SUPER VOODOO

DESIGNED & DRAWN BY JOHN JO

TRACING BY JOE DEMARCO

John Jo

Super Voodoo

The author, a former Nationals Combat Champion, has taken home hardware from three out of five Nats to date, and has won 80% of local meets he has entered. Consistent equipment and a positive mental attitude are his keys to success, not to mention a well-designed/trimmed airplane.

IN MY beginning days of Combat, there was the Voodoo. The performance of the plane was good in stock form; however, I sought a higher level. I started to experiment.

During the first two years of development, the ensuing modified Voodoos were quite successful for me in local, regional and national competition. Now, after seven (cumulative) years of evolutionary work, the Voodoo's great-grandson no longer gives clues to its family ancestry. The Super Voodoo is completely different than its forebearer in every way.

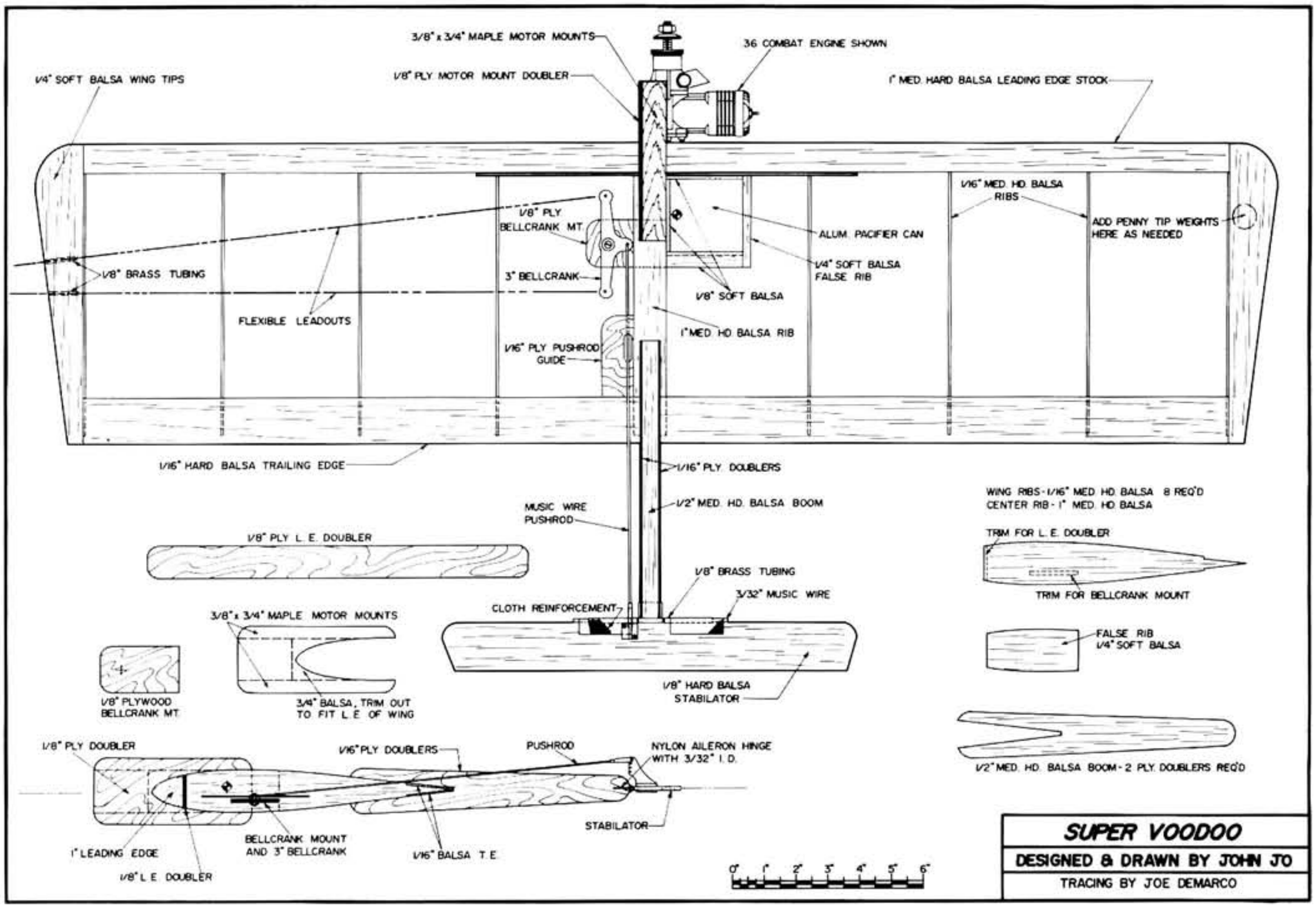
The Super Voodoo's design concept focuses on competition practicality without sacrificing anything in Combat maneuvering ability. This is an easily said but most difficult to achieve design parameter. The Super Voodoo satisfies the desired goal only through careful research and application of proven aerodynamic theories. This plane is scientifically designed and thoroughly engineered.

