

SONIC

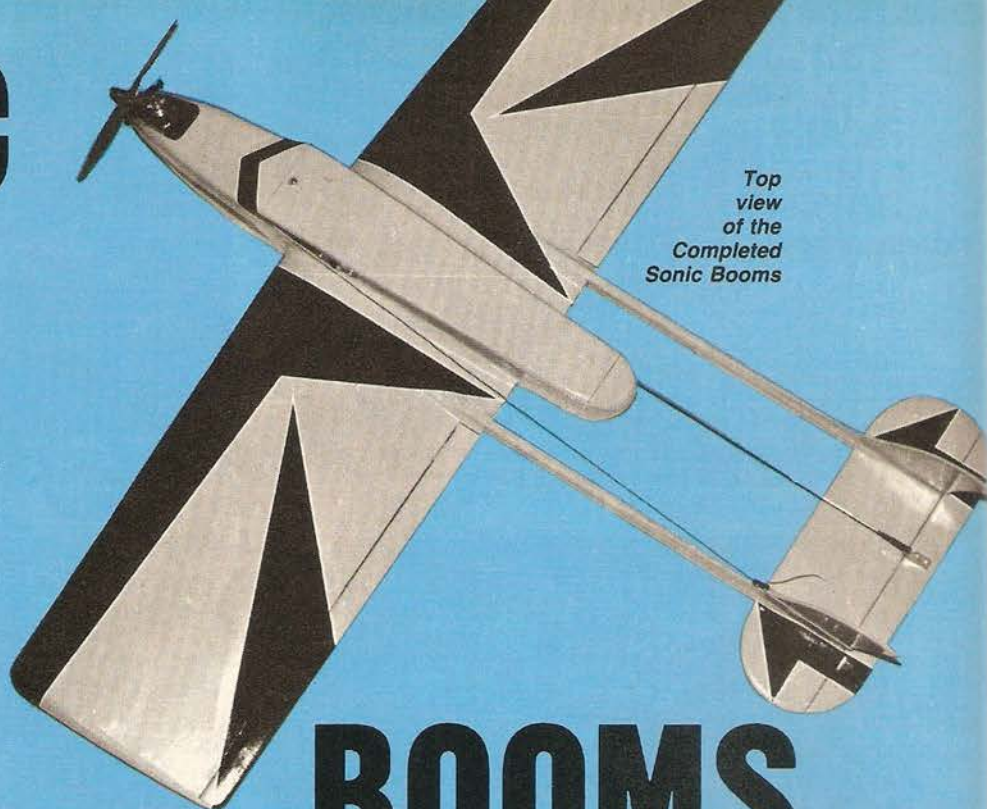
An easy to build 1/2A airplane with personality

It all began one evening after finishing reading the February '79 issue of RCM. I thumbed through it again to look for the design contest advertisement, which I had only glanced at the first time through, to get a clearer description of the rules. After reading the rules and looking at the fabulous prizes, I threw away the "I wouldn't have a chance" attitude and tried to think of a unique design.

I pondered the subject for a considerable amount of time until, finally, at 2:30 a.m., a unique configuration struck me. I had often been drawn to twin-boomed aft sections which I've seen on scale planes such as the P-38 "Lightning." I thought, "How about incorporating booms on a 1/2A sport ship?" That simple thought alone was the beginning of the "Sonic Booms."

Quickly, I sketched out my idea on the first paper and with the first pencil I could find for fear I would forget about it the following day. Next, the task of drawing up a set of construction plans was begun. These plans, like the earlier sketches, were done on the first paper I could get my hands on which was, believe it or not, the back of a bowling alley score sheet!

I had a small list of requirements that the plane was to fulfill. Among them was the desire for a small, economical (1/2A), plane



Top view of the Completed Sonic Booms

BOOMS

which could be easily built and show fairly maneuverable flight characteristics. I was aiming for a light wing loading of about 12 to 15 ounces per square foot because dead-stick was the only way it was going to land (purposely, anyway) and a light wing loading would give a little longer flying time for **planned** landings as opposed to the landing of a "streamlined brick" with an astronomically high wing loading. The weight necessary to achieve this wing loading is between 24 to 28 ounces. If you are as heavy handed as I am with the glue bottle, you may find that building it light may be difficult, but not impossible when built utilizing cyanoacrylate adhesives for

most of the ordinary joints and epoxy or white glue for points of high stress, like the firewall. It had to be large enough to house standard size radio equipment because the only radio I own is standard. All of these basic requirements started to flow onto the drawing board.

