#428

Profile Bearcat

Frank Williams

Unique sidewinder engine mount (with the cylinder on the inside of the flight circle) provides a good engine run for aerobatics. Idea is for centrifugal force to help keep the glow plug free of oil. This provides better ignition so that the engine runs rock-steady in a "four-cycle" throughout the flight.

This airplane started out as a quick-to-build testbed for checking if side-mounting of the .60 engine, with the cylinder inboard, would improve power characteristics for CL Precision Aerobatics purposes. A lot of heads were turned when it was flown in the 1982 National Contest.

IF NECESSITY is the mother of invention, then the Profile Bearcat was "born" from a need for a flying engine testbed to exercise the merits of a rather wild idea I had about engine performance in a Stunt ship. I wanted to test an engine mounted in the profile position, but not the standard profile setup with the engine mounted facing outboard. I wanted the cylinder facing the inside of the circle. As I will try to explain later, I felt that the performance of the engine was being adversely affected by the standard Stunt ship's inverted mount. The inboard cylinder placement was to let centrifugal force keep the glow plug free of oil and, thus, promote better ignition characteristics and, hopefully, a better Stunt run.

This all came about at the end of the 1981 flying season. I felt I needed a steadier engine run than I was getting. Oh, I had plenty of power with the ST .60 I was running—power to spare, really. But it just wasn't sounding like the engines of the top 20 fliers at the Seguin Nats. To my ear, the "top 20 sound" is one that, in the round maneuvers, rarely breaks at all—a solid four-cycle all the way around. For the four years I had been running the ST .60, I had never been able to run quite in this manner. I wanted to be able to run a big prop real slowly.

A full built-up fuselage for this testbed airplane was out of the question. I needed an airplane that would be fairly quick to build, one that I knew flew well, and most importantly, had easy access to the engine, tank, and associated plumbing. It had to be a profile. Since I can muster enough energy to undertake only one Stunt ship a year, I was risking a whole season on something that might not work at all.

In 1978 I had built a full-blown molded fuselage Rabe Bearcat. It was about 56 oz., had a ST .46 for power, and sported a nice enough finish for it to receive 16 appearance points at the Lake Charles Nats that summer. The plane flew great. Unfortunately, I wasn't its equal. I had been seriously flying Stunt for only two or three years at the time, so my performance was not that good. Even so, for my first Nats, I was satisfied.

Of all the Stunt ships I've flown, the Bearcat is different. No other plane has shown the inherent well-damped dynamic response that the Bearcat possesses. It will fly out of a hard corner without a trace of a bobble or overshoot. No matter how hard you hit the corner, it just turns and lays there. I have always felt that the Bearcat has benefitted from its short nose and tail lengths, resulting in a lower-than-normal pitch inertia. I feel that this lower pitch inertia, in comparison with most of today's Stunters, contributes to the superior damping in pitch that the Bearcat possesses. Also influencing the pitch dynamics are items like the Bearcat's flap size and, most importantly, CG placement. The more rearward the CG can be located, the better the pitch damping (up to a point, of course). This must be coordinated with line spacings, control throw, etc., to achieve the perfect feel.

For several years I had been wanting to try another Bearcat. Why not do it in my testbed profile; the tall fuselage would hide the muffler or exhaust stack that would be pointing up instead of out the inboard side, I reasoned.

The Profile Bearcat is basically a copy of the Rabe Bearcat, though I pumped up the profile view to full vertical scale (if you're going to have a profile fuselage that big, you might as well add in the extra inch to make the scale correct). The stabilizer and elevator are slightly increased as per info from Ron

Harding, who was also the source for the airfoil, trailing edge sweep, and flap size. The modest wing area, 600 sq. in., is enough to do the job, but not so large as to be greatly affected by the wind. The biggest benefit of any semiscale Stunter, though, is that it is a lot of fun to fly.

