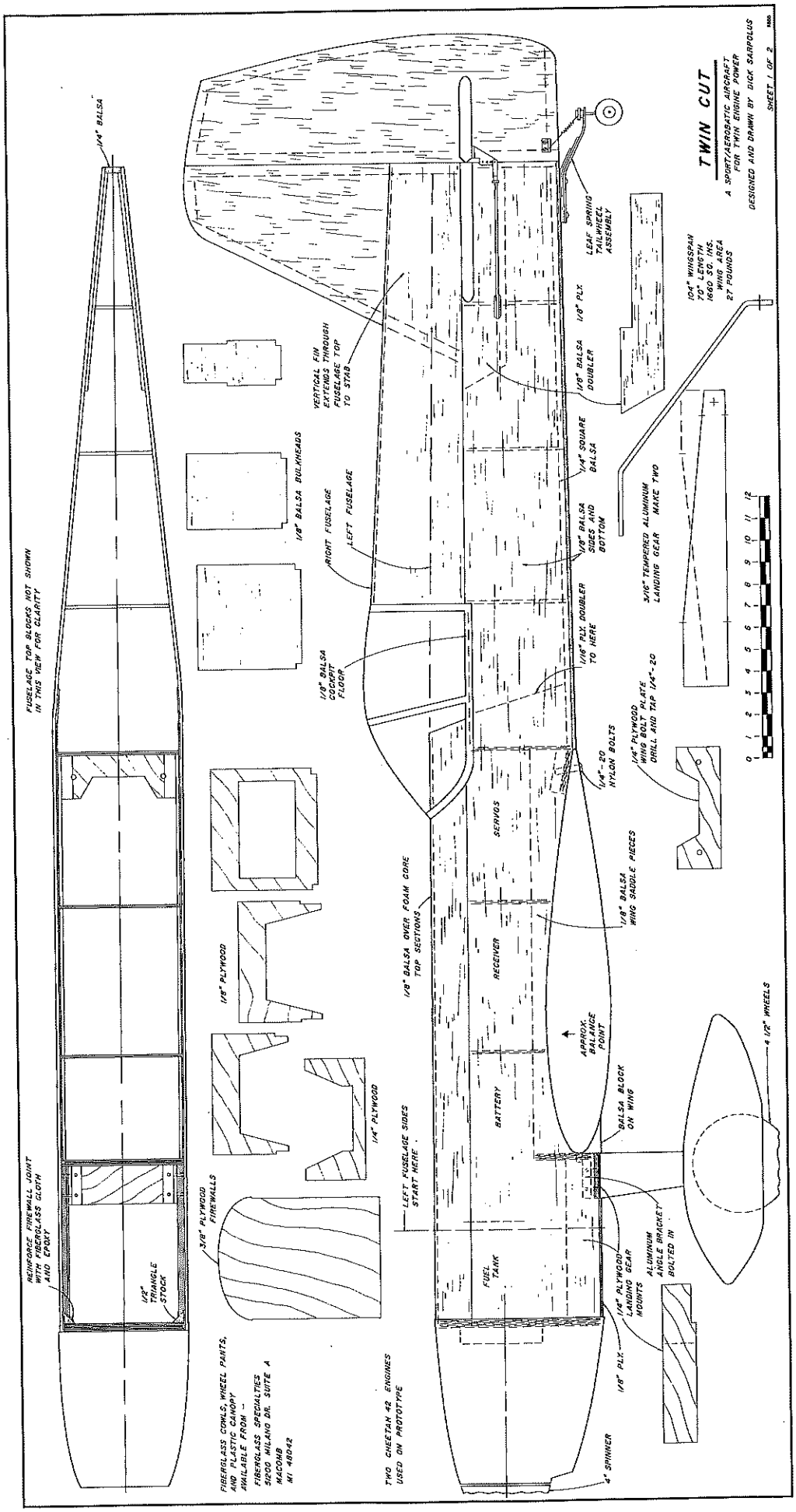
Engines: Cheetah 42s