The fuselage was drawn as a basic box, utilizing only thick (1/8") sides and hollowed blocks for rounding the wingtips and the shaping of the rearward end.

Upon completion of the drawings, I wondered to myself if I had bitten off a little more than I could chew. It looked a bit large for a T.D. .051, but then again, they always look bigger on the plans. Just to play it safe I built it with the lightest grained balsa I could find. The use of light balsa proved to be a factor in my favor as far as its performance, but let's not get ahead of the story.

CONSTRUCTION

Wing:

If you only have a little experience with cutting foam wings, it would be advisable to get some help, even if your helper has had no experience. Wing cutting, for the most part, is a two person operation.

The procedure of cutting the wing is as follows:

(1) Get a piece of foam large enough to accommodate the span, chord and thickness. Expanded bead (white) foam is

Bottom view prior to addition of wire boom skids
Tough clear plastic skid on bottom of engine compartment.



By
Jeffrey
Smith

preferable; however, "blue" foam may be used with a slight weight increase.

(2) Cut out the tip and root templates from 1/8" ply. Number the **root** template every 1/4" on the rearward part of the airfoil from the apex in wing thickness to the trailing edge. From the apex in thickness to the leading edge, number in 1/8" increments. Do the same to both sides, top and bottom. To get the tip template numbering in correct proportion to the numbering of the root template, I used a little trick I just recently picked up. Pin down the **tip** template. Place a rubberband of approximately the same thickness as the template itself around the outside border of either the top or bottom (since it's symmetrical) but do not stretch the rubberband. Pin down the rubberband at both ends and mark the end points of the template onto the rubberband. Pin down the **root** template and stretch the rubberband across the outer edge of this template matching up the end points of the tip template marked on the rubberband to those of the root template. Pin down the rubberband and mark the increments from the root template onto it. Unpin it and replace it to the edge of the tip template. Now transfer these measurements onto the tip template.

The reason for this elaborate system of numbering is so that during the process of cutting the wing, the distance of the hot wire can and must be equal at all times in order to get an accurate and smooth surface. To keep the hot wire equidistant proportionately, you must have one person calling the numbers so that the other person can keep the wire even proportionately. Of course, the person operating the tip side of the cutter will have to move at a slightly slower pace because of the taper that is involved. The increments are closer in the leading edge portion in order to slow down the cutting wire so that the middle, more cooler part of the wire, does not trail behind, causing a bow.

(3) Cut the foam block to the length and width, considering the taper, but do not cut the thickness as you may need some room for the "fudge factor."

After the wing is cut, only a light sanding should be necessary. The sheeting material which I used was a type of cardboard called "chrome coat." I have found this to be an excellent sheeting material. It has one shiny side which makes a good surface for painting. This cardboard can be purchased at most art supply or craft stores. The cardboard was attached with 3M spray adhesive.

1/16" balsa may also be used; however, to me it has one definite disadvantage . . . cost. I sheeted the entire wing with cardboard for about 70¢ and the finish actually came out smoother than most balsa sheeted wings I've seen because there are no unsightly glue lines where the balsa was attached together.

After the wing is sheeted, add the 1/8" balsa strips for the leading and trailing edges and sand roughly to shape so that the

fuselage sides will slip over the wing properly. Sand a slight bevel in the center section for the 1/2" dihedral.

According to the size of your flight pack, you may have to cut the slot in the center of the wing on the leading edge larger than is shown on the plans. Cut the slot large enough to accommodate your receiver.

Epoxy the wing halves together with 1/4"

SONIC BOOMS

Designed By: Jeff Smith

TYPE AIRCRAFT

1/2A Sport

WINGSPAN

34.75 Inches

WING CHORD

Root 8 3/4", Tip 7 1/2"

TOTAL WING AREA

294 Sq. In.

WING LOCATION

Shoulder Wing

AIRFOIL

Symmetrical

WING PLANFORM

Swept L.E.