As stated earlier, the sidewinder engine-mount was intended to utilize the ever-present centrifugal force to keep the plug free of oil and promote better ignition. I seemed to recall reading several years back that Rich Porter had found better performance with his ½A Stunters with the "jug" facing inboard. I figured it might be worth a try for a .60, also.

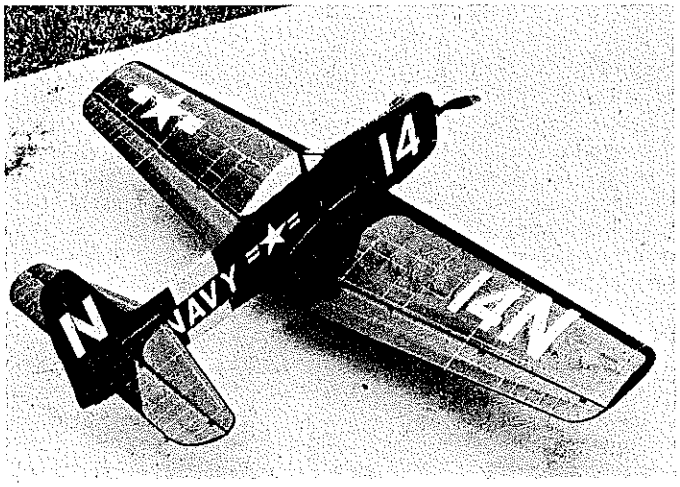
The problem I was experiencing was just something I had learned to live with for a long time. For all the time I had been using the ST .60, I couldn't successfully run a full 14-6 prop. I knew the .60 had the power to turn it; I just couldn't run the engine slowly enough to get lap times down to a flyable speed. With the plane sitting on the ground, I estimated that I needed to be turning about 7,000 rpm to achieve the proper airspeed. However, as I backed the needle out on the ground, it would get down to about 7,500 rpm and then just fall off into a very rough, hit-and-miss stumbling idle. Sometimes I would get off the ground with it running fairly slowly, only to have the engine suddenly flameout and die at the bottom of an inside square.

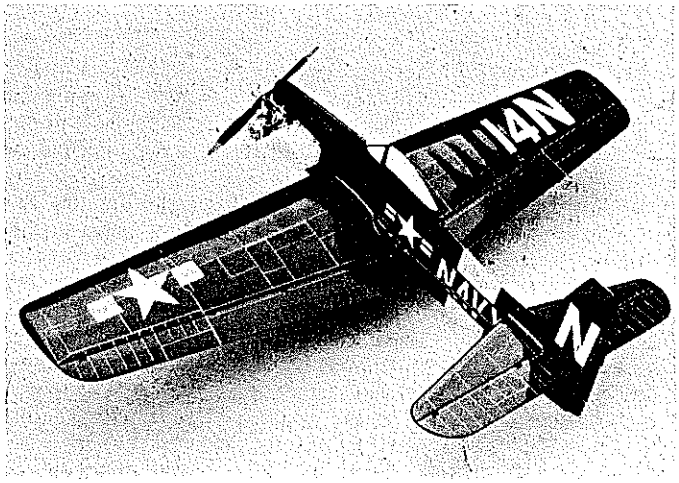
Consequently, for several years, my best results were with 14-5 Zingers, which are really a little less than 5-in. pitch. The engine runs fast enough with this prop for it to stay warm and keep the plug lit. Although this isn't a bad engine-prop combination, it doesn't have that "top 20 sound." I felt that it was running just fast enough for it to break a little too much and stay on just a little too long down the backside of the figure. It was turning loose just a little bit too much power. I could live with it, but it was a nuisance (if I had to have the engine run with either a bit too much power or with too little power, I figured that I was probably better off with too much.)

I've also had experience with 12 and 13-in. props. Yes, they help the problem, but once you've felt the bite of the big 14-in. props as you pull up in a wingover in the wind, you can't go back. Actually, for a nice smooth run on the ST .60 on calm days, the 12-6 Top Flite Power Prop is great.