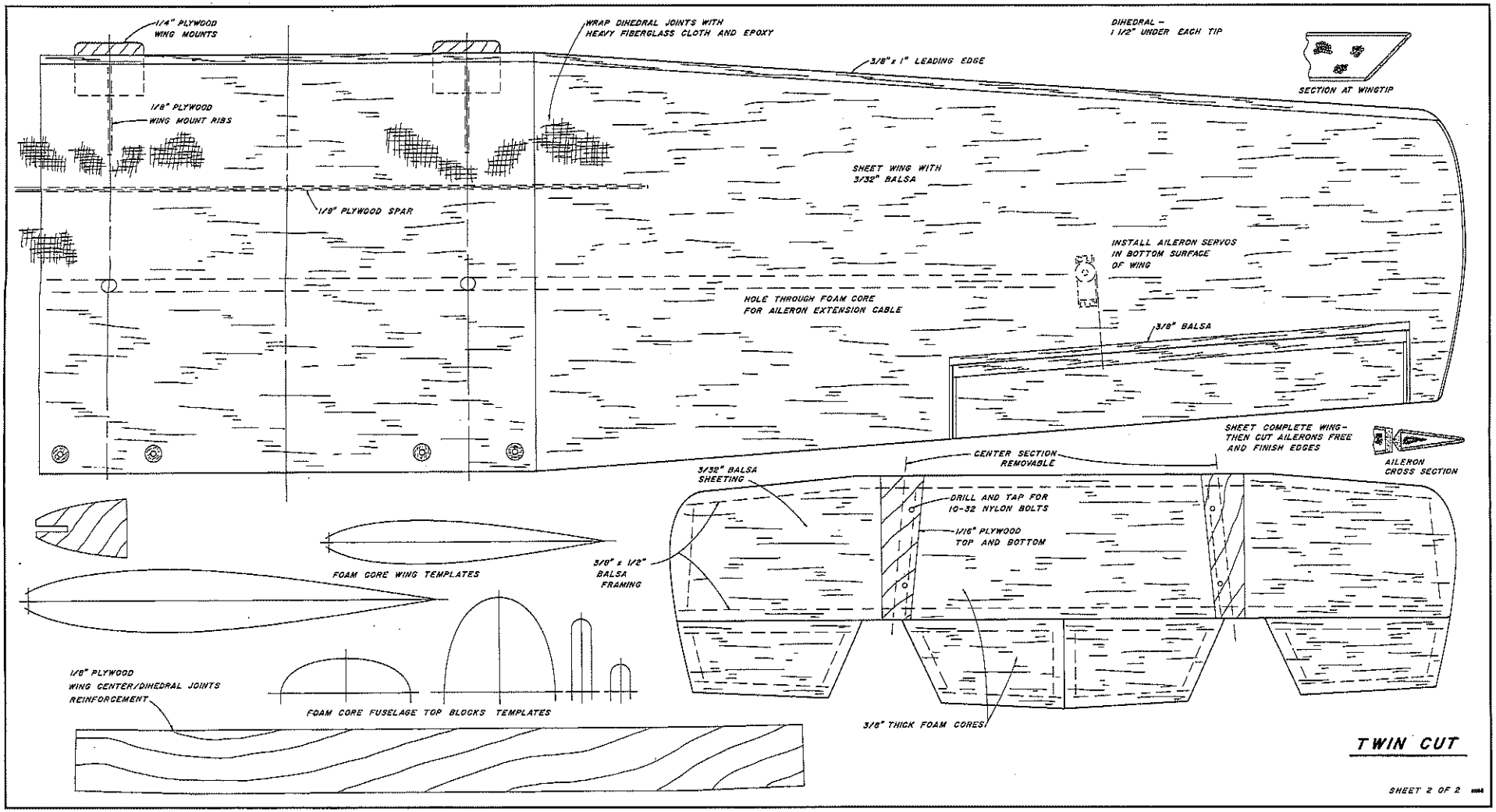
Functions: Throttle, elevator, rudder, ailerons

