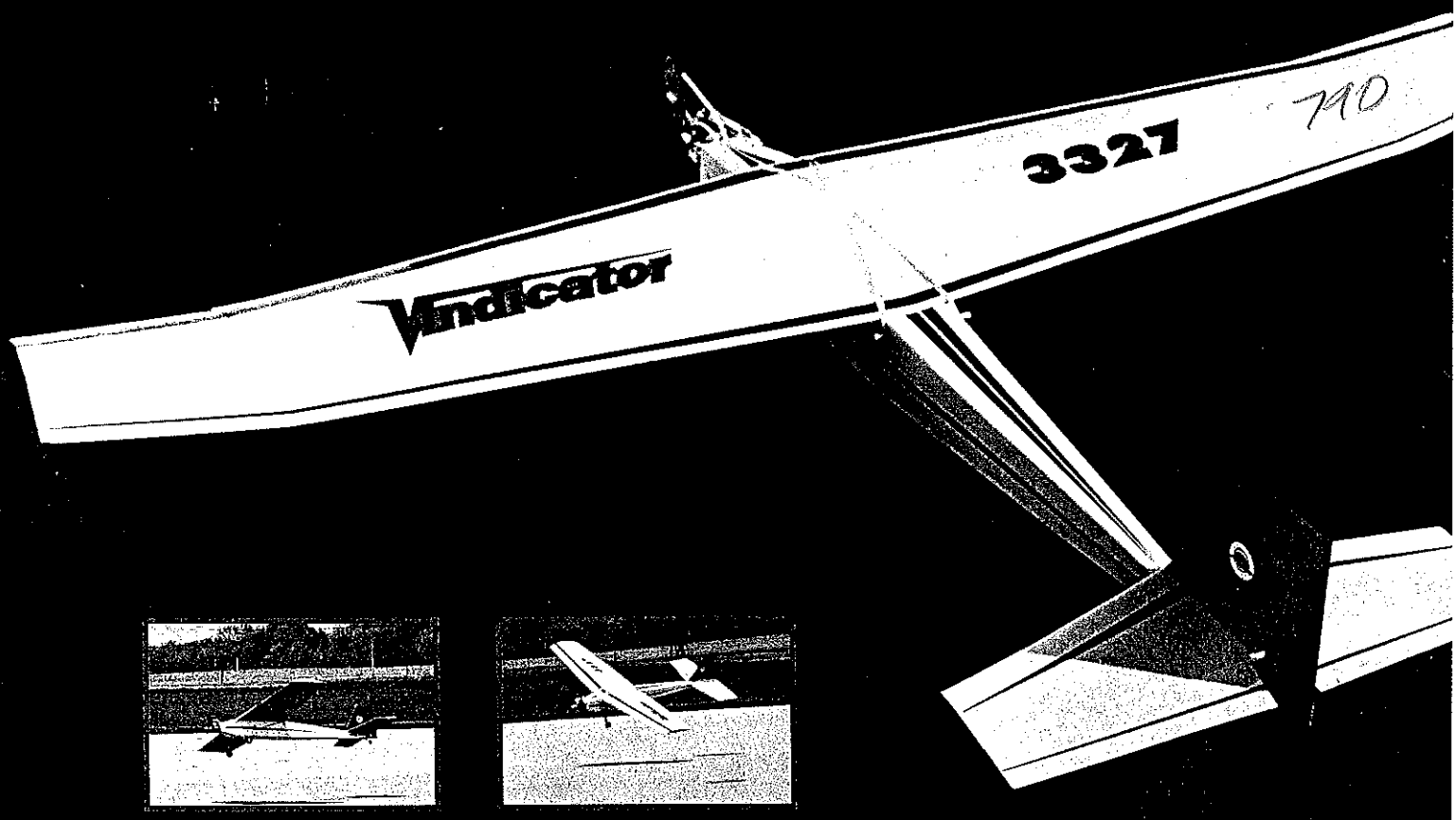
Vindicator

Easy-building second-step model with two flight modes

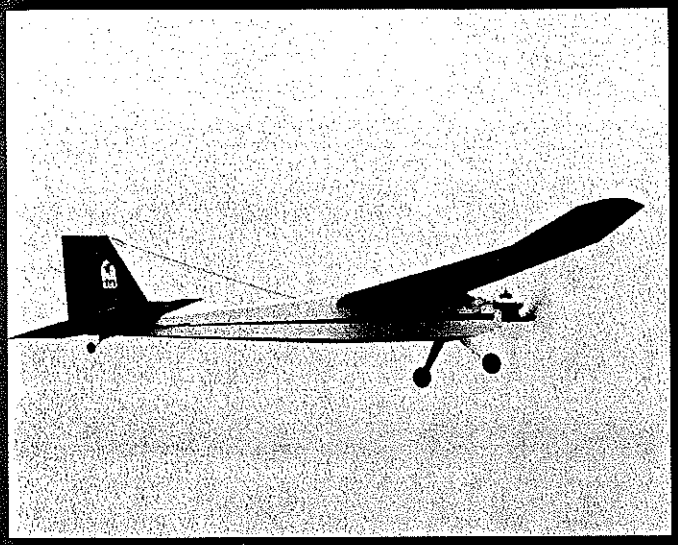


"Hey, aren't you that free flight *guy?"*

Well, it's like the commercial: *"Yes, I am."* Flown FF since before I can remember. Eastern VP for the National Free Flight Society, and all that. But I've built and flown all types of models.