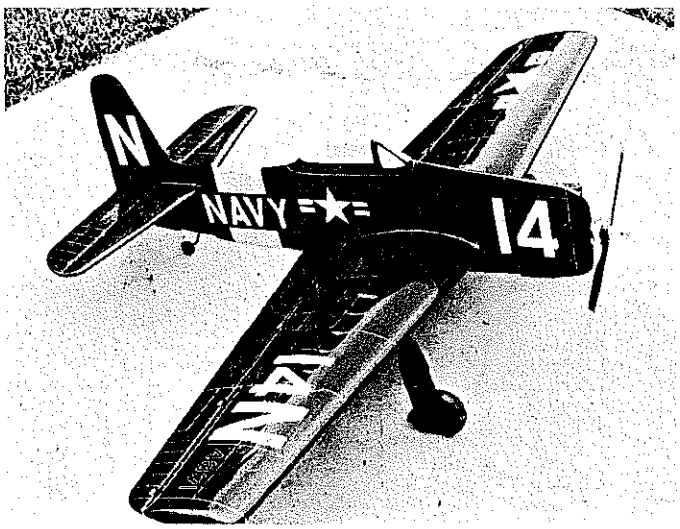
I tried more propylene oxide in the fuel, more nitro, less oil, purer alcohol, different plugs—all with no luck. Finally, I pulled the engine out of the plane and put it in the test stand. I fired it up; to my surprise, it would idle beautifully down to 5,000 rpm. (In the plane, it wouldn't go below 7,500 rpm.) Then it dawned on me: on the test stand the cylinder was pointing up, with gravity cleaning the plug; in the plane the jug was inverted. Whether it's oil, fuel, or what fouling the plug, I'm convinced that the idle of an engine is definitely affected by the inverted-engine configuration.

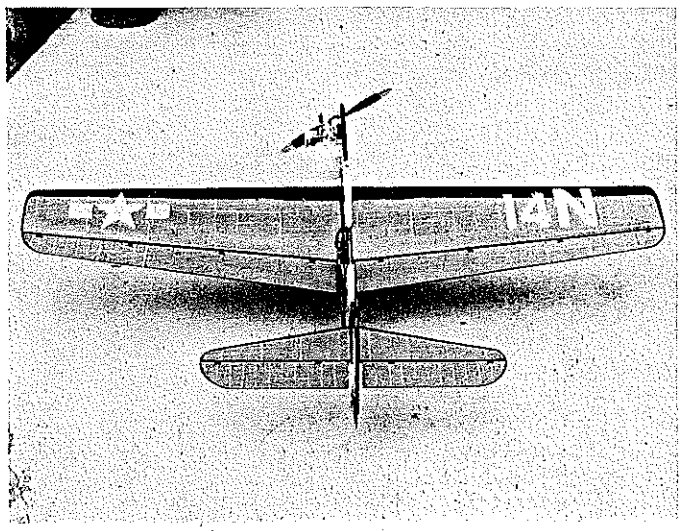
Looking back, I was getting a good run in upright flight, for the most part, though it would slightly stumble every now and again. But I would take the same plane and pull it over inverted, and the engine never missed a tick all the way round the circle. I had also noticed that I was scoring better on outside maneuvers than on insides. An outside figure also develops G-forces that clean the inverted cylinder. My outside figures had that "top 20 sound," of a constant power setting all the way around. The break I was getting on the insides was causing a power