Flying Weight: 27 pounds

Construction: Balsa and foam

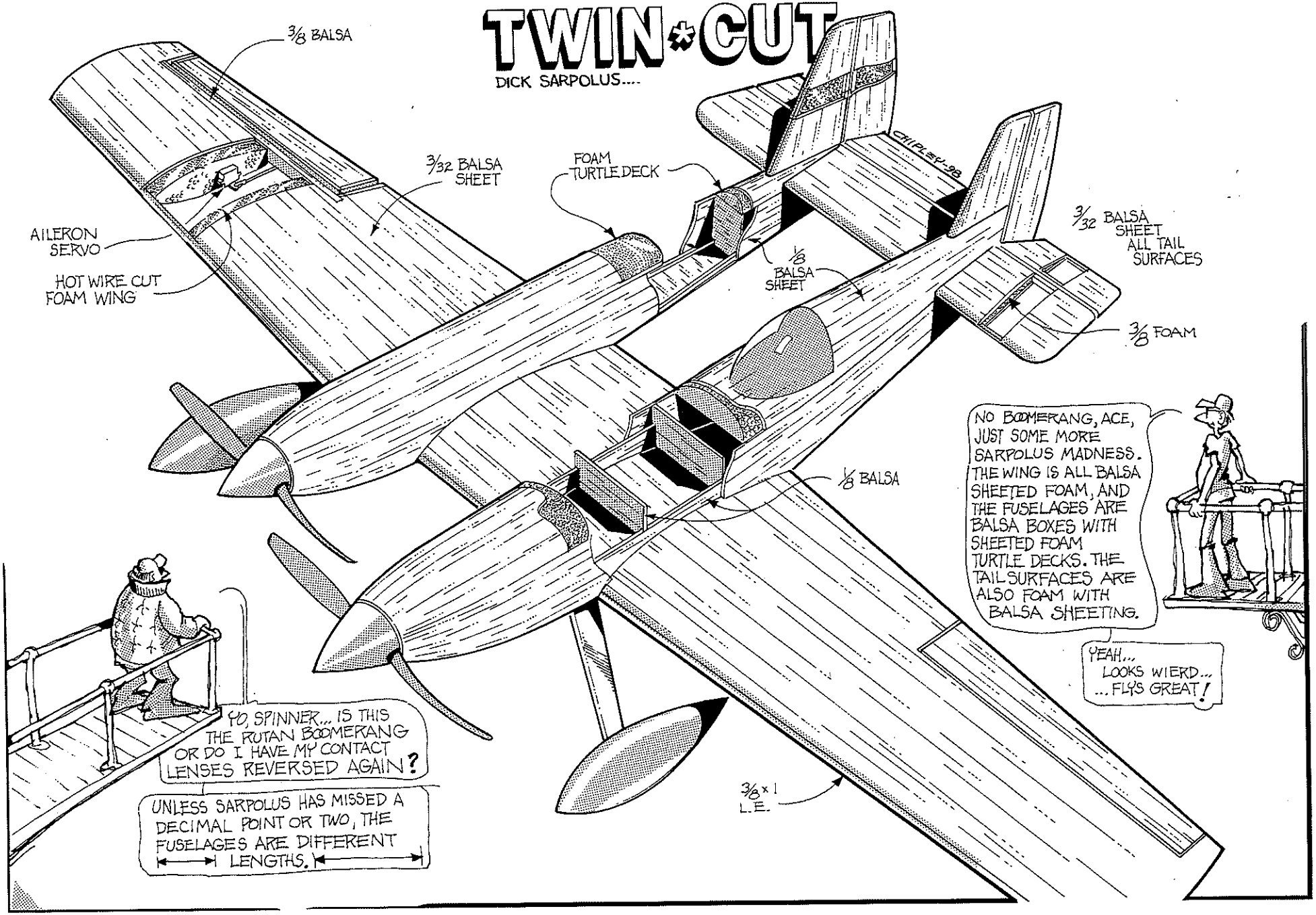
Covering: Film


TWIN CUT
A SPORT/AEROBATIC AIRCRAFT
FOR TWIN ENGINE POWER
DESIGNED AND DRAWN BY DICK SARPOLUS
SHEET 1 OF 2
104" WINGSPAN
72" LENGTH
1600 SQ. INS.
WING AREA
27 POUNDS
FUSELAGE TOP BLOCKS NOT SHOWN
IN THIS VIEW FOR CLARITY
1/4" BALSA
REINFORCE FIREWALL JOINT
WITH FIBERGLASS CLOTH
AND EPOXY
1/2"
TRIANGLE
STOCK
3/8" PLYWOOD
FIREWALLS
FIBERGLASS COWLS, WHEEL PANTS,
AND PLASTIC CANOPY
AVAILABLE FROM -
FIBERGLASS SPECIALTIES
31200 WILAND DR. SUITE A
MACOMB
MI 48042
TWO CHEETAH #2 ENGINES
USED ON PROTOTYPE
1/8" PLYWOOD
1/4" PLYWOOD
LEFT FUSELAGE SIDES
START HERE
1/8" BALSA OVER FOAM CORE
TOP SECTIONS
FUEL
TANK
BATTERY
RECEIVER
SERVOS
1/8" BALSA BULKHEADS
RIGHT FUSELAGE
LEFT FUSELAGE
1/8" BALSA
COCKPIT
FLOOR
VERTICAL FIN
EXTENDS THROUGH
FUSELAGE TOP
TO STAB
1/8" PLX DOUBLER
TO HERE
1/8" BALSA
SIDES AND
BOTTOM
1/4" SQUARE
BALSA
1/8" BALSA
DOUBLER
1/8" PLX
LEAF SPRING
TAILWHEEL
ASSEMBLY
3/16" TEMPERED ALUMINUM
LANDING GEAR MAKE TWO
1/4" - 20
NYLON BOLTS
1/4" PLYWOOD