Bill Netzeband, one of the premier geniuses of Control Line aeronautics, aided me immensely with his pearls of wisdom. After reviewing all his published articles (no easy task in itself!), after many eight-hours-a-day question and answer sessions, after explanations and re-explanations of his data sheets that cover just about everything in Control Line aerodynamics, the Super Voodoo slowly started to form on the drawing board. Let's take a peek.

Wing, top view. The ultimate layout would be one in which the leading and trailing edges would taper towards each other at each tip in such a way that the center-of-pressure would be located at every quarter-chord point along the span. When compared to a non-tapered rectangular wing, a tapered layout locates the mean aerodynamic center of each wing half closer to the plane's center line. This reduces stress concentrations which bear directly on the plane's center structure. (Sweeping the trailing edge forward at each tip, while leaving the leading edge straight, progressively moves the center-of-pressure forward from

How much of CL Combat is piloting ability, and how much is the plane? We know how most would answer this question. But if a top pilot was flying a top plane, then . . . The Super Voodoo is carefully thought out and proven in contests.

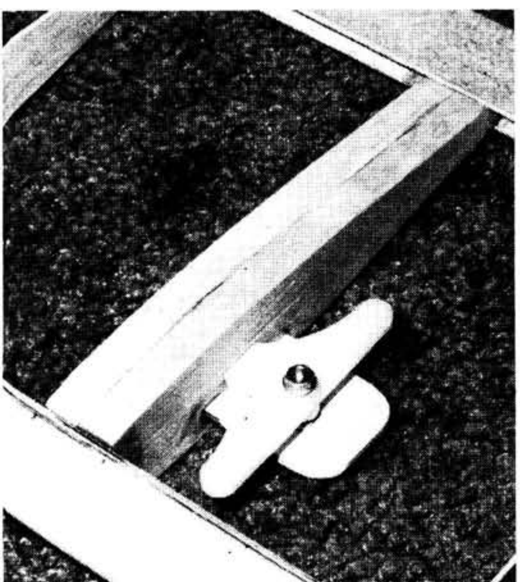
FULL-SIZE PLANS AVAILABLE . . . SEE PAGE 128