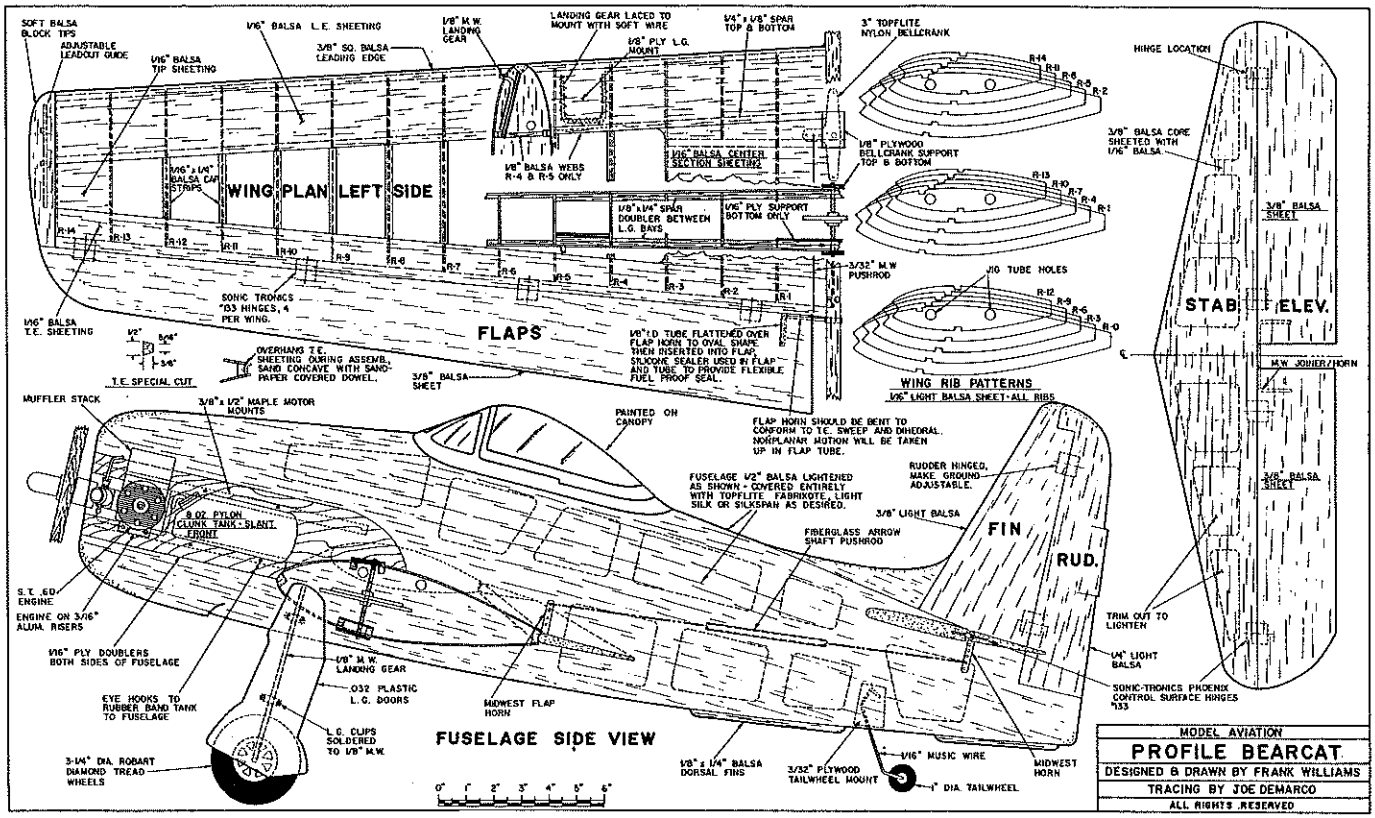


The Profile Bearcat is a great competitor. Although far from contemporary standards with respect to areas and moments, the plane's short-coupled configuration allows bobble-free, square corners. Lead-outs are adjustable for obtaining the proper line tension under different flying conditions. The front lead-out is for the up-line. The plane was covered with Top Flite FabriKote Lite, painted with K&B Super Poxy.





Left: Landing gear doors are cut from .032-in. plastic sheet. The long landing gear provides for realistic main-gear landings and takeoffs. Dihedral in the wing adds to the scalelike impression. Right: It's definitely a profile, readily apparent from this view. The slab-sided fuselage performs great in windy weather. Large wing flap area of the Profile Bearcat also shows nicely in this view.



surge and producing irregular shapes.

The stumbling in upright flight, I've since been told, may be from voids or pockets between the sleeve and case in the bypass area of the engine. They fill up with raw fuel and then spill onto the plug.

