# Rocket Diagrams

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NAR

## *Lil' Mama*
### *1/2A R/G*

***By Kevin Kuczek***

I have flown and lost to thermals quite a few swing wings and believe that their design is the most optimum one out there for free flight R/G. Al Nienest, was the real pioneer and when he was a competitor, nobody could touch him in R/G. I've written him a couple of times and spent a lot of late night hours with him at previous NARAMS discussing the ins and outs of what makes gliders great.

Most notably, the swing wing design is characterized by its high aspect ratio wing. High aspect ratio wings are used by most sail planes to yield superior lifting characteristics when compared with a low aspect ratio wing with the same area because lower induced drag is realized. Induced drag is inversely proportional to a wings aspect ratio.

The Lil' Mama is based on many of Al Nienest's designs. When designing swing wing R/Gs, I usually try to aim for a 0.75 TVC (Tail Volume Coefficient) since I've had pretty good luck in thermalling gliders which had this value.

a TVC of 0.9 is considered optimum and 0.5 is considered poor. Also, depending on the airfoil you choose, this glider should be highly stable in flight.

With the airfoil I'm using and a C.G. 33% back from the leading edge, I calculated a static margin of 0.12 (the neutral point was at 45% of the wing chord). Building your first Lil' Mama will probably be a challenge. Please read through the directions below carefully and think through the design while building.

Begin construction by cutting the entire wing from light 1/16" thick 4 – 6 lbs./cu. ft. contest balsa. Sand your favorite airfoil into the entire wing making sure that the high point is 25% back from the leading edge. Cut the wing in two and using a compass, draw a curve at the trailing edge to facilitate rotation (see plans). Next, cut out the wing holder panels from bass wood or hard balsa. Make sure that your wing holder panels, when attached to the wing, extend approximately 1/8" to accommodate the boom (see plans).

Using your compass and Dremel tool, draw and then bore a 1/2" diameter hole into each wing holder panel. Cut two pivot discs from 1/16" bass wood or hard balsa and glue to bottom of wing first. Next thread them through each wing holder panel and glue to the plywood retaining discs.

Next, glue a length of carpet thread to the inside corner of each wing, making sure that this glue joint does not extend past the curved section of the wing. Sand the 1.5" dihedral into each wing holder panel and then glue the two wing holder panels together. Next, glue the wing assembly to the bottom of the boom making sure everything is lined up properly.

The tail feathers, (stab and rudder) can now be constructed out of 1/32" medium balsa. Sand an airfoil into the stab and a symmetrical airfoil into the rudder. Glue the rudder to the airfoil surface of the stab – do NOT glue the tail feathers to the end of the boom.

Next, build your engine pod and glue a 3/4" long x 1/2" high x 1/8" thick engine pylon to the engine pod. Load the engine pod with a spent engine casing and tape to front of boom, positioning it so that the glider balances 33% back from the leading edge of the wing. Your actual pod attachment may not match the plans but should come close. Just make sure that the engine nozzle is at least 1/2" from the leading edge of the wing or else erratic boosts may result.

Next, glue two wire hooks to the bottom of each wing 1 1/2" from the tips, two near the large inner radius on each wing, and one near the pod on the engine pylon, as shown on the plans. Next, tie a 1.5" rubber band to the two carpet threads that were glued to each wing (the threads go through the corresponding wire hook on top of each wing). The carpet threads are longer than what is needed so that knots can be tied easily. You will know at this step how long they need to be to actuate the swing wing mechanism via the particular rubber band you're using. A wire hook is glued on the bottom of the boom just in front of the tail feathers so that the rubber band can be attached.

Next, sand a negative incidence to the bottom of the boom where the tail feathers are to be attached. Re-tape the tail feathers to the boom and gently hand toss the glider. If the glider sails, too much incidence was sanded in. This usually isn't the case and more incidence will have to be put in so that a flat glide results. Finally, glue two 1/4" long launch lugs to the bird-one at the rudder/stab joint and one on the bottom of the wing holder panel.

To flu, tie the wings back with dental floss. Tie the dental floss to the outer right wing hook, and fold the wings back into the launch position. Thread the floss under the boom through the left wing hook, forward under the pylon hook, and through the two exhaust holes on the pod. Use the engine friction fit to hold the floss tight. Connect the rubber band last.

Finishing the Lil' Mama is simple. I just apply one coat of sanding sealer to all parts and then sand smooth. Depending on how light and fragile the wing is, sometimes I'll put some CA all along the trailing edge. I'll usually blast it with a little fluorescent paint after it's all put together. Happy flying and good luck!