DIHEDRAL EACH TIP

1.4 Inch

O.A. FUSELAGE LENGTH

18 3/4 Inches

STABILIZER SPAN

11 Inches

STABILIZER CHORD (incl. elev.)

4 Inches

STABILIZER AREA

40.5 Sq. In.

STAB. AIRFOIL SECTION

Flat

STABILIZER LOCATION

Mid-Boom

VERTICAL FIN HEIGHT

3 Inches

VERTICAL FIN WIDTH (incl. rudder)

2.5" (approx.)

REC. ENGINE SIZE

T.D. .051

FUEL TANK SIZE

Cox Tank Mount

LANDING GEAR

NA

REC. NO. OF CHANNELS

2

CONTROL FUNCTIONS

Ailerons & Elevator

BASIC MATERIALS USED IN CONSTRUCTION

Fuselage Balsa and Ply
Wing Foam and Cardboard
Empennage Balsa
Wt. Ready To Fly 28 Oz.
Wing Loading 13.71 Oz./Sq. Ft.

dihedral under each tip.

Sheet the center section cut-out with 1/16" balsa.

Bend the aileron torque rods from 1/16" music wire to the specifications shown on the plans. Use 3/32" o.d. brass tubing for the bushing on the torque rod.

Slot the trailing edge stock (3/16" x 3/4") to accommodate the torque

rods and bushings. Glue the rods into the trailing edge and glue the trailing edge to the aft section of the wing. Sand the trailing edge to crude, approximate shape.

Fuselage:

Cut the firewall from 3/32" ply, Former 1 from 1/16" ply, and the fuselage sides from 1/8" balsa sheet, paying careful attention to the outside limits of the sides in the nose.

Mark the center lines for the wing, and then cut out the section where the wing will go through the fuselage sides. Make lines perpendicular to the bottom of the battery compartment as reference to where the firewall and Former 1 will be attached.

Glue all the 1/8" x 1/4" vertical stiffeners and the 1/8" square strips to the sides. Using Titebond, attach the 1/4" balsa doubler, with a slight bevel, to the front section so that it will come in contact with the front of the firewall when it is added. Be certain not to affix the stiffeners and doublers to the same face of each side. Building an airplane with two left sides isn't practical.

Cut to length all cross-spars that will be necessary to join the two sides. Accuracy in cutting is extremely important here, or a crooked fuselage will occur.

From the center, mark on the leading and trailing edges of the wing where the fuselage sides will be affixed at those particular points.

Slide the fuselage sides to the coinciding marks on the leading edge. Glue in Former A on the marked position which is perpendicular to the bottom of the battery compartment. Using just one or two drops of Hot Stuff, spot-glye the fuselage sides to the L.E. on the specified position. (Note: do this while holding the rearward part of the sides on the position marked on the trailing edge.)

Glue in the bottom most rearward cross spar, making sure that the sides are not pulled to one extreme, either left or right; pull them together symmetrically.

Pull the sides over the two marks on the trailing edge and Hot Stuff just at the very end. Place in the other cross stringers.

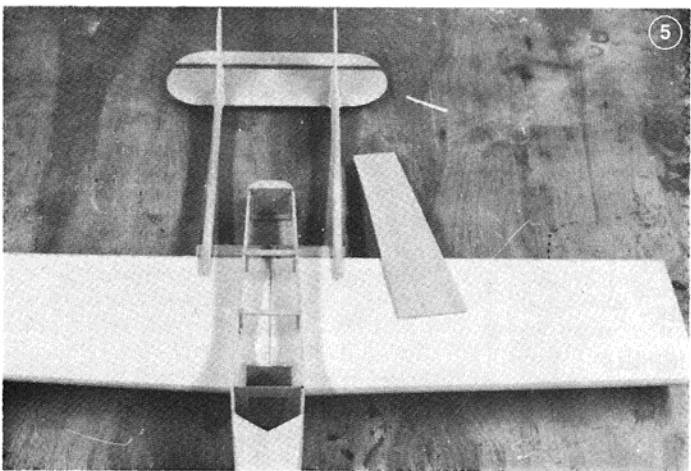