Somehow, all of this fits in with the fact that, when using the ST .60 in a standard inverted configuration, you must locate the tank centerline about ⅜ in. above the spraybar to achieve a satisfactory run on both insides and outsides. (I might add here the curious fact that I'm told that the OS Max FSR engines are just the opposite, needing a tank located low with respect to the spraybar when used in Stunt ships.)

If there is a drawback to the sidewinder mount, it's that special care must be taken to assure that the plumbing from the tank to the venturi stays close to the engine. What usually happens with a profile engine mounted in a Control Line Airplane is that the engine will burp rich when accelerating in one direction and lean in the other. This simply is caused by the fact that the fuel line comes into the venturi from the top or bottom. As the airplane accelerates in the direction of the fuel line, the engine momentarily sags rich. If the airplane pulls up away from the line, the engine peaks lean. This is most apparent in the square corners. The best way to minimize these effects is to keep the fuel line as close to the engine centerline as possible. (An alternate technique that works well is to bring the fuel line around the cylinder from one side, pass it behind the venturi, and connect it to the venturi on the opposite side. This places a line of fuel close to the needle valve seat that is both above and below it. Many Slow Combat planes utilize this technique.)

The tank and tubing configuration shown on the plans is what I currently use. I have found it to be quite satisfactory. I recognize that the New Jersey and other East Coast fliers using the ST .60 at the Lincoln Nats were very impressive and seemed to have no problem with the inverted mount. Maybe it's just me or the high humidity in Houston, where I live. I do know, though, that I can now run a big prop down at a speed that is flyable whereas, before, I wasn't able to do so at all. I think that the lower power setting that is attainable is probably most beneficial in windy conditions.

As luck would have it, though, after being one of the very few fliers out practicing on Sunday, Monday, and Tuesday in the stiff winds at Lincoln (1982 Nats), I flew my first

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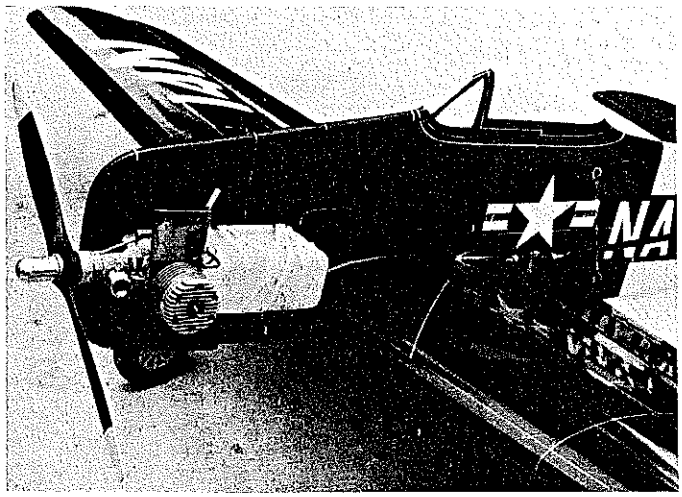

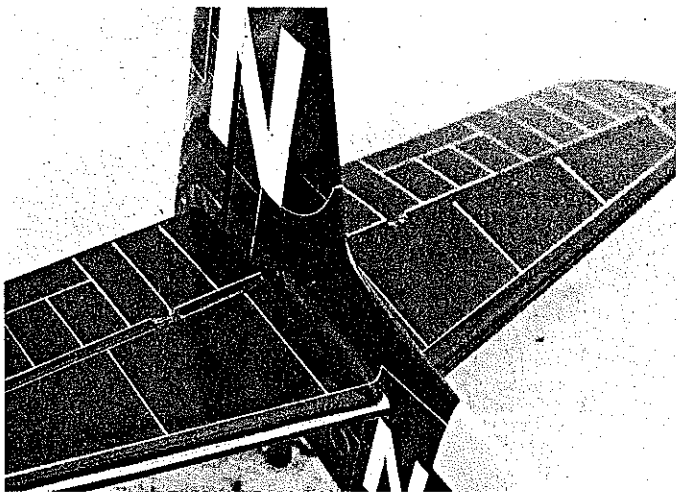

Left: Supertigre .60 engine with .295-in. venturi is completely exposed for easy adjustments. Same goes for the 8-oz. clunk tank. RC Quik Links on the flap horn allow adjusting the flap/elevator movement ratio. Right: Panel line detailing is white India ink applied with a technical drafting pen with the aid of a flexible straightedge. The greatly improved appearance makes the work very worthwhile. All photos by the author.