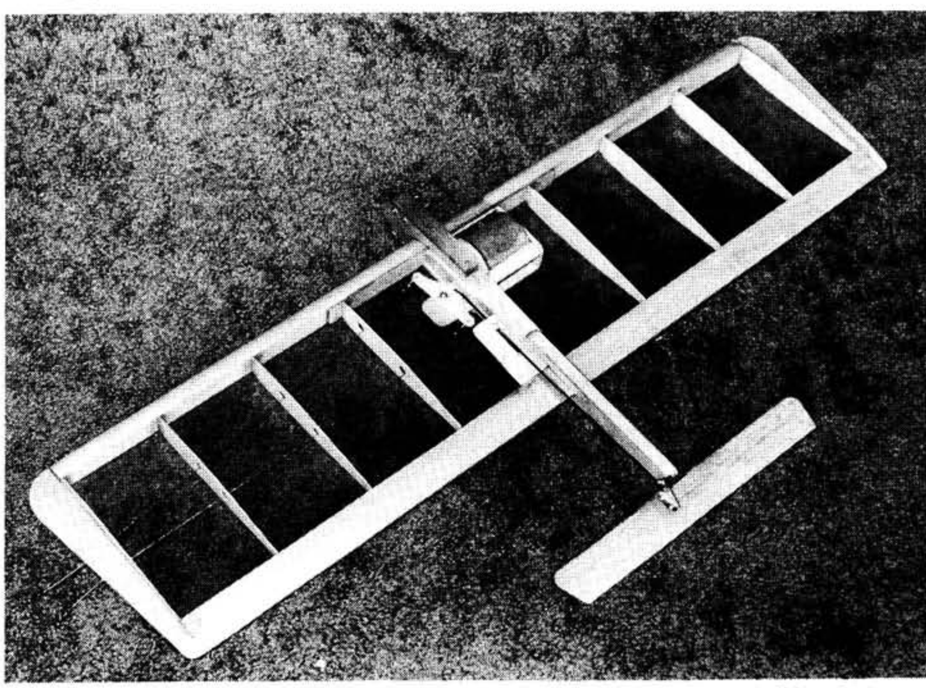
the wing center line to each tip; this can produce sudden, unwanted glitches.)

The Super Voodoo's rectangular wing also keeps its center-of-pressure along the quarter chord; however, this layout builds up more stress in the wing's center structure due to each panel's more outwardly displaced mean aerodynamic center. Fortunately, this extra stress is easily compensated for in construction technique. Strong Sig leading edge stock of two-ounce density per 36-in. length and integral five-ply doubler keep the wing intact. Trailing edge stock should be of very hard balsa to complement the leading edge components in keeping the wing together. Incidentally, plastic coverings contribute virtually nothing to structural integrity.

Wing, side view. There has been a lot of conjecture concerning airfoil design for our relatively low speed (90-110 mph) aircraft. I have seen everything in Combat design, from a sharp leading edge with rapier airfoil to a blunt leading edge with blimp airfoil. The former would be more suited to hypersonic moon shots, while the latter would be quite happy in a leisurely balloon



One-inch center rib with integral bellcrank mount allows easy checking and maintenance of the complete control system. Frayed flexible leads or worn bellcrank holes (either of which indicate need for replacement) can be seen readily through clear iron-on covering. Author uses Fascal.



With latest miracle adhesives, such as Hot Stuff and epoxy, the Super Voodoo builds as fast or faster than any other plane. Once parts are cut out, plane can be built in a couple of hours.

Pacifier compartment. Location (see plan) does not change pitch-axis CG. An added bonus is that the pacifier system doesn't displace lateral CG outward as much as a long surgical tubing bladder.

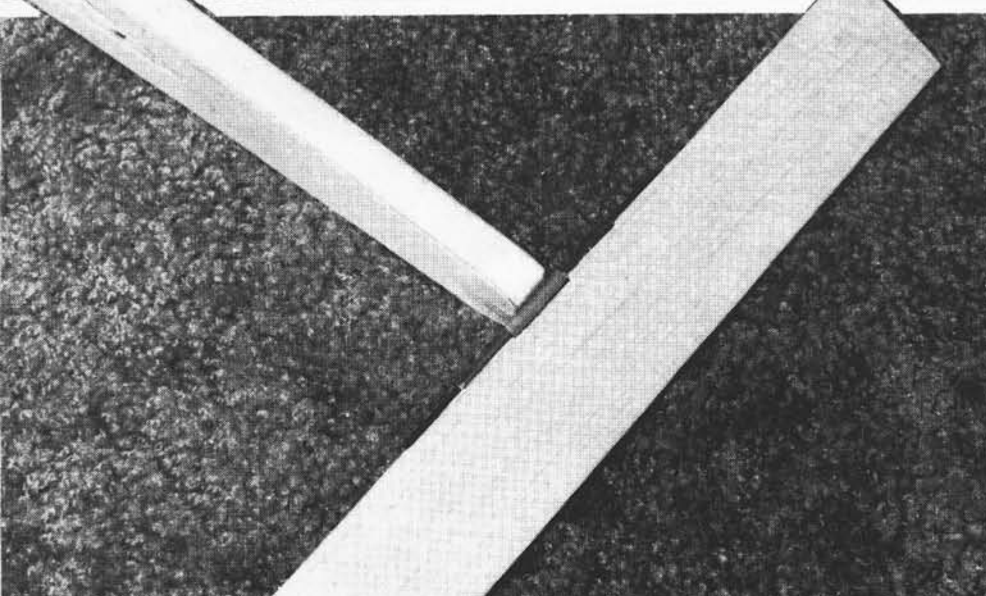
race.