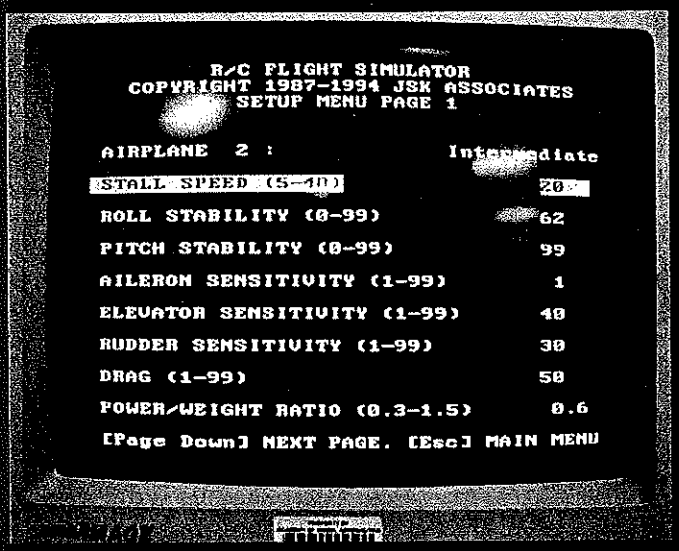
"But what do you know about RC?"

The Vindicator was born of such conversations. I flew some Two-Meter sailplanes in the late 1970s, but



Long-wing version on flyby. Tee Dee .09 has plenty of power, but in this mode Vindicator will float with power off.

Short-wing version at rest on the runway at Muncie. Hoerner tip blocks help efficiency and improve appearance.



Entering Vindicator's parameters prior to construction let us see if the design was sound before wood was cut.

A number of lunch hours were spent "flying" Vindicator to get me acquainted with powered RC. I broke lots of props!

never a powered RC model of any kind. So naturally I decided to design my own trainer/fun model.

"Everyone has a .40. You should design it for that size, at least."

Maybe … but I'm nothing if not stubborn. I wanted a big, light, floater—a model that would glide a bit if I cut the power. And besides, I just don't like "big" engines like .40s and .60s.

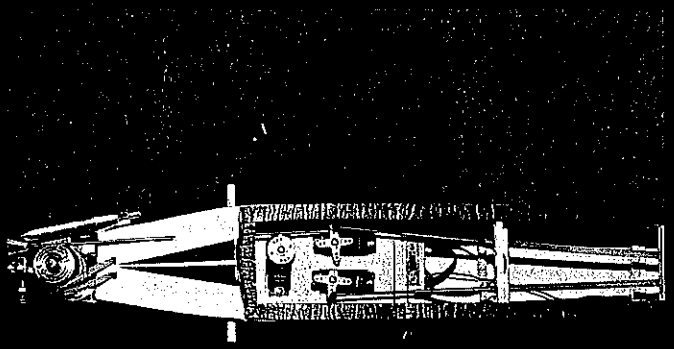
So when I heard about the new Cox Tee Dee .09 RC engine, the power plant quickly became a "given." I have used Cox engines from the .010 on up since the 1960s, and I have a real fondness for their quality and performance.

But originally I wanted a two-channel model—something nice and simple, akin to my sailplane experience. Then AMA's Competitions Director, Steve Kaluf, spoke up:

Vindicator

Vindicator logo: Carla Kunz Photos by the author and Matthew Usher

Preparing for short-wing tests. Rubberband wing mount is simple and allows wing to "give" on mild impact.



Radio installation in progress. Throttle linkage and muffler pressure tap not yet added at this point. Hitec microservos.

My first powered RC flight. "Just keep it two mistakes high." (Four or five was more like it!) Nervous? Absolutely!

Right: Jay Mealy (center) tries a flight while Steve Kaluf (right) snickers and I try to act nonchalant about everything.

"If you don't put a throttle on this airplane, people will say it's just a powered free flight. If you want to make your point, put a throttle on it."

Okay, fine—throttle it is. Now it's a "real" RC model. But I didn't want another boxy-looking, ugly-but-functional model. It had to have a bit of a different look. So I double-tapered the wing and used a swept-back stab and rudder design. It had to at least *look* fast, even if it really wasn't.

I also used removable wingtips, to satisfy the guys who want to go faster—who would be bored with a trainer. Built in some tip dihedral for added stability in the long-wing mode, too. The tips use telescoping Du-Bro brass tubing to plug in.