to tell you that this series is being guided, to a large extent, by much on-field experience with fellow fliers' problems and questions and by the many persons who have called or written to me, or those questions I have read in various magazines. Since my biggest concerns are over what I may have unintentionally missed, inadequately covered, or innocently confused, I again invite you to say so. Bob Kopski, 25 West End Dr., Lansdale, PA 19446.

Now, a really import address. SEAM is the Society of Electric Aircraft Modelers, a national organization dedicated to the advancement of electric-powered model flying. The SEAM newsletter contains much information about things Electric—news, views, and how-tos. Membership is a mere 10 bucks (under 16, Junior, is $5). Write to SEAM, 11632 Flamingo Dr., Garden Grove, CA 92644. Of course, AMA membership is required.

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qualifying flight on Wednesday in conditions all Stunt fliers dread more than anything else—absolute dead calm.

Even though this is a profile airplane, I'm not sure that I would classify it as a novice project. This is mainly because of the wing dihedral. The wing must be built on "jig tubes." As far as I'm concerned, this method is the only way to build a wing whether it has dihedral or not. The jig tubes assure a straight, warp-free wing, which is imperative for any Stunt ship. This plane won't work without the dihedral, either. It won't look right for one thing, and the dihedral is needed to get the lead-outs up to the CG of the airplane.

Don't be influenced by those who say that a plane with dihedral won't turn the same inside and outside. T'aint so. We're only talking about 3°. The performance is as good as any straight-wing ship.

If you can't find aluminum tubes, most hardware stores have solid ⅜-in. aluminum rod. This works just as well. The tubes are supported and leveled at both tips and also in the center section.

The wing is completely constructed on the jig tubes, including leading and trailing edge sheeting, center section sheeting, landing gear installation, and installation of the bellcrank and leadouts. After the wing construction is complete, the tubes are carefully removed and the tip blocks are added. The balsa you use must be in the 4 to 6-lb. range.

The trailing edge spar is cut from ⅜-in. sheet with a table saw or radial arm saw. The trailing edge sheeting purposefully overhangs the back of the spar. A sandpaper-covered dowel is used to achieve the concave shape of the trailing edge. This produces a somewhat tighter and aerodynamically cleaner hinge line than is normally attained. The counterlever hinges, as noted on the plans, are the key to making this setup work correctly. The flaps are made from ⅜-in. sheet. The center of rotation of the flaps is the center of the flap leading edge diameter. The same technique is used on the stabilizer and elevator.

The flap horn is simply bent to the proper shape to conform to the dihedral and trailing edge sweep. I know it seems that the motion on the arms will be too unplane to be useful, but it works. The out-of-plane motion is taken up in the brass tubes that are inset in the flaps. This tube is ⅛ in. i.d., flattened over the flap horn arm to an oval shape. When the flap is assembled, I usually fill the tube with aquarium sealer as a fule-proofer. The aquarium sealer will stay flexible for the life of the plane. (Actually, for planes with only 1 in. of trailing edge sweep and no dihedral, I just make the proper bend to the horn and solidly affix the arms in the flaps. It works fine with no bind whatsoever.)

The fuselage can get too heavy if you're not careful. The lightening holes are a must. It's a bigger chunk of wood than you might think. Be prepared, also, for the shock of that big "slab" perched atop your wing.