WING BOLT PLATE
DRILL AND TAP 1/4" - 20
1/8" BALSA
WING SADDLE PIECES
APPROX.
BALANCE
POINT
BALSA BLOCK
ON WING
1/4" PLYWOOD
LANDING GEAR
MOUNTS
ALUMINUM
ANGLE BRACKET
BOLTED IN
1/8" PLX
4" SPINNER
4 1/2" WHEELS
0 1 2 3 4 5 6 7 8 9 10 11 12


1/4" PLYWOOD WING MOUNTS
WRAP DIHEDRAL JOINTS WITH HEAVY FIBERGLASS CLOTH AND EPOXY
DIHEDRAL – 1 1/2" UNDER EACH TIP
3/8" x 1" LEADING EDGE
SECTION AT WINGTIP
1/8" PLYWOOD WING MOUNT RIBS
SHEET WING WITH 3/32" BALSA
1/8" PLYWOOD SPAR
INSTALL AILERON SERVOS IN BOTTOM SURFACE OF WING
HOLE THROUGH FOAM CORE FOR AILERON EXTENSION CABLE
3/8" BALSA
SHEET COMPLETE WING– THEN CUT AILERONS FREE AND FINISH EDGES
AILERON CROSS SECTION
CENTER SECTION REMOVABLE
3/32" BALSA SHEETING
DRILL AND TAP FOR 10-32 NYLON BOLTS
1/16" PLYWOOD TOP AND BOTTOM
3/8" x 1/2" BALSA FRAMING
FOAM CORE WING TEMPLATES
1/8" PLYWOOD WING CENTER/DIHEDRAL JOINTS REINFORCEMENT
FOAM CORE FUSELAGE TOP BLOCKS TEMPLATES
3/8" THICK FOAM CORES
TWIN CUT
SHEET 2 OF 2

TWIN*CUT

DICK SARPOLUS....



extension cable. To melt the tunnel, again use the heated end of a piece of ¼ metal rod.