Vindicator won't fly the pattern, or tear 'em up around #1 pylon, but this is a fun model to fly. And the fact that even *I* can fly it successfully should be encouragement enough for others to try.

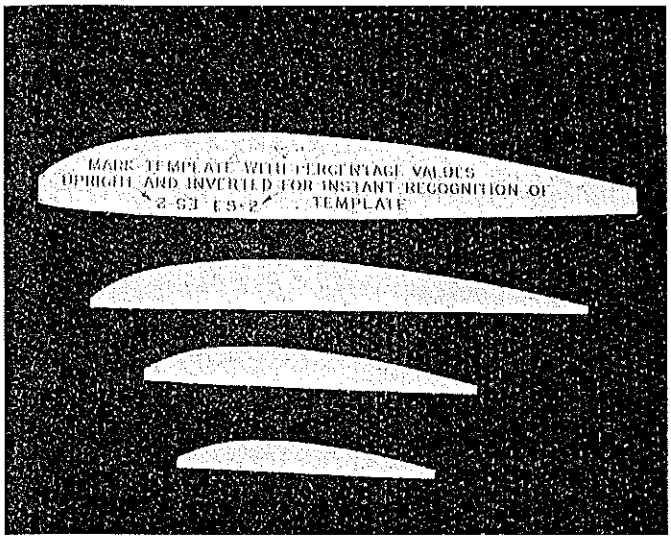
CONSTRUCTION

The following construction summary contains brand names of products I used when building Vindicator. I have reached a "comfort level" with each product mentioned; I get the results I want from them. But brand loyalty is an individual thing; each builder should use the products that will give him/her this same "comfortable" feeling—not necessarily what I or anyone else may recommend. Results *are what matters!*

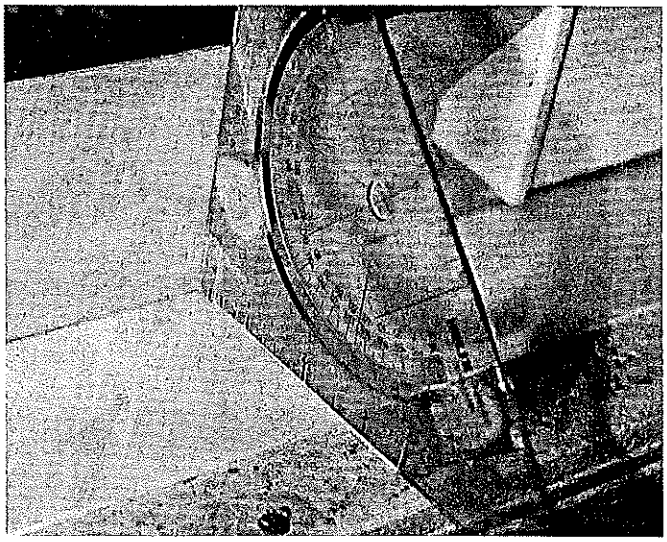
Many corners were cut with the original model in an effort to save weight, mainly due to my paranoia about the .09's power. With a great deal of conscious effort, I got the weight down to 28 ounces ready to fly. Even then I was concerned, despite assurances from Larry Renger at Cox that the .09 was the best Tee Dee in power-to-weight ratio. More on this later.

Wood: Sig balsa, plywood, and basswood was used throughout.

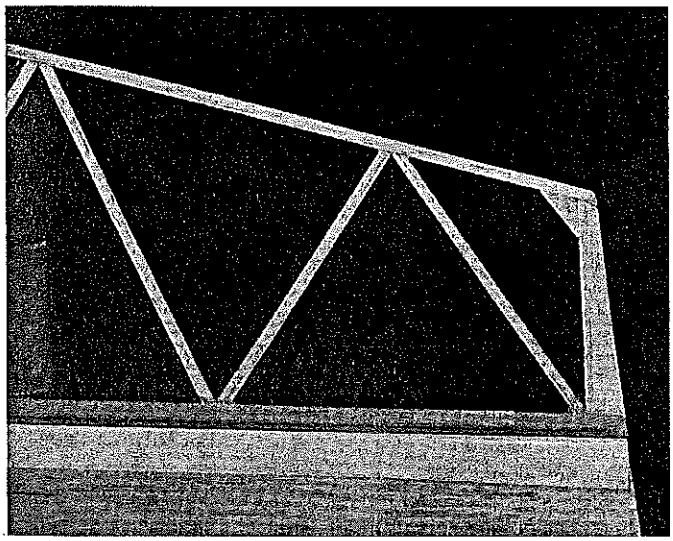
Adhesives: Vindicator was assembled with Duco Household Cement, Hobbypoxy Formula IV epoxy, Satellite City Hot Stuff