Seldom does my wife comment about my Stunt ships at all during the construction stage. Sometimes after they are completed I get a, "Oh, thats a nice shade of blue," or, "Why doesn't it have a pilot in it?" My wife confronted me the morning after I cut out the profile fuselage and had mounted it atop the wing: "What in heaven's name are you doing out there this year?"

The entire airplane was covered with Top Flite FabriKote Lite. Each component was

covered separately before I joined them together. (The FabriKote is heat-shrinkable. It is nice for covering compound curves.) The finished product, after two to three coats of K&B Superpoxy clear to fill the weave, looks like you have covered the plane with silk and dope. The nice thing about heat-shrinked materials is that, in one evening of work, you can go from raw balsa to a surface that will never ever fall back into the grain of the wood.

The weight of the FabriKote isn't that bad, either. The raw material to cover the top and bottom of the 600 sq. in. wing and flaps was only 1.9 oz.; after three sprayed coats of K&B clear, 3.3 oz., (If I were to do it again, I might just use the regular FabriKote in the Navy blue color and eliminate the clear filling coats.) Why do I use epoxy paints? They produce a fine finish, for one thing, and they are quite durable. Mainly though, I'm about a mile from Galveston Bay, and there are only about four days of the year that one can use dope without terrible blushing problems.

If there is a drawback to the FabriKote, it's that the stuff doesn't sand at all. Therefore, all seams should be kept on the underside of the plane. Those seams that are visible, like at the tips, must be dealt with by using primer to build up a ramp from the low side. This is then feathered smooth.

The Navy blue color is a one-to-one mix of K&B blue and black. Jim Lynch, noted Bearcat builder and flier, once told me that he's never seen two Bearcats the same color. The one-to-one mix looks mighty dark when in the workshop, but when out in the daylight, the blue comes through.

The white panel lines are white India ink, drawn with drafting pens. The white ink usually doesn't want to work as well as black ink; it tends to bead up. This problem can be alleviated by adding a drop or two of liquid detergent to the ink in the pen reservoir.

The final weight of my Profile Bearcat was 59 oz. Why so heavy? Actually, a profile fuselage really doesn't have much less material than a built-up one. So far, no one ever accused me of being a light builder, either. Mainly though, if I had used a .46 in it instead of the .60, it would have weighed 56 oz.—not a bad weight, you might say. If I had a choice between a 56-oz. place with .46 and a 59-oz. plane with a .60, I'll take the .60 every time. Horsepower is addictive.

Aerodynamically, what does this tall fuselage do to the airplane's performance? Does it solve some line-tension problems when overhead? It sure doesn't hurt. You can get the plane yawed out too much though; it'll tend to block the tail somewhat and shadow the outboard wing. Also, the glide after engine shutdown will be all of one-half lap. My best performance has been with the leadouts fairly far forward. You do experience some buffeting on breezy days in level flight as a result, I assume, of vortices rolling off the relatively sharp edges of the fuselage.

The Profile Bearcat's maiden contest outing was July 4th at Ft. Worth. Semiscale model-flying Stunt pros Al Rabe and Frank McMillian were in attendance. The plane only had about a dozen test flights on it, and the day was quite windy. However, it performed beautifully. Whereas others were getting blown out of the pattern, the Profile Bearcat chugged along with very steady 5.7-sec. lap times and rock-solid line tension. I think everyone was impressed with its performance.

I've always thought that profile Stunt ships have been sold short on their flying abilities and that many intermediate and advanced-level fliers spend too much time and effort in building the "ultimate" full-fuselage Stunter, overlooking the benefits of more quickly building a profile so that there will be more time flying.

Will the sidewinder engine mount and semiscale profile airplanes revolutionize Stunt flying? Probably not, but it does work quite well, and it is a lot of fun to fly. If you feel like you're in a rut with your usual year-after-year classic Stunter and you want to try something a bit out of the ordinary, then consider the Profile Bearcat. It may be just the plane you need.

Miniatures/O'Dwyer

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which doesn't break easily is best. Wood selection is very important when you are working in this size, as the softer woods will break away when you come to thin regions