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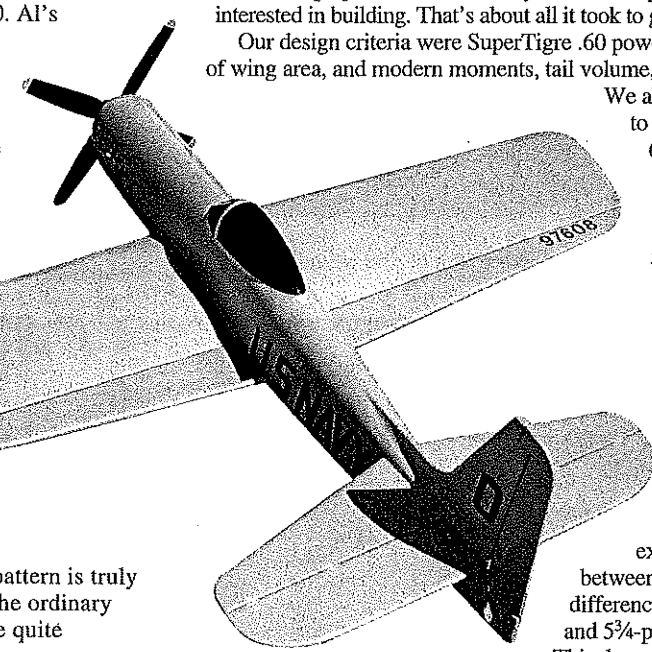
BEARCAT

▪ Pat Johnston

I have loved the Bearcat as a Stunter since I watched Al Rabe's version (March 1970 *American Aircraft Modeler*) fly at Fort Worth, Texas in 1970. Al's model was designed originally for the McCoy .40, and later the SuperTigre .46. It had approximately 585 square inches of wing area.

My approach to this design was not as a Scale aircraft, but rather a competition-class Stunt model. The general outlines and proportions follow the look of the Bearcat as closely as possible and while retaining good Stunt-flying qualities. Coupled with an appropriate paint scheme and the fact that a Bearcat's shapes are somewhat distinctive, no one should have difficulty identifying this model; we have created the *illusion of scale.*



The appearance of a Bearcat flying the Stunt pattern is truly awesome. Building Stunters that stand out from the ordinary planform produces an audience appeal that can be quite noticeable.

This also spills over to the judges. They really like watching and judging an airplane that grabs their imagination. Al Rabe used the term "impression points" to describe the psychological condition in the judges' minds that may just be worth a little bit on the final score. This provides that little bit of extra incentive when getting into a building project like this.

My own description, borrowed from the Indoor Free Flight Bostonian event, is "charisma effect." Charisma effect is evident when people ask, "Who manufactures the kit?" so they can build a copy of the airplane for themselves.

My Stunt partner Jim Welch and I decided to build Bearcats as our 1998 Stunt projects. This is the only scalelike airplane that Jim would be interested in building. That's about all it took to get me enthused.

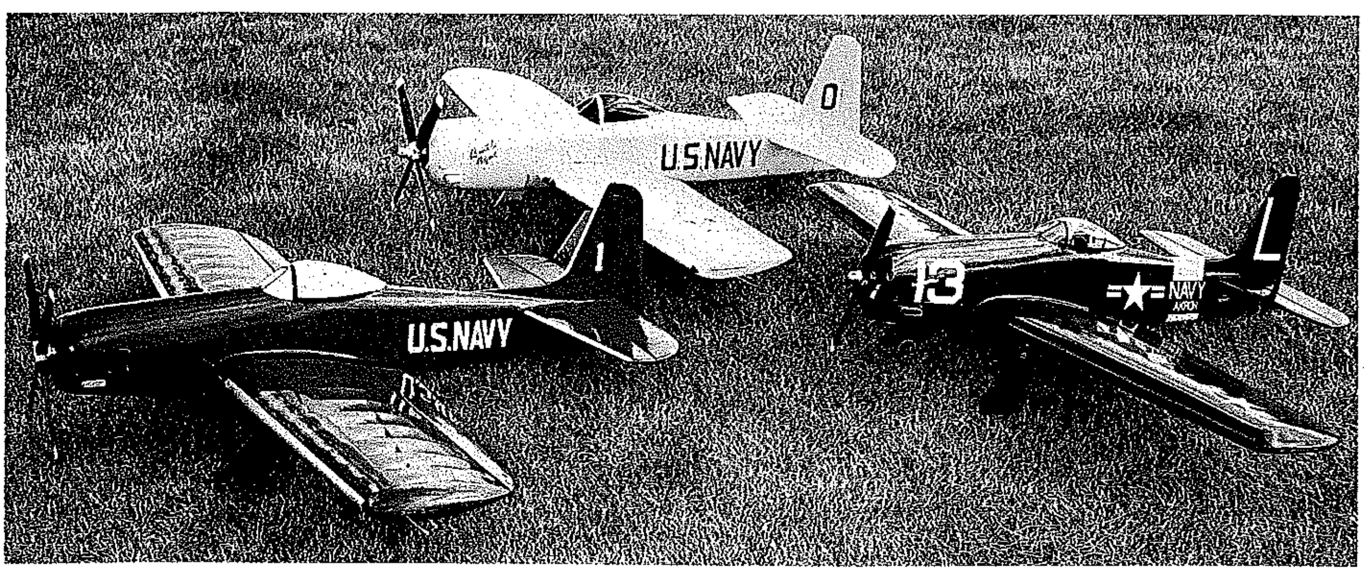
Our design criteria were SuperTigre .60 power, 675 square inches of wing area, and modern moments, tail volume, and building methods. We also wanted the model to weigh approximately 60 ounces ready to fly. (Jim's Bearcat weighs approximately 62 ounces; mine was 57½ ounces).