The plywood wing mounting tongues are used at the wing leading edge to position and retain the fuselages on the wing. Done this way, the contact area of the fuselage bulkhead retaining the wing mount can be trimmed or shimmed as necessary to get the correct wing-to-fuselage fit. When adding the outer wing panels to the center section, I used 1½ inches of dihedral under each wingtip.

Epoxy the wing panels together, sliding the tip panels over the dihedral brace protruding from the center panel. I wrap the dihedral joints with heavy fiberglass cloth and epoxy for plenty of strength. I used a 12-inch-wide length of cloth around each wing joint; probably overkill, but I've never had a wing break with this type of construction.

I also used a six-inch-wide strip of cloth around the leading edge of the center section, between the two fuselages, for more insurance. I brush on a coat of slow-drying epoxy, position the fiberglass cloth, and brush on more epoxy to be sure the cloth is saturated. To get the excess epoxy off for a smooth finish and to save weight, I squeegee off the epoxy with a piece of cardboard, leaving enough so the cloth is soaked for strength, but smooth and level.

Fuselages: The fuselages are basically the same, except for the shorter nose section on the left fuselage. Select firm-to-hard balsa for the sides, edge-gluing and splicing as necessary. Glue the 1/16 plywood doublers, ¼ plywood landing gear mount doublers, balsa wing saddle pieces, stab saddle doublers, and balsa rear lower edge strips to the fuselage sides. I used ⅜ plywood firewalls, laminating ¼ and ⅛ plywood.

With one fuselage side flat on the workbench, add the firewall and the next four bulkheads, installing them perpendicular to the side. Glue the second side to those bulkheads; the sides are parallel from the firewall to the wing trailing-edge position. Add triangle stock and heavy fiberglass cloth behind the firewall to reinforce its joint with the sides; I also put several small screws into the firewall through the fuselage sides.

Add the ¼ plywood wing bolt plate and ¼ plywood landing gear mount, then pull the tail end together, installing the rear bulkheads. Be sure that the fuselage sides taper in a straight line to the rear, so the straight-cut foam rear top blocks will fit correctly.

Trial-fit the rear top block as you install the bulkheads; they can be trimmed or moved so the block fits well. The foam block can also be sanded on its edges for a good fit, before it is sheeted. Check to see that when sheeted they will line up flush with the lower fuselage assembly.

Sheet the fuselage top foam blocks as was done with the wing cores. Trim the sheeting and glue the top blocks in place on the fuselages. I used a high rear top block and plastic canopy only on the right fuselage, with a low top block on the left fuselage, for the asymmetrical appearance.

The plywood landing gear mount is epoxied into the fuselage, and you can add some hardwood blocks inside where the holes will be drilled and tapped for the nylon gear retaining bolts to provide more wood for the threaded bolt holes. I also use an aluminum right angle bracket on each side of the gear mount, bolting it to the gear mount and through the fuselage sides. With an airplane of this size and weight, I believe that epoxy alone won't hold the gear mount in place during a rough landing. We want the nylon gear retaining bolts to break when appropriate—not pull out a section of the fuselage.

I mounted the engines on a ¾ thick plywood spacer ring to provide clearance for the stock Cheetah mufflers. I use 10-32 Allen bolts through the engine mount, with blind nuts on the rear side of the firewall, so the engine can be removed from the front of the aircraft without having to get inside the fuselage.

After the engine mounting is done and the holes are drilled through the firewall for the fuel tubing, throttle linkage, and ignition wiring, the plywood forward bottom piece can be glued to the fuselage, the lower front corners rounded, and the fiberglass cowls trimmed to fit. I leave the rear fuselage bottom planking off until the tail surfaces are added, so I can cut the holes in the rear bulkheads for the elevator and rudder pushrods.

Tail Surfaces: The tail surfaces are built from ⅜ thick cut sheets of foam, with ⅜ by ½ balsa edging and reinforcing added before sheeting the cores with 3/32 balsa just as with the wing cores. The horizontal stab is made in three pieces, so the center section can be easily installed and removed. 1/16 plywood tabs on the top and bottom of the fixed stab sections accept the removable center section; two 10-32 nylon bolts on each side retain the stab center. Hardwood blocks are installed in the ends of the center section where the nylon bolts will go.