Through unprejudicial testing, it has been found that airfoil selection for our speed and type of aircraft is not really all that critical. Just remember this: if an airfoil is neither too blunt nor sharp of leading edge, and it has a 12-18% maximum thickness with the high point located between 20-30% of the chord, the airfoil has more than enough potential for the job at hand. The airfoil on the Super Voodoo is not a magical one. It is a modified St. Cyr 172, which has a 13.5% maximum thickness at 30% of the chord.

A model of 38.74-in. span by 6.46-in. chord and the St. Cyr 172 airfoil was tested in a wind tunnel at a 90 mph velocity. The results showed a lift coefficient approaching 1.0 with a 20/1 lift/drag ratio. The airfoil's center of pressure stayed at 25% of the chord throughout the lift curve. The St. Cyr 172 displayed non-violent stall characteristics. I'd like to pass on this interesting fact: the St. Cyr airfoils were designed and tested in 1925! As the saying goes, "New news is only reintroduced old news."

Here's a multiple choice. Which two are the correct answers? The two most important factors in Combat design are: (a) wing loading, (b) power loading, (c) span loading, (d) trim, (e) aspect ratio, (f) the prop nut, (g) none of the above.

After careful reviewing, it was determined that the correct answers are (a) and (d). Let's take the former first.



Brass tubing spacers with nylon aileron bushing promotes long trouble-free hinge life. System eliminates wear on the stabilator surface, boom, and hinges from side loads.

Wing loading. Through experimentation, the maximum wing loading for winning performance is at or very close to 15 sq. in. per oz. This wing loading can be obtained by building a kit Voodoo so that all-up weight, including fuel, is exactly 22 oz. (A stock Voodoo has 330 sq. in. wing area.) By contrast, a 17½-oz. Super Voodoo with 356.2 sq. in. computes to 20.3 sq. in. per oz. wing loading, or roughly 35% more favorable than the first example. In regards to wing loading, just remember that 15 sq. in. per oz. is adequate, but 20 or more sq. in. per oz. is gravy.

Trim, what's that? Trim has nothing to do with getting a haircut, unless a plane is trimmed incorrectly; then it may bank towards the center circle for a close shave, if not a haircut. Proper trimming of the Voodoo or any Combat craft is accomplished through the use of pins for pin-point accuracy. Note the Super Voodoo's center of gravity (CG) position on the plans. Push in strong straight pins (such as T pins) part way, at the wing tips, exactly opposite the CG position shown on the plans. The CG isn't correct until the model remains level when supported only by finger tips under the shafts of the pins.

The Super Voodoo requires this exact location for maximum performance. An eighth-inch forward placement of the CG from the Super Voodoo's ideal spot turns the aircraft into a smooth-turning bomber. For highly maneuverable fighter performance, make sure the plane's CG is *exactly* where shown on the plans. Unless you like to helplessly watch a Free Flight, do not move the CG further rearward; you will have no