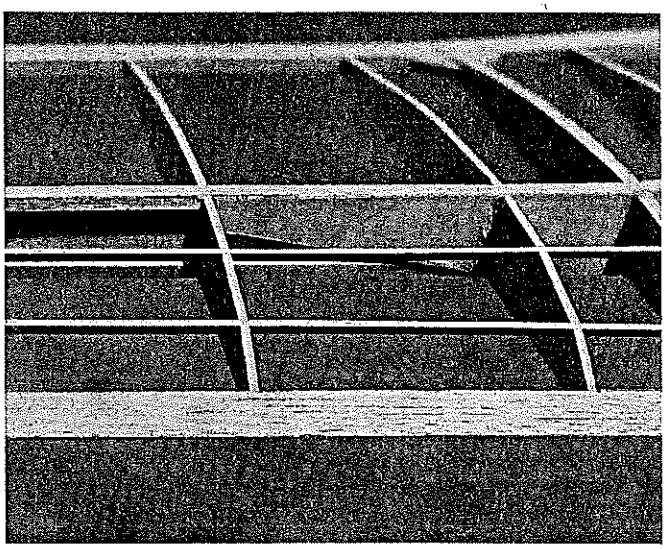
Simplex logarithmic spiral airfoil from 1960 *Air Trails Annual* allows all ribs to be cut from a single template.



Drafting triangle used to assure fuselage alignment. Note diagonal grain of fuselage bottom—reverse angle on top.



Trussed stabilizer framework. MonoKote-type hinges were used for a tight, smooth fit with no gap or slop.



Wing center section has full-depth plywood brace. All wood near dihedral joint is "case-hardened" with CyA.

Super T, and Bob Smith Industries Insta-Set accelerator.

Hardware: Du-Bro bolts, nuts, and glow plug driver; Tatone metal engine mount; Sullivan two-ounce flex tank; Sig pushrods, clevises, and horns.

Radio: Hitec microservos were used with a JR Max 4 FM transmitter, NER-226X receiver, and 600 mAh battery pack.

Wing: The beauty of the wing lies in the Simplex logarithmic spiral airfoil (I first saw this section presented in the 1960 *Air Trails Annual*). A number of FF models (including the record-setting Niblite 584 in this issue) have used this airfoil with great success. It has a relatively sharp entry, and models built with it have excellent glide considering that it's a flat-bottomed section. I felt that the relatively thin section (9%) would help the model penetrate under power—the .09 paranoia again—but would still glide well once the engine was cut off.

The high point remains the same (about 37%) regardless of rib length, so a single template can be used for all ribs. This makes it easy to build a double-tapered wing like Vindicator's. Simply cut a rectangular rib blank to length, mark the LE and TE height, align the front of the template to the LE, and pivot the template to match the TE mark. A quick knife slice for the top camber, and presto! instant rib. Use the first rib as a template to cut a

Vindicator

Type: RC Sport/trainer

Wingspan: 60 inches (long wing)
46 inches (short wing)

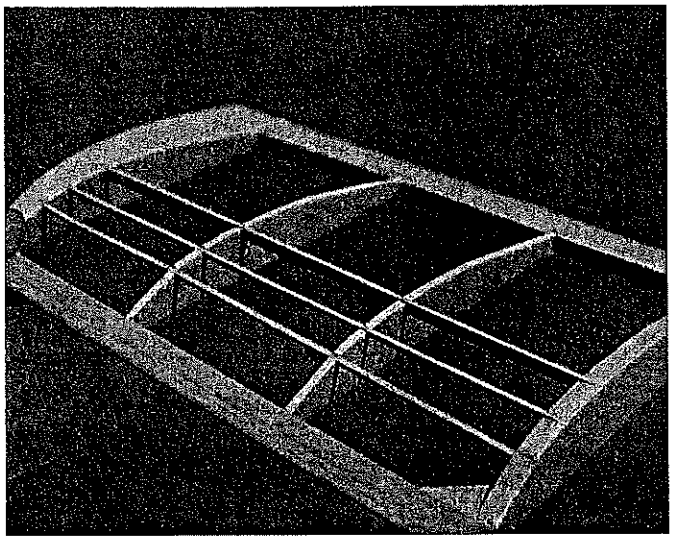
Engine: Tee Dee .09 RC

Functions: Throttle, rudder, elevator

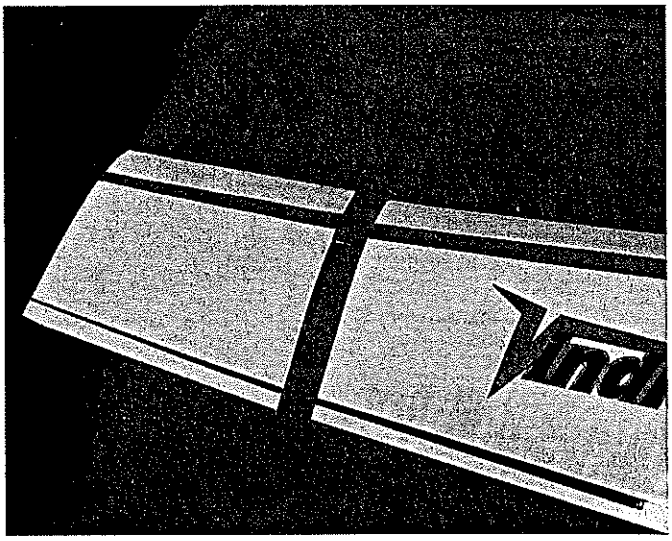
Flying weight: 28 ounces

Construction: Built-up

Covering/finish: UltraCote



Wingtip framework is classic FF style for lightness. Turbulator spars are added after panel has been "framed up."