The challenge here is to use balsa that is almost all six-pound-per-cubic-foot density or lower. I have the Double Star .60 Lite in my airplane, which is 1½ ounces lighter than Jim's ST .60, but the three extra ounces' difference between our models is the difference between five-pound- and 5¾-pound-density balsa. This demonstrates what careful wood selection can do.

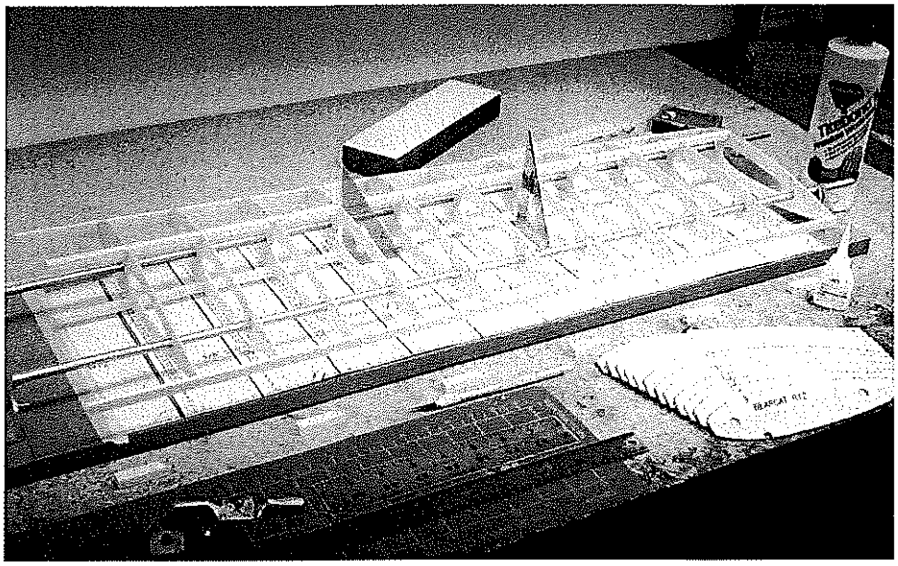
CONSTRUCTION

Building a project like the Bearcat will be a lot of work and a bit of a challenge. Expect to spend some serious time in the building room. Good things do not happen without effort.

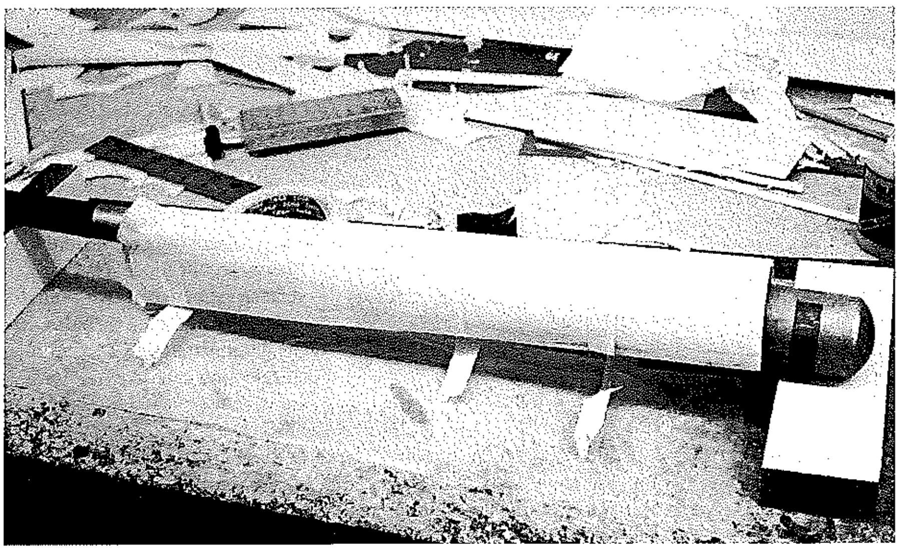
The construction type and techniques are mostly conventional. The plans show some very normal types of construction, along with some alternate methods and additional design option considerations. The builder may wish to customize