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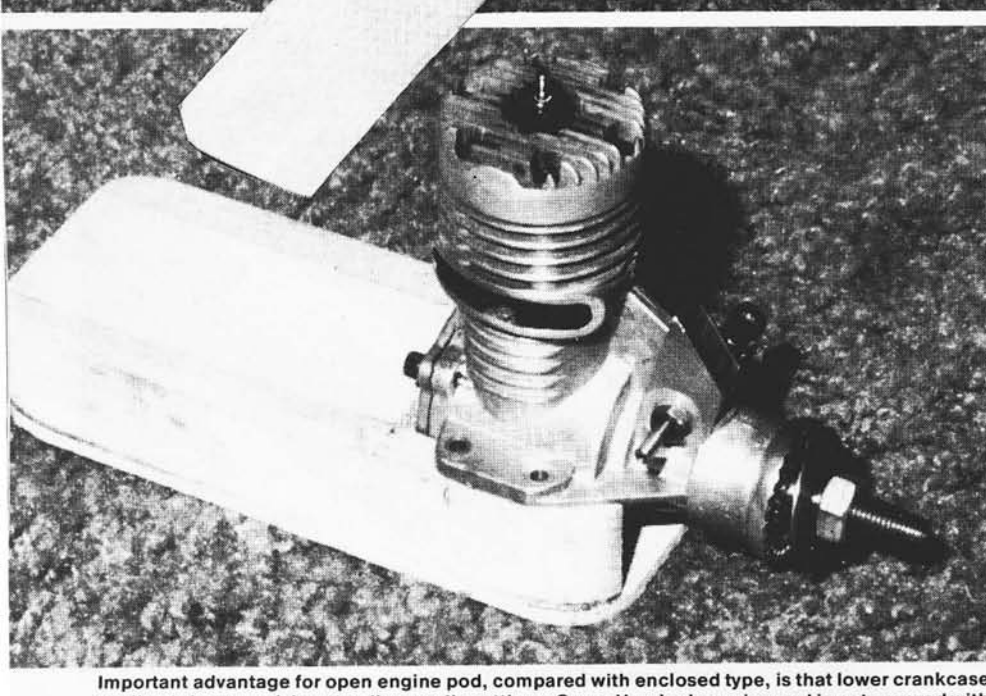

Important advantage for open engine pod, compared with enclosed type, is that lower crankcase cooling is better—giving steadier needle settings. Super Voodoo's engine pod is not covered with glass cloth and resin. It builds faster, and still offers exceptional strength.

Super Voodoo/Jo

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control!

Trim, line rake? Proper line rake has been computed via formula and flight-adjusted for a minimum aircraft speed of 90 mph. Those who build in line rake for 120-mph speeds will suffer decreased line tension as soon as the plane lifts off with the streamer. (A full streamer can slow down a Fast Combat plane almost 10 mph.) Those who build in excessive line rake will waste engine efficiency by directing the power outwards.

Proper line rake was computed to a 90-mph minimum Combat speed because of my observations at five Nationals to date. At these varying contest locales, I observed that under average atmospheric conditions the top Combat fliers were usually turning 90-100 mph. Under ideal atmospheric conditions, these same fliers upped their speeds to the 100-110 mph region. Poor atmospheric conditions dropped their speeds to the 80-90 mph range. All flights were with full streamer. All flights were accurately timed. With this data and a little interpolation, you can see why I selected 90 mph as the minimum Combat speed to compute line rake.

Before we go on to the next area of trim, here's a tip that I use to find the true air speed of a Combat plane when it is not flying absolutely level.

Step 1: Note the angle between the lines and the ground.

Step 2: Look up the cosine of this angle, and multiply it with the apparent speed of the plane to get true speed.

Example: I clocked a plane which was flying at 45 degrees. The plane's apparent speed was 100 mph. (The speed charts assume that the plane remains level during the clocking. In this case, the plane wasn't level, so its chart speed is not the true speed but the *apparent* speed.) To get true speed, multiply the cosine of the angle the plane was flying at (cosine 45 degrees is .707), with the apparent speed (100 mph)—100 times .707 equals 70.7 mph *true* speed. If the plane was flying at 25 degrees (cosine 25 degrees is .906), the true air speed would be 100 times .906, or 90.6 mph. The cosine values used in these examples are for the two most popular angles at which Combat pilots cruise their planes while waiting for their opponents to become airborne. The cosine values for the 45- and 25-degree angles can be rounded off to .7 and .9, respectively, for easy multiplication and with less than 1% error in true air speed. Memorization of these two angles and values could be of future use to you at the contest field.