Tubing is imbedded into tip rib/block, then telescopes into next-larger-size tubing/block assembly in main panel.

matching rib for the other wing half.

The main spar notches are cut into the ribs before assembly, but don't cut the other spar notches until the framework has been assembled. Mark the spar locations on the ribs with a soft-lead pencil, then use a sharp razor blade to cut the notches.

A simple notching tool can be made from a couple of thin razor blade pieces CyAed on each side of a piece of wood that's slightly smaller in thickness than the desired notch. A depth spacer can also be attached to the blades, giving uniform depth and width to the notches.

Vindicator's wing derives a good deal of strength from the vertical-grained shear webs, so a snug fit (no gaps) is important. The full-depth 1/64 plywood center brace has proven to be adequate, but if you're planning to really horse the model around, you may want to go up to 1/32 plywood for added peace of mind.

Plug-in tips: Both the tips and tip blocks have brass tubing imbedded for the plug-in feature. The tip tubing (3/32 O.D.) telescopes into the next-larger size tubing (1/8 O.D.), which is imbedded into the end ribs of the main panels and a small supporting block. This locks in the correct dihedral and/or assures correct alignment for the small tip blocks.

A couple of straight-pin hooks in the main spar capture a #8 rubber band to hold each wingtip in place. If I feel like a real wuss, I wrap a piece of tape around the dihedral joint.

Both sets of wingtips use Hoerner-style shapes, to cut tip losses and give a pleasing appearance.

But Will it Fly?

Once I had roughed out the Vindicator's parameters, I enlisted the aid of a Dave Brown Flight Simulator to see if I was on the right track (and to give me an easy way to brush up on RC flying, which I hadn't done for some years).

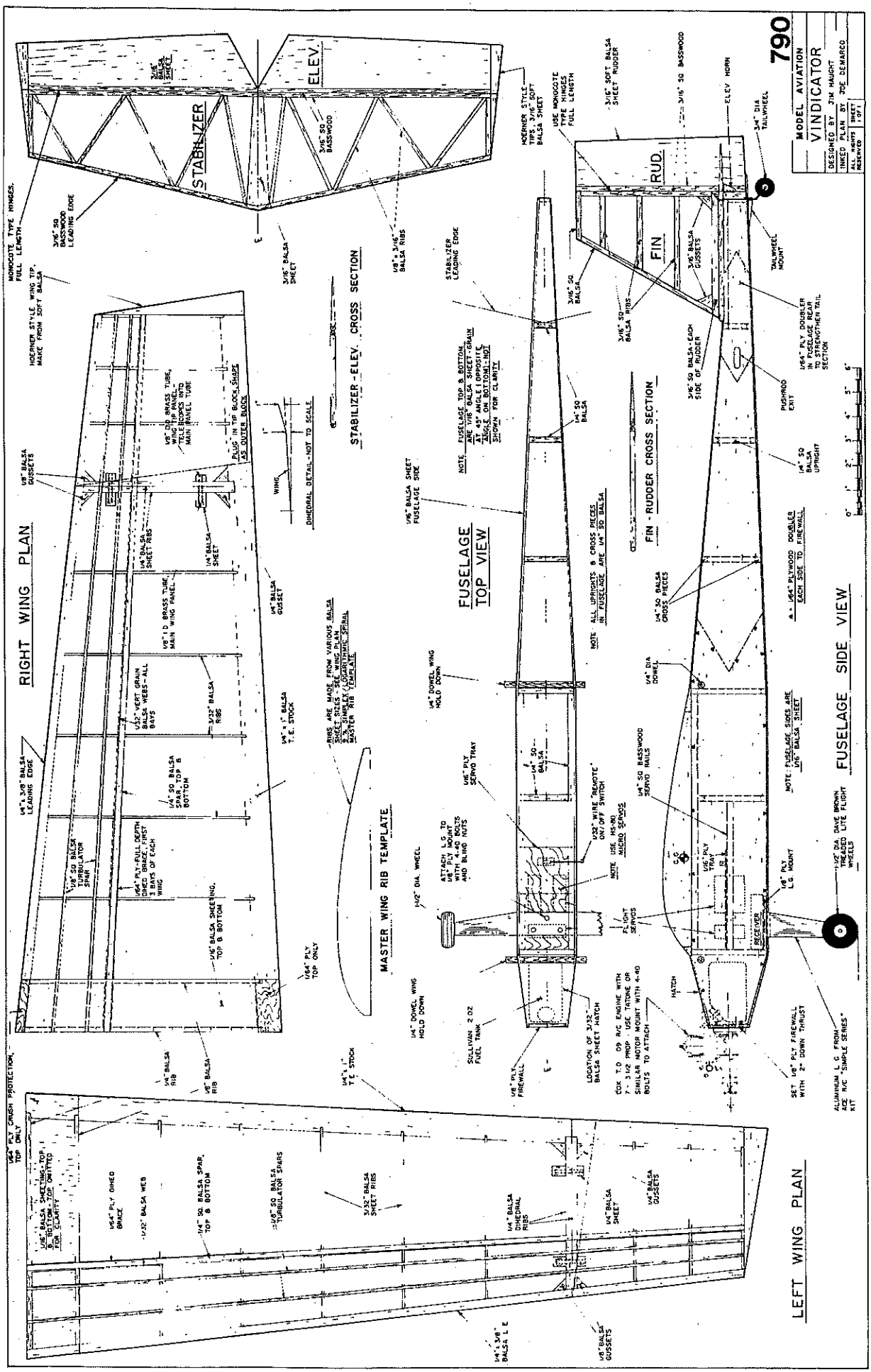
The program's setup feature allows entry of most model specifications, so I felt we could reasonably approximate the finished model. Sure, there were a few things we had to estimate—after all, this was a prototype—but I was quite pleased with the simulation.