The elevators are made in four sections, the two elevators on each side driven by one elevator servo in each

fuselage with a Y pushrod. Cut the slots or drill the holes along the center lines of the surfaces for whatever hinge type you're using, and notch the control surfaces as needed to permit a close fit of the surfaces to the main structure, allowing proper movement. I use ¼ plywood pads for the control horn mounting, recessing and epoxying the plywood into the elevators and rudders. The horns are mounted with self-tapping screws.

Each fuselage has a leaf spring tailwheel assembly, mounted on ⅛ plywood in the fuselage bottom, and linked by coil springs to the rudder. There is a rudder servo in each fuselage, and a throttle servo in each fuselage. Servo extension cables through the wing center section connect the two elevator servos, two rudder servos, and two throttle servos via y-harnesses to the receiver in the left fuselage.

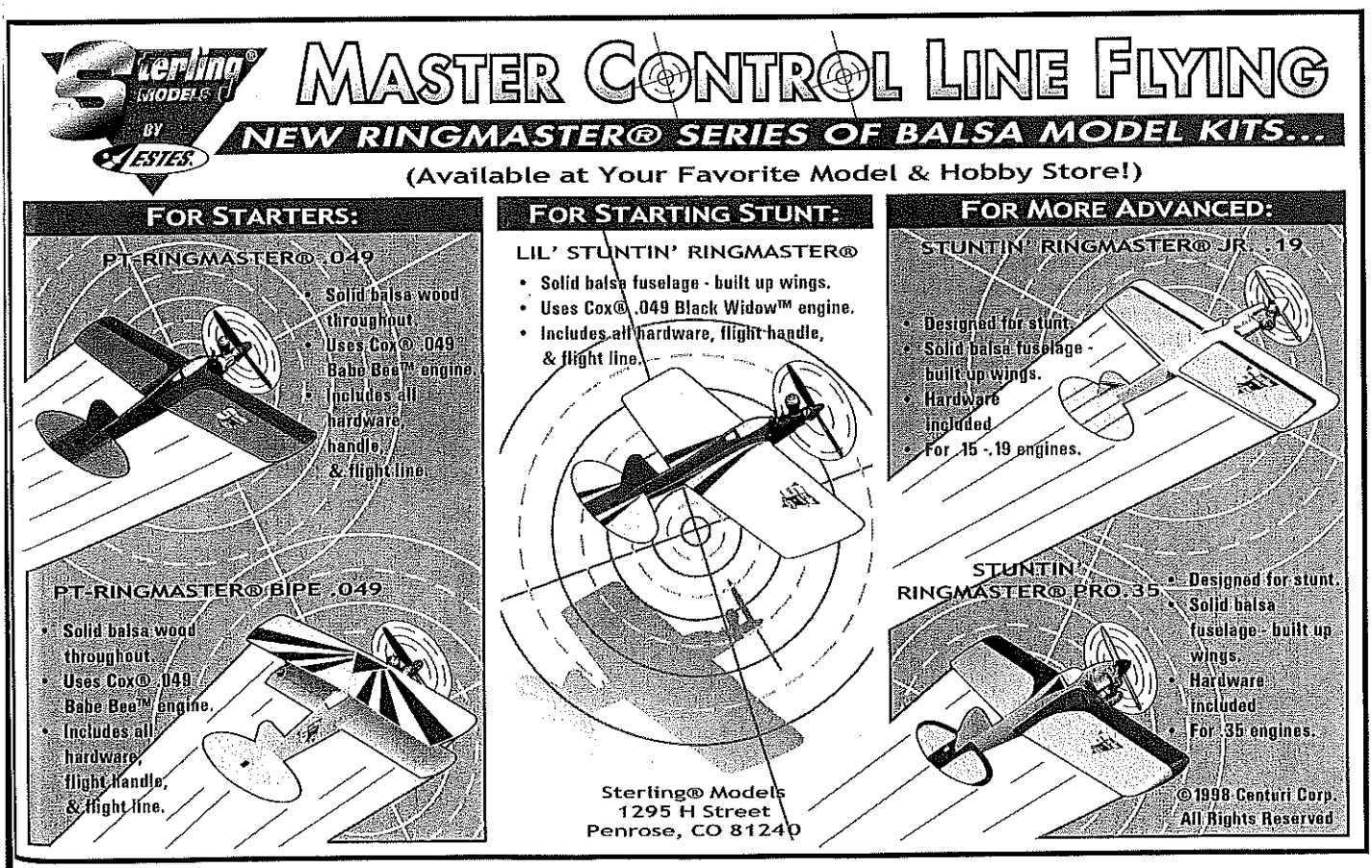
I fit the fuselages to the wing next, adjusting the fit of the wing mounting tongues as necessary through the fuselage bulkhead, and drilling and tapping the wing mount plates for the two ¼-20 nylon bolts that hold each fuselage in place. Adjust the fit of the two fuselages so the horizontal stab will be parallel to the wing center section.