Trim, wing offset. Because the outboard wing travels faster than the inboard, the wing lift center on a Control Line aircraft is not the same as its geometric center. The proper amount of wing offset trim needed on the Super Voodoo was precisely calculated. It was found that the Super Voodoo's wing lift center is laterally located .312-in. outboard from the geometric center of the wing. The plans show the wing lift center's lateral reference point as the engine thrust line.

Trim, CG-offset-from-thrust-line. The plans show that the lateral CG is displaced .250-in. outboard from the engine thrust line. This CG-offset-from-thrust-line distance was precisely calculated, too.

Trim, Stabilator. Most Combat pilots would probably prefer the exact amount of stabilator movement to produce minimum radius turns without speed loss. On the Super Voodoo, this figure is 16 degrees in each direction. Personally, I prefer 24 degrees up and down movement on my stabilator (this is 50% more stabilator movement than needed if CG is per plan). In certain situations, I use this extra stabilator movement to my advantage by sacrificing a little speed to gain a tighter turn.

Trim, control system. Use your favorite method to suit your timing. Personally, I prefer to set up my control system where each degree of bellcrank movement produces one degree of stabilator movement. This is an extremely fast-reacting setup *within* the wing; however, I adjust the plane's internal control system externally, by reducing the line spacing at the handle until the plane flies perfectly to my eye-mind-hand rhythm.

What happens when all this extensive trimming is done? If done properly, the Super Voodoo will have its drag center in line with the wing lift center and thrust line; hence, the plane will react positively to every command, giving no surprises to the pilot. This allows full concentraion on winning the match.

Performance. With 50% nitro-methane, 8-in. pitch epoxy-fiber prop, and flying a couple of feet off the deck on a speed pylon, the Super Voodoo has attained 126 mph with a Fox Combat Special and 121 mph with a Fox 36XBB (both engines had been retimed, freed, and fitted with special rear bearings). Timing was for seven level laps on exactly 60-ft. lines.

Now comes a big Combat tip: 50% nitro, 8-in. pitch props, flying level, and 60-ft. lines have lost many more matches than they have won! If you want to win more, try this combination: 10-15% nitro-methane; 9-6½ Rev-Up or 9-6 Top Flite prop; do not ever fly level unless attacking; and use 60-ft. 5½-in. lines for added reach. Using 12½% nitro fuel and 9-6 prop, the Super Voodoo's *Combat* speed without streamer is 114 mph with Fox Combat Special, and 109 mph with Fox 36XBB. This is more than enough performance to consistently win.

Building outline. Epoxy the plywood doubler to the leading edge. Pin down the trailing edge on a flat building board. Instant-glue (Hot Stuff, etc.) the tip ribs to the trailing and leading edges, then finish instant gluing the other ribs in place, except for the center rib. With plywood bellcrank mount installed, epoxy the center rib to the trailing and leading edges. Go over all instant-glue joints with epoxy, then epoxy the upper trailing edge in place. Glue wing tips on.

Build up the motor mount as a single unit, then cut out appropriately for leading edge and center rib clearance. Epoxy motor mount unit to wing.

Epoxy plywood doublers to both sides of a ½ x 1½ x 9-in. boom blank. Cut out the monoboom from this sandwich. Cut out the stabilator from very hard balsa. Using a Klett aileron hinge, 3/32-in. wire, ⅛-in. brass tubing and cloth, join the stabilator to the boom, then epoxy boom unit to wing.

After pushrod and leadout guides are epoxied in, install controls. Install fuel system. Cover wing using Fascal. Fuel-proof exposed wood parts. Drill holes for engine and streamer (move engine fore and aft to achieve correct CG placement). Using wing-tip weight, balance for correct lateral CG.

The Super Voodoo is ready for flight!

Final note. Whether you're new to Combat or an expert flier, I sincerely hope that you have learned something of use from this article. Have fun in the Combat circle!