We entered parameters for the short-wing version, and tried a number of "flights" by Jay Mealy, Steve Kaluf, and me. The consensus? "A bit sluggish," said Jay. The model also had a tendency to balloon a bit, so when I built the Vindicator I increased the area of the movable surfaces and added 2° downthrust.

Life did imitate art, and the model handles quite well. I believe it trimmed out more quickly than it would have had we not done the simulation. And I felt better about its chances (and mine!) on the flightline; I was less nervous when it came time to take the sticks.

We did have to change the transmitter setup, though. The test pilots were so used to flying aileron-equipped models that they kept trying to turn the model with the wrong stick! Putting both rudder and elevator on the right stick solved the problem—on the simulator and the model. ✈

Jim Haught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MODEL AVIATION
VINDICATOR
DESIGNED BY JIM HAUGHT
INKED PLAN BY JOE DEMARCO
ALL RIGHTS RESERVED
SHEET 1 OF 1
STABILIZER
ELEV.
3/16" BALSA SHEET
3/16" SQ BASSWOOD LEADING EDGE
3/16" SQ BASSWOOD
1/8" x 3/16" BALSA RIBS
STABILIZER LEADING EDGE
HORNER STYLE TYPE, 3/16" SOFT BALSA SHEET
USE MONOCOTE TYPE HINGES FULL LENGTH
3/16" SOFT BALSA SHEET RUDDER
3/16" SQ BASSWOOD
ELEV HORN
3/4" DIA TAILWHEEL
RUD.
FIN
3/16" SQ BALSA
3/16" SQ BALSA RIBS
3/16" BALSA GUSSETS
TAILWHEEL MOUNT
MONOCOTE TYPE HINGES, FULL LENGTH
HORNER STYLE WING TIP, MAKE FROM SOFT BALSA
3/16" BALSA SHEET
STABILIZER - ELEV. CROSS SECTION
DIHEDRAL DETAIL-NOT TO SCALE
WING
1"
RIGHT WING PLAN
1/8" BALSA GUSSETS
PLUG IN TIP BLOCK SHAPE AS OUTER BLOCK
1/8" OD BRASS TUBE, WING PANEL JOINER TUBE
1/8" ID BRASS TUBE, MAIN WING PANEL
1/4" BALSA SHEET RIBS
1/4" BALSA SHEET
1/4" BALSA GUSSET
1/4" x 3/4" BALSA LEADING EDGE
1/32" VERT GRAIN BALSA WEBS - ALL BAYS
3/32" BALSA RIBS
1/4" x 1" BALSA T.E. STOCK
1/4" SQ BALSA SPAR, TOP & BOTTOM
1/8" SQ BALSA TURBULATOR SPAR
1/64" PLY-FULL DEPTH DIHED BRACE, FIRST BAYS OF EACH WING
1/16" BALSA SHEETING, TOP & BOTTOM
1/64" PLY TOP ONLY
RIBS ARE MADE FROM VARIOUS BALSA SHEET SIZES - SEE WING PLAN
2.7% SIMPLEX (LOGARITHMIC) SPIRAL MASTER RIB TEMPLATE
MASTER WING RIB TEMPLATE
1/4" DOWEL WING HOLD DOWN
1/2" DIA WHEEL
1/4" DOWEL WING HOLD DOWN
SULLIVAN 2 OZ FUEL TANK
1/4" x 1" T.E. STOCK
1/4" BALSA RIB
1/8" BALSA RIB
1/8" PLY FIREWALL
1/64" PLY CRUSH PROTECTION, TOP ONLY
1/16" BALSA SHEETING - TOP & BOTTOM - TOP OMITTED FOR CLARITY
1/64" PLY DIHED BRACE
1/32" BALSA WEB
1/4" SQ BALSA SPAR, TOP & BOTTOM
1/8" SQ BALSA TURBULATOR SPARS
3/32" BALSA SHEET RIBS
1/4" BALSA DIHEDRAL RIBS
1/4" BALSA SHEET
1/4" BALSA GUSSETS
1/4" x 3/8" BALSA L.E.
1/8" BALSA GUSSETS
LEFT WING PLAN
FUSELAGE TOP VIEW
1/16" BALSA FUSELAGE SIDE
NOTE: FUSELAGE TOP & BOTTOM ARE 1/16" BALSA SHEET GRAIN AT 45° ANGLE (OPPOSITE ANGLE ON BOTTOM) - NOT SHOWN FOR CLARITY
1/4" SQ BALSA
1/4" SQ BALSA CROSS PIECES
NOTE: ALL UPRIGHTS & CROSS PIECES IN FUSELAGE ARE 1/4" SQ BALSA
1/4" DOWEL WING HOLD DOWN
1/16" PLY SERVO TRAY
1/4" SQ BALSA
ATTACH L.G. MOUNT WITH 4-40 BOLTS AND BLIND NUTS
1/2" DIA WHEEL
NOTE USE HS-80 MICRO SERVOS
1/32" WIRE "REMOTE" ON/OFF SWITCH
1/4" SQ BASSWOOD SERVO RAILS
1/4" DIA DOWEL
1/16" PLY TRAY
1/8" PLY L.G. MOUNT
1/2" DIA DAVE BROWN TREADED LITE FLIGHT WHEELS
LOCATION OF 3/32" BALSA SHEET HATCH
FOR T.D. OR R/C ENGINE WITH 7 - 3 1/2 PROP USE TATONE OR SIMILAR MOTOR MOUNT WITH 4-40 BOLTS TO ATTACH
HATCH
SET 1/8" PLY FIREWALL WITH 2° DOWN THRUST
ALUMINUM L.G. FROM ACE R/C "SIMPLE SERIES" KIT
FUSELAGE SIDE VIEW
NOTE: FUSELAGE SIDES ARE 1/16" BALSA SHEET
1/64" PLYWOOD DOUBLER EACH SIDE TO FIREWALL
1/64" PLY DOUBLER IN FUSELAGE REAR TO STRENGTHEN TAIL SECTION
PUSHROD EXIT
3/16" SQ BALSA EACH SIDE OF RUDDER
1/4" SQ BALSA UPRIGHT
FIN - RUDDER CROSS SECTION
0" 1" 2" 3" 4" 5" 6"

Stabilizer and rudder: The framework is medium-weight strip balsa, with basswood or spruce at high-stress areas. CyA is fine for construction, provided the joints are well made.

I used what are euphemistically referred to as "MonoKote" hinges for both rudder and stabilizer. They allow a tight, clean hinge line, yet can be easily repaired or replaced. I hinged the surfaces prior to covering the framework.

Don't forget to cover the mating surfaces with a thin strip of the same color material you will use on the balance of the part (before you apply the hinges) so you don't have a nasty-looking off-color hinge gap.

Fuselage: The diagonal cross-grained top and bottom planking (opposite grain directions from top to bottom) is an effective way to make a light fuselage with adequate stiffness for this application. Otherwise the fuselage is a basic box with liberal use of 1/64 plywood doublers.

The 1/64 may not seem like enough thickness, but it is surprisingly tough, and there is plenty of room for most radio equipment. I mounted my servos on a 1/16 plywood tray for easy removal of the unit.

Cut the bottom sheet pieces oversize and glue them together on your building board. Draw a centerline and bottom view directly on this sheet, and work from the bottom up to attach the sides and other fuselage pieces. The top pieces are attached individually after the rest of the fuselage "box" is complete and the hardware has been installed.

Vindicator's short nose makes it imperative that weight be saved wherever possible behind the CG. My model balanced just right with the Sullivan flex tank crammed as far forward as it would go, with the foam-wrapped battery pack beneath it. The receiver fits below the servo tray, which was also positioned as far forward as possible.

A remote *on-off* switch was used (see Ivan Munninghoff's how-to in the April 1995 issue), arranged so that pushing the switch wire *in* is the *on* position.

The landing gear was absconded from an ACE R/C 1/2A Simple Series kit, but there's no reason why any similar gear wouldn't work, along with a generic tail wheel. I wanted a relatively wide stance to aid the inexperienced (me) in ground handling. Dave Brown treaded Lite Flite wheels were used to save weight.

I intended to use cable for the throttle control, but the cable was backordered when I was ready to finish the fuselage, so I used a solid rod instead, and it has worked fine. I was also going to be fancy and use nylon bolts to attach the wing, but I was reminded that most beginning modelers would use/prefer the classic rubberband attachment, so I drilled the fuselage for two hold-down dowels and bought a box of #64 rubber bands. The dowels are removable for replacement and easier access to the fuel tank.

The pushrods are "trapped" between pieces of 1/4 square balsa at the former locations.

Covering: All of my models use a red-white-black color scheme, and since we had some sample rolls of Goldberg UltraCote and UltraCote Plus, this gave me a chance to try something new.

The white UltraCote Plus was particularly unusual for me because it is self-adhesive. I quickly discovered that I had to be much more accurate than I'm used to when positioning pieces of covering; there's no chance to slide the covering in place for alignment first. It worked out fine, though, and I believe the adhesive helped me cover the fuselage with much less trapped air/bubbling than usual when covering sheeted surfaces.

The red UltraCote was likewise easy to use—it's a more standard heat-activated adhesive. Both UltraCote variations shrank and took a "set" very well. I used MonoKote Trim Sheets for the logo, stripes, and numbers, because that's what I had on hand. The red is not quite a match for the UltraCote, but it's really not too noticeable.

All covering and shrinking was accomplished with a Coverite 21st Century iron, which is an outstanding piece of equipment. Its light weight, conveniently shaped shoe, and excellent temperature control make it the best iron I have used.

Setup and preflight: Vindicator balances at approximately 33% of the Mean Aerodynamic Chord (MAC). Considering the model's short nose—a feature I wanted very much, as I felt it would aid in recovery from awkward flight attitudes—I was fortunate to achieve this without having to add useless ballast. If you decide to beef up the structure a bit, it would be wise to extend the nose an inch or so.

After the model has been properly balanced, there is really nothing unusual in preflight. It's simply a matter of checking standard things like free movement of control surfaces, tightened bolts, proper wheel tracking, range check, etc. If you've been "through the drill" once before, you'll have no problems here.

Flying: We waited for ideal testing conditions for this untried model: 39° windchill and 15-mph wind. And it was decided that we would send it aloft the first time in the short-wing (go-fast/less-inherently stable) mode.

With this burst of intelligence out of the way, and a total breakin time of 10-15 minutes on the engine, we checked everything out, fired up the Tee Dee, and I wobbled onto the runway, model in hand. What would happen? Stall? Violent spin? Ground loop? I checked with designated pilot Jay Mealy, and turned the Vindicator loose.

The model had a short, straight takeoff roll, and climbed steadily on out. Jay made a few trim corrections and tried some gentle maneuvers. "Not bad," I thought.

Naturally, the engine quit two minutes into the flight! I hadn't run the Tee Dee in cold weather, and it didn't have enough breakin time anyway, so it quit early. Thus we had an immediate look at how the model tracked dead-stick.

To my surprise Vindicator came "right down the chute." It held line very well, and Jay floated it safely back onto the runway without a problem.

After a brief discussion and refuel, we immediately restarted the engine, let it warm up a bit, and flew a full flight. There were no engine problems, and the model handled fine, other than a tendency to turn left more easily than right. This was traced to a misaligned engine mount that gave some left thrust. I was elated that the model survived!

Further testing showed that the model has plenty of power, so it will move right along. And it has been flown several more times in 15-mph winds with no problem and good penetration, so it seems that my assessment of the airfoil requirement was accurate.

When we added the wingtips for the floater/trainer version, the model tracked even better than before, and definitely reacted to thermals in the area—even under power.

The fuel choice (10% nitro K&B) made for an interesting dilemma. The engine ran so well (beyond manufacturer's expectations, even on this low-nitro fuel) that I saw no need to advance the nitro content to the 25% or so that Tee Dee .09s usually use. However, we had problems getting the idle low enough to land the model—it wanted to keep on flying, even with the throttle stick all the way back!

The model doesn't *need* the extra power from the 25% nitro, but word from Cox is that it may make a low idle more reliable, so we'll try it at some point. The idle will likely come down some more anyway as we accumulate more flight time and the engine is more broken in.

Vindicator has come surprisingly close to the goal: a second-step fun/trainer model. It's a little faster than a trainer, and takes a little more "real piloting" but I wanted a model for me and others like me: those with a little bit of RC experience, but not much. If you're pondering a first scratch-built effort, consider that this model can be built with a straightedge; the only curve is in the airfoil.

And let me state unequivocally that my fears about the .09's power were groundless. On the recommended 7 x 3 1/2 prop, and only 10% nitro K&B fuel, Vindicator will climb steadily on as little as 1/4 throttle. There is plenty of room for a bit of beefing-up here and there if you desire—the model can clearly handle more weight. And I have replaced the original microservos with standard-size versions.

It has even been postulated that Vindicator would fly on a Tee Dee .049/.051, but we haven't tried it yet.

Special thanks to test pilots Jay Mealy and Steve Kaluf, whose critique of this project from its inception was an invaluable help—except for comments like these:

"But hey, think how much fun it would be to go pylon racing with this airplane! Why don't you cut out parts for three of them, while you're at it? And let's add ailerons, and ..." ✈

Vindicator

JIM HAUGHT