With the wing mounted to both fuselages, I add the horizontal stab with it bolted up as one piece, aligning it with the wing. Glue both outer stab sections securely to both fuselages; done this way, the stab center section will be easily removable and will go precisely into place. The vertical fins are added, perpendicular to the stabilizer.

I use ¼ plywood for the servo mounts in the fuselages, and fiberglass tube pushrods for the elevators and rudders, along with all 4-40 threaded rods and clevises. Y harnesses and extension cables are used as needed for the radio hookup. I color-coded the servo leads and extensions with dots of paint to make the hookup easy when assembling the aircraft. A 1,200 mAh battery pack was used, wrapped well in foam.

The fiberglass cowl is cut to clear the cylinder and the carburetor air intake; the muffler, right behind the cylinder, exits straight down toward the ground. The stock muffler that comes with the Cheetah 42 engine works quite well; if you really need a lower noise level, I'd suggest using a higher pitch prop and running the engine slower.

The interesting ignition system that comes with the Cheetah 42 is a Jump Start made by C&H Electronics; only an electronic module is carried in the aircraft, not a battery pack. The Jump Start is only used when starting the engine; an external battery pack is plugged into a jack mounted on the side of the fuselage, the switch put in the start position, and the ignition module retards the spark timing for easy, safe starting. When the engine is running, the switch is flipped to the run position, the battery pack unplugged, and the engine continues to run on its own magneto



ignition setup. The engines start quite easily and never kick back when starting.

Four-inch spinners are required; I use the CB units. The fiberglass wheel pants are mounted to the axles on the landing gear with Sig's nylon brackets. While a conventional sheet aluminum landing gear could be cut in half and each half mounted to one of the fuselages, I had the opportunity to try a molded epoxy composite landing gear on my Twin Cut. The gear was made by fellow modeler Bill Koster of Lake Havasu City AZ. He made a conventional gear; I cut it in half for use on the Twin Cut, holding each gear leg in place with four ¼-20 nylon bolts.

I covered my model with the usual iron-on plastic film finish, trimmed with the aircraft name and my AMA number in computer-cut vinyl by Vinylwrite Custom Lettering. The fiberglass cowl and wheel pants were painted with spray cans; quick and easy.

Flying: Before the first flight, we took our time starting and adjusting each engine separately. We adjusted the carburetor setting on each engine for a reliable idle, and adjusted the top end slightly rich as the engines were brand new. After considerable experience with twin- engined aircraft, I set up each engine with a tach to about the same speed—and then I don't touch either engine after both are running, even if they're not in perfect sync. It's much more important that each engine is running well, and reliably; they don't have to be at exactly the same rpm. With the two Cheetah 42s each turning an 18 x 10 prop, I figured there would be plenty of power, even at a slightly rich setting, in this 27-pound aircraft; there was.

That twin-engine sound made it all worthwhile. I like different aircraft, but only if they perform well and are practical; Twin Cut does the job for me. ✈

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