### Tail Volume Coefficient Equations:

$$\mathbf{TVC} = \frac{S_s \times L_s}{S_w \times c}$$

$$\mathbf{TVC} = \frac{5 \times 6.4375}{26 \times 1.625} = 0.76$$

**TVC** = Tail Volume Coefficient

$\mathbf{S_s}$ = Stab Area

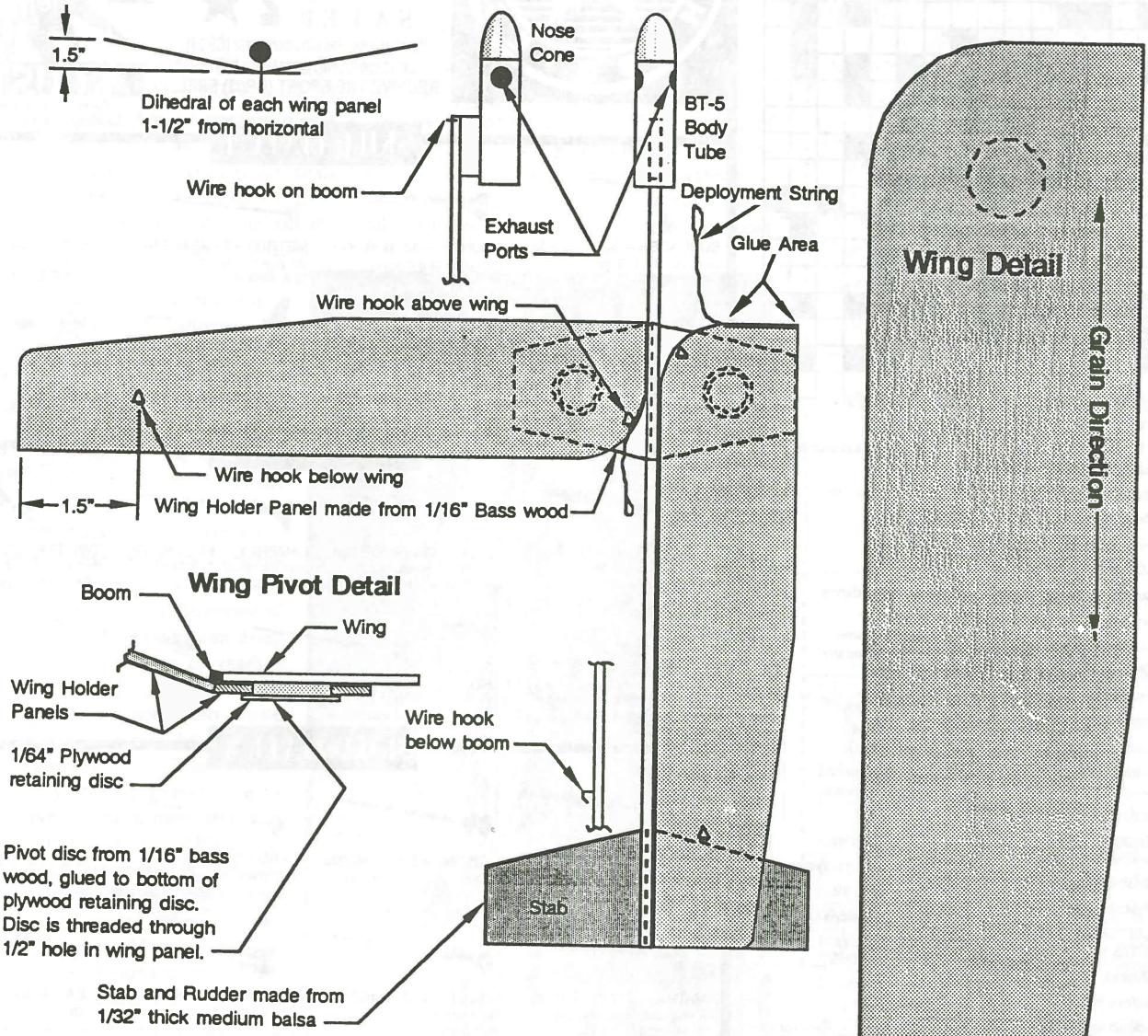
$\mathbf{S_w}$ = Wing Area

$\mathbf{L_s}$ = Distance from aerodynamic center of wing (0.25 x wing chord) to 25% point of stab chord

**c** = Average wing chord = $\frac{S_w}{Span}$

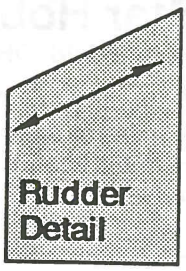
# Rocket Diagrams

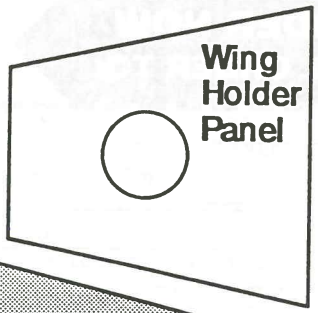
TO SUBMIT YOUR ORIGINAL ROCKET DESIGN, MAIL PLANS AND INSTRUCTIONS TO:
SportRocketry, 1202 Mosswood Court, Florence, KY 41042

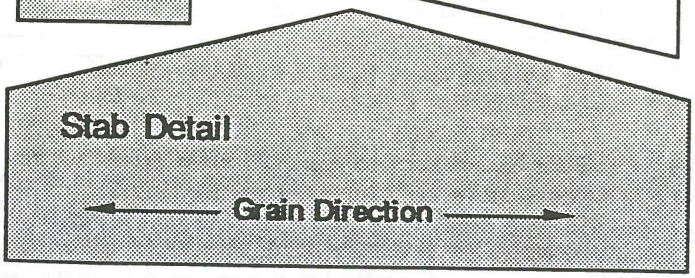









PLAN # 10-1994
PROJECT Lil' Mama
DESIGNER Kevin Kuczek
SCALE Not to Scale (see instruction for sizes)