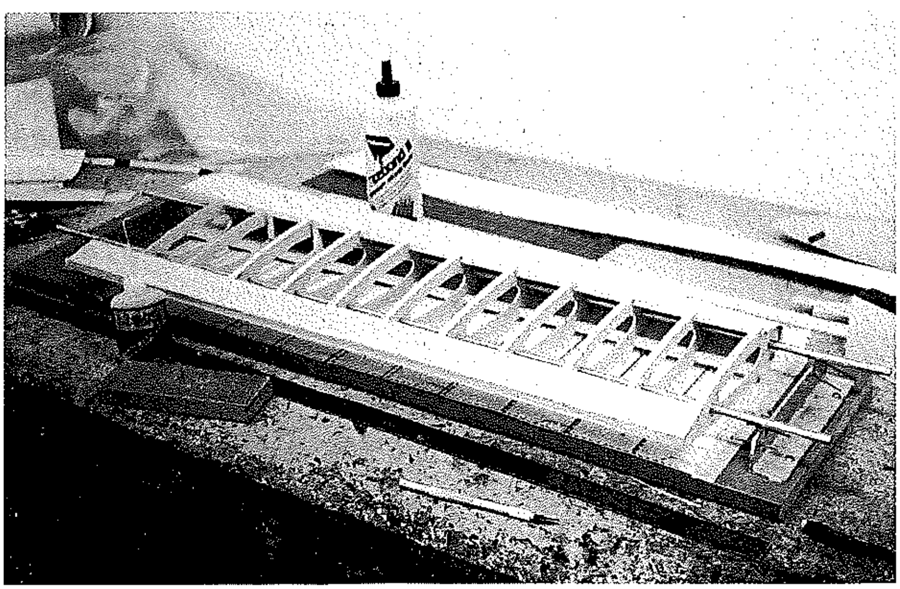
Two new Bearcats with the original Al Rabe version (right). New version is larger, uses bigger engine.



Use drafting triangles to square up the ribs on the wing fixture.



Rear deck 3/32 sheeting being formed over a baseball bat.



Wing fixture maintains alignment when installing sheeting and shear webs.

this airplane to suit his personal style and preferences.

The first thing a builder must do is to procure a good supply of really light balsa. That's hard to do here in Idaho, so we ordered a stack of wood from Lone Star Balsa. Specify the four- to six-pound stock. Most of the sheets calibrate to around 5 pounds. You must be cognizant of every gram that goes into a model.

I utilized some of the building techniques from Al Rabe's original Bearcat that lent themselves to this design. The airfoil is thick, with a nice curvature toward the back. Al Rabe discovered that this keeps the air attached to the wing when the flaps are deflected. In his testing, this airfoil produced an increase of lift at the same angles of attack. We wanted an efficient wing to handle an airplane of this size.

Engine: I use the ST .60 as my first choice, but I have a Double Star .60 Lite and a Double Star .60 ABC (available from Tom Dixon or Brodak) as alternate engines. This gives me the ability to alter the Center of Gravity (CG) by changing the engines. Other suitable engines are the Merco .61 (from RSM) and the K&B .61 ABC Stunt from Brodak.

One very interesting possibility is the Stalker .61 rear exhaust. The muffler would reside in the cowling with just the outlet stinger protruding out the bottom. Very clean!

The last engine to mention is the Moki 51. This engine has approximately the same power as the ST .60. It weighs 11¾ ounces.

Consult *Stunt News*, the PAMPA (Precision Aerobatics Model Pilots Association) publication for more information about the multitude of fine Stunt engines available these days.

Wing: The wing construction is a standard "D-tube" design. Shown on the rib patterns are 5/16 diameter holes for the wing fixture. I use two Easton 2013 aluminum arrow shafts supported on parallel supports as my homemade fixture.

(Any good archery shop will have appropriate shafts. While you are there, think

BEARCAT

Type: CL Stunt

Wingspan: 58 inches

Engine: .51-.60 two-stroke

Flying weight: Approx. 60 ounces

Construction: Built-up

Covering/finish: Silkspan and dope

Photos by the author Graphic Design by Jill Ann Cavanaugh

ıout buying a half-dozen 2013 shafts; the tra shafts can be used for pushrods. The 0" designator is 20/64 inches diameter, or 6 inch, and the "13" is .013 wall thickness. ıis is an ultralight shaft—9.01 grains per ch—that is the right size for these rods. ɔst should be less than $20 a half-dozen. ıese are as light as carbon-fiber shafts, but ıst considerably less.)

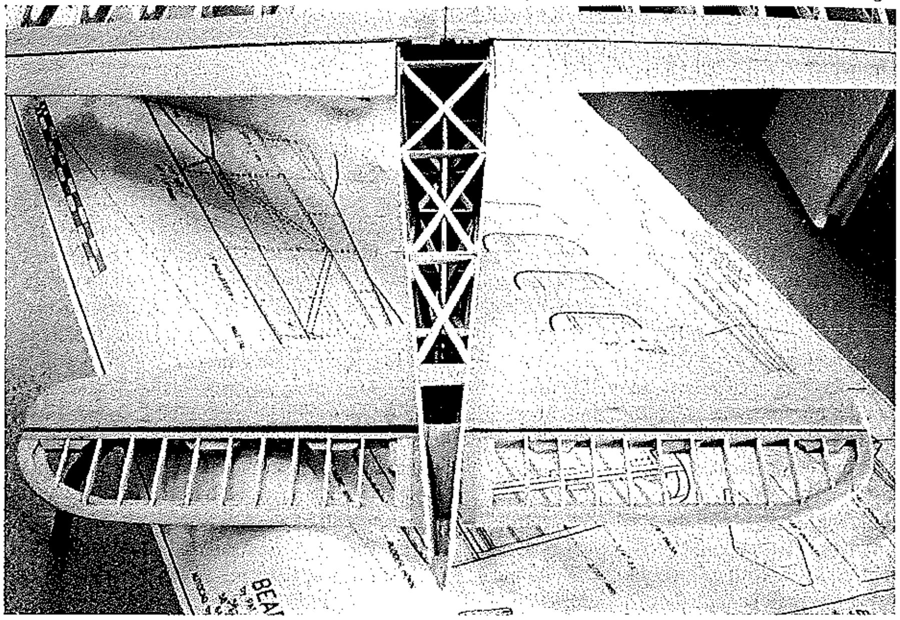
Wood for this entire project must be in e five- to six-pound-density range, with e exception of the spars. Hard spars are eap insurance for a strong wing. If a rson wishes to get fancy, the spar could made from 1/4 balsa, but is 3/8 wide at the ot and tapers to a 1/8 at the tip. This weighs e same as a 1/4 square spar, but provides ore strength toward the center of the wing here it is needed.

Ribs are stacked on the fixture over a ıpy of the plans so as to align and space e ribs accurately. I use some small aftsman's triangles to square everything). Spars, the 1/8 leading edge, and trailing ıge assemblies are installed.

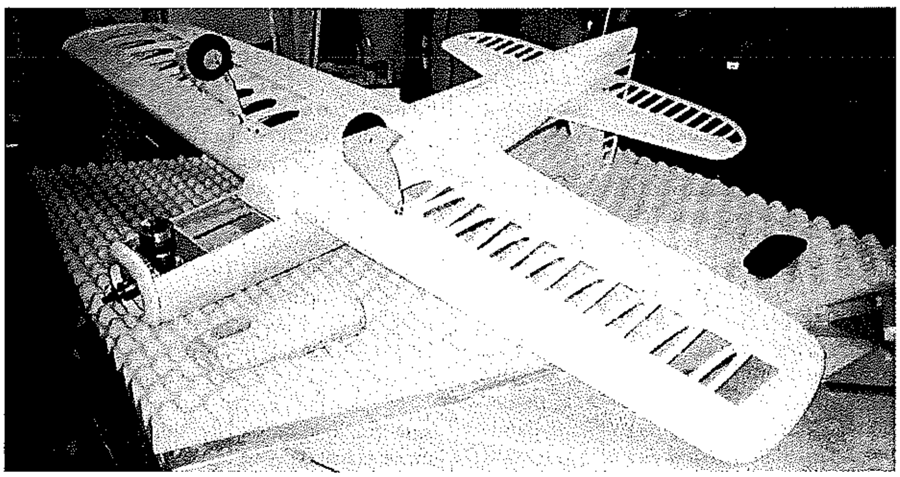
The landing gear mounts are shown built ı from 1/8 and 1/16 plywood, supported rtically with plywood. The 1/16 plywood ans to both spars effectively creating a nding gear box, making it strong and light. ɔrefer this method to conventional ırdwood landing gear blocks, which are avier. A 1/16 plywood gear cover secures e 1/8 gear with 4-40 flathead screws.

The wing leading edge is made from two yers of 1/8 balsa. The first layer holds the ɔs into alignment and is trimmed to ınform to the airfoil.

The 1/16 leading edge sheeting is installed ıd the front of the wing is block-sanded ıt to receive the front piece of leading lge sheeting. This construction "locks" the eeting into the leading edge, and allows a ce, fat radius to be sanded into the ading-edge. Be sure that the wing is still in e fixture when the vertical shear webs are aced at the front of the trailing edge and



Light internal bracing in fuselage and ribbed elevators saves crucial grams.



Ready to cover. Bearcat's fiberglass cowl was made from foam covered with epoxy and glass. Foam is then removed, leaving only the final fiberglass part.

Designed as Grumman's ultimate fighter design, the Bearcat was arguably the hottest-performing fighter that came out of World War II.

Unfortunately, Grumman's ultimate fighter never had the opportunity to prove itself in war. On its way out to battle aboard the carrier USS *Langley* in August 1945, the atomic bombs were dropped on Japan. The Bearcat's guns were never fired offensively for the United States during its service life (1945-1955).

One of the most colorful exploits of the Bearcat was the replacement of the Hellcat for the Navy's Blue Angels. Their Bearcats were painted blue, several shades lighter than standard Navy blue. The most-popular airplane of this team was the glossy orange-yellow Bearcat named Beetle Bomb, the solo demonstration airplane.

The Bearcats thrilled audiences until 1949, when they were replaced with Grumman F9F Cougars.

—*Pat Johnston*

Jim Welch and Beetle Bomb.

between the spars. The shear webs lock the wing into position and resist twisting forces. The wing must be held straight at this stage.

Each wing panel is raised one inch to establish the necessary dihedral. Join the two wing halves and install the four-inch bellcrank. I installed a flap horn assembly, homemade from 1/8 music wire. Commercial units are available from RSM Dist.

Be sure that the flap horn wires are exactly in line with the centerline of the flaps. The flaps will have "lucky boxes" to receive the 1/8 wire horns. These allow enough lateral movement to permit free controls. I have experienced no problems using a one-piece control horn and dihedral.

The center-section sheeting, capstrips, and wingtips complete the wing at this stage. Install an adjustable leadout guide of your choice. I like to install the Paul Walker unit, which is 1/4 basswood drilled with 1/8 holes at 3/16 frequency with a slot connecting all holes. An eyelet may be pulled out and the leadout wire slides to the desired position, then the eyelet is pushed back in. This unit weighs about four grams and is simple.

At this stage, the wing should weigh 10 to 10½ ounces.

The flaps are shown built up using a method found on Bob Whiteley's Derringer 46: a border of 1/4 square balsa and geodetic 1/16 ribs, skinned with 1/16 balsa. This method produces a lightweight, flat, extremely stiff surface.

(An alternate method is to eliminate the 1/4 square trailing edge rim and taper the flaps. Paul Walker's Impact uses this method. It saves a little weight, may be a bit more efficient and is a little more difficult to keep the flaps flat.)

"Lucky boxes" are installed in the flaps. These are plywood boxes with slots built in to receive the flap horn. They allow the flaps to be "tweaked" for trim purposes without risking damage to the flap. The flaps should weigh less than two ounces.

Stabilizer and Rudder: The stabilizer is shown built using the Whiteley method. The elevator is built up with ribs, as is the rudder. This saves a bit of weight and provides the look of the cloth-covered control surfaces used on the full-scale Bearcat. The completed weight of the stab and elevators with the control horn and hinges should be 2½ ounces (70 grams).

A "Rabe" rudder is shown. It helps to counter gyroscopic precession caused by large props and helps to maintain line tension on the top portions of the outside square maneuvers.

Keep the rudder assembly as light as possible. Excess weight in the tail will have to be made up with lead or some form of heavier components in the nose.

Fuselage: Begin by building the engine crutch assembly. The 1/2 square maple engine mounts are bridged with 1/2 balsa epoxied in crossgrain. This ties the nose components together, clamping the vibration from the engine.

The front firewalls are built up from five layers of balsa laminated at 45° to each other. The first and last layers have horizontal grain. Square "windows" are cut in to receive the engine mount crutch. More 1/2 balsa is installed outboard of the maple engine mounts and is then sanded flush to the sides of the formers. This extra balsa makes a bridge to the plywood fuselage plywood doublers, helping to tie the mounts to the doublers.

The 3/32 fuselage sides are cut out and the 1/32 plywood doublers are epoxied to them. The sides are then glued to the completed crutch assembly. Diagonal braces are installed on the fuselage sides. These stiffen the sides and resist any splitting tendencies in high-stress situations.

Top formers are glued in. Pushrods will be installed at the appropriate stage. Top sheeting will be premolded over available forms. I use a three-inch diameter piece of PVC irrigation pipe to form the front sheeting. When wetted on the outside curve with hot water, the 3/32 sheeting will be very easy to wrap around a form. Tape it to the form and allow it to dry.

A baseball bat can serve as a good form for the tapered sheeting. Once preformed, the sheeting is installed over the formers.

A front top nose block is carved to shape and hollowed. The cowling may be carved and hollowed from balsa, or a fiberglass unit may be formed up. Jim Welch came up with the fiberglass mold for our canopies.

Finish: I recommend a dope finish, and I prefer to use Sig dope throughout the finishing process.

Start with two coats of nitrate as a base, followed with silkspan covering everything. Four to six coats of Sig Supercoat dope is used on the wings and other open bays to get the covering to tighten up. Then use Sig Lite-Coat (a low-shrink butyrate) for everything that follows; a total of at least six coats of dope, sanding with 220- to 320-grit wet-or-dry sandpaper between coats to control the weight and smooth the base.

Nothing but elbow grease can create a beautiful, light finish. Nice thing about elbow grease is that it doesn't fisheye the color coats.

Apply the color scheme of your choice, ink lines or whatever else, then spray on clear. I rub out my clear with a regular automotive rubbing compound and wax it after the dope has time to cure. For the highest gloss possible, use Gorham's silver polish.

The all-up weight of my model's finish, from bare wood to final clear, was 8½ ounces.

Trimming and Flying: The fuel tank is wedged in with foam to resist vibration. Fuel vents are permanently mounted in the fuselage and fuel lines connect them to the tank. This provides great isolation between the tank and vents.

Mount the engine on aluminum pads. Position the center of gravity as indicated on the plans. This is about a 20% CG; I find that anything farther forward slows the turn down too much and demands too much control handle output pressure. (A .60-sized Stunter can be a lot of work to fly in a stiff wind; don't add any more work than necessary.)

Balance the model laterally by supporting it on the tail wheel and glow plug. The right wing should measure two ounces heavy for equal-span wings. Install enough lead in the tip box to achieve this figure.

The leadout wires are swept back one inch from the CG. My handle is adjusted for approximately three inches of line spacing. This controls the turn rate and makes the exits on the square corners easier to control, helping to eliminate the usual bobble. You may wish to start with four-inch spacing on their first flights. If clean squares are difficult, start reducing the spacing until the squares exit flat and smooth.

My ST .60s seem to "run happy" with Rev-Up 13 x 6 props and the most excellent BY&O 13 x 5 or 13 x 6. Rev-Up props are tough to find, and Clarence Bull's BY&O props are tops. His 13 x 5 gives 5.4-second laps and lots of pulling power. The Rev-Up 13 x 6 produces 5.2-second laps.

I set up my Bearcat with lightweight three-inch wheels to handle the sometimes-poor grass fields, but many will opt to install lightweight 2½-inch wheels. (I'm not so sure that the soft three-inch wheels don't give more consistent landings on pavement.)

The initial flights on the Bearcat were made with a Moki .51. The Moki turned a 13 x 5½ prop (a BY&O 13 x 6 that had been depitched and cleaned up), producing lap times of 5.2 to 5.4 seconds. Turning a wide-bladed 13-inch prop at appropriate Stunt speeds for an engine that actually is a .49 is definitely impressive.

The airplane exhibited the rare form of not needing any trim changes. On the second flight I was able to put in the full pattern.

This is truly a fun airplane to fly, and has an awesome appearance in the air. Landings on those long legs look really great, with the tall rudder way up in the air as it rolls out on its main gear.

Thanks to Al Rabe for providing the inspiration years ago. The Bearcat is a fun Stunter, and can produce good flight scores in the hands of a good pilot. Be advised that people will notice this airplane. MA

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Sources:

Tom Dixon
Box 671166
Marietta GA 30066

Tom Lay
T&L Specialties
Box 6052
Torrance CA 90504

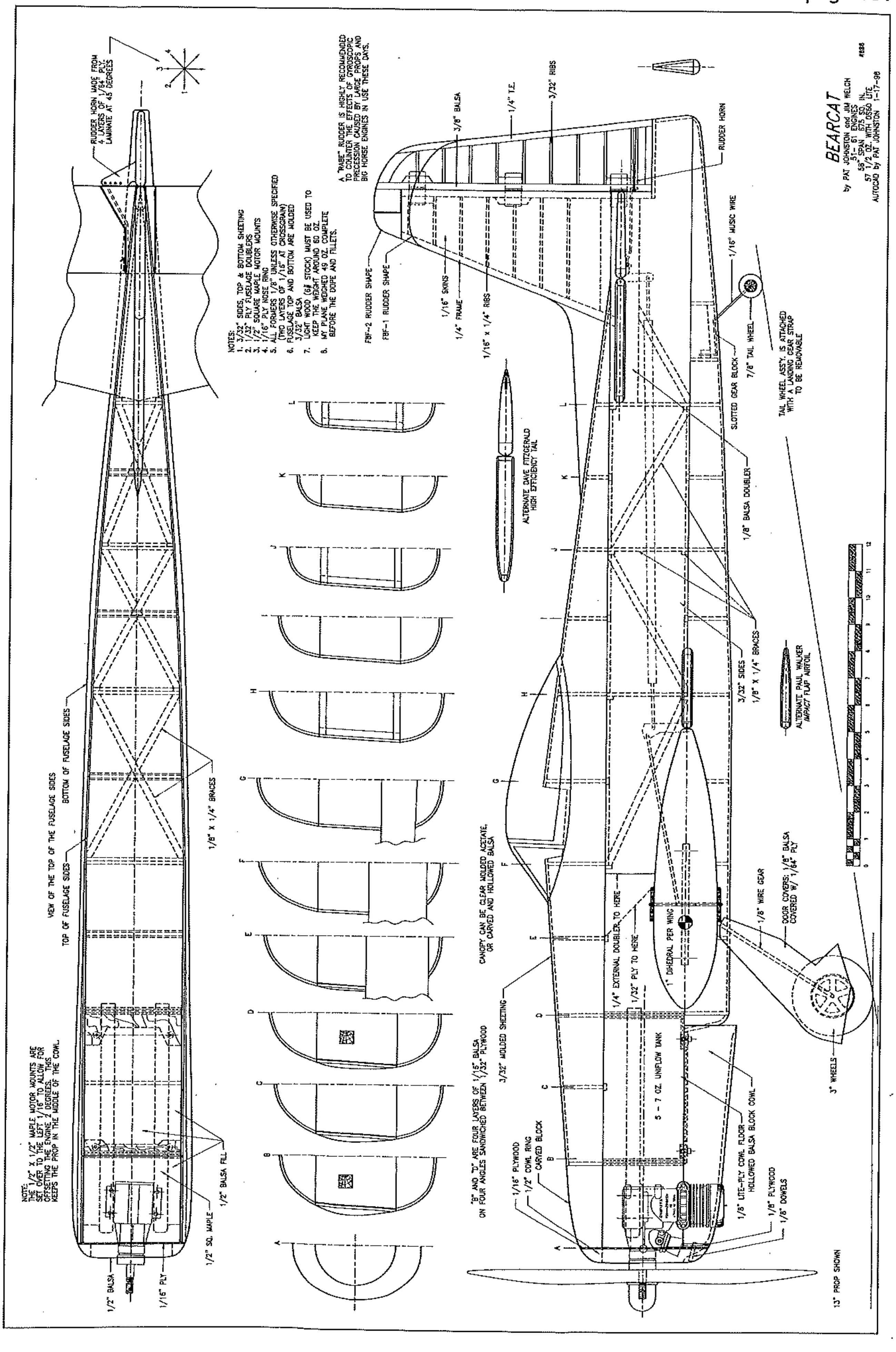
Windy Urtnowski
93 Elliott Pl.
Rutherford NJ 07070

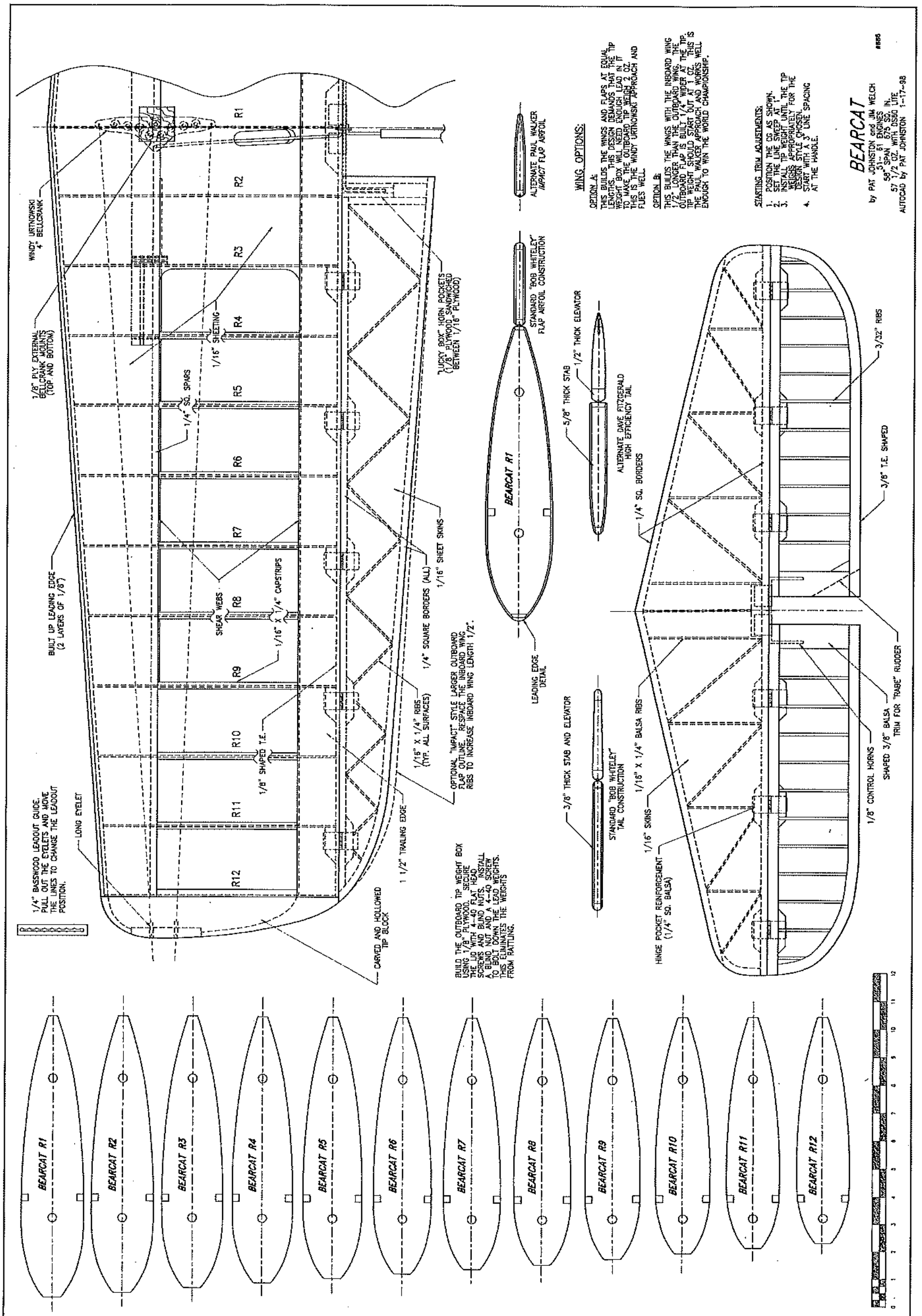
RSM Distribution
1570 E. Edinger Ave. Unit G
Santa Ana CA 92718

Brodak Distribution
100 Park Ave.
Carmichaels PA 15320

PAMPA
158 Flying Cloud Isle
Foster City CA 94404

Full-Size Plans Available—see page 181





BEARCAT
by PAT JOHNSTON and JIM WELCH
51 - 61 ENGINES
58" SPAN 675 SQ. IN.
57 1/2 OZ. WITH DS60 LITE
AUTOCAD by PAT JOHNSTON 1-17-98
WING OPTIONS:
OPTION A:
THIS BUILDS THE WINGS AND FLAPS AT EQUAL LENGTHS. THIS DESIGN DEMANDS THAT THE TIP WEIGHT BOX WILL NEED ENOUGH LEAD IN IT TO MAKE THE OUTBOARD TIP WEIGH 2 OZ. THIS IS THE WINDY URTNOWSKI APPROACH AND FLIES WELL.
OPTION B:
THIS BUILDS THE WINGS WITH THE INBOARD WING 1/2" LONGER THAN THE OUTBOARD WING. THE OUTBOARD FLAP IS BUILT 1/4" WIDER AT THE TIP. TIP WEIGHT SHOULD START OUT AT 1 OZ. THIS IS THE PAUL WALKER APPROACH AND WORKS WELL ENOUGH TO WIN THE WORLD CHAMPIONSHIP.
STARTING TRIM ADJUSTMENTS:
1. POSITION THE CG AS SHOWN.
2. SET THE LINE SWEEP AT 1".
3. INSTALL TIP WEIGHT UNTIL THE TIP WEIGHS APPROPRIATELY FOR THE DESIGN STYLE CHOSEN.
4. START WITH A 3" LINE SPACING AT THE HANDLE.
WINDY URTNOWSKI 4" BELLCRANK
1/8" PLY EXTERNAL BELLCRANK MOUNTS (TOP AND BOTTOM)
BUILT UP LEADING EDGE (2 LAYERS OF 1/8")
1/4" BASSWOOD LEADOUT GUIDE. PULL OUT THE EYELETS AND MOVE THE LINES TO CHANGE THE LEADOUT POSITION.
LONG EYELET
CARVED AND HOLLOWED TIP BLOCK
BUILD THE OUTBOARD TIP WEIGHT BOX USING 1/8" PLYWOOD. SECURE THE LID WITH 4-40 FLAT HEAD SCREWS AND BLIND NUTS. INSTALL A BLIND NUT AND A 4-40 SCREW TO BOLT DOWN THE LEAD WEIGHTS. THIS ELIMINATES THE WEIGHTS FROM RATTLING.
1 1/2" TRAILING EDGE
OPTIONAL "IMPACT" STYLE LARGER OUTBOARD FLAP OUTLINE. RESPACE THE INBOARD WING RIBS TO INCREASE INBOARD WING LENGTH 1/2".
1/16" X 1/4" RIBS (TYP. ALL SURFACES)
1/4" SQUARE BORDERS (ALL)
1/16" SHEET SKINS
"LUCKY BOX" HORN POCKETS (1/8" PLYWOOD SANDWICHED BETWEEN 1/16" PLYWOOD)
1/16" SHEETING
1/4" SQ. SPARS
SHEAR WEBS
1/16" X 1/4" CAPSTRIPS
1/8" SHAPED T.E.
R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12
ALTERNATE PAUL WALKER IMPACT FLAP AIRFOIL
STANDARD "BOB WHITELEY" FLAP AIRFOIL CONSTRUCTION
1/2" THICK ELEVATOR
5/8" THICK STAB
ALTERNATE DAVE FITZGERALD HIGH EFFICIENCY TAIL
LEADING EDGE DETAIL
3/8" THICK STAB AND ELEVATOR
STANDARD "BOB WHITELEY" TAIL CONSTRUCTION
1/4" SQ. BORDERS
1/16" X 1/4" BALSA RIBS
1/16" SKINS
HINGE POCKET REINFORCEMENT (1/4" SQ. BALSA)
1/8" CONTROL HORNS
SHAPED 3/8" BALSA TRIM FOR "RABE" RUDDER
3/8" T.E. SHAPED
3/32" RIBS
BEARCAT R1
BEARCAT R2
BEARCAT R3
BEARCAT R4
BEARCAT R5
BEARCAT R6
BEARCAT R7
BEARCAT R8
BEARCAT R9
BEARCAT R10
BEARCAT R11
BEARCAT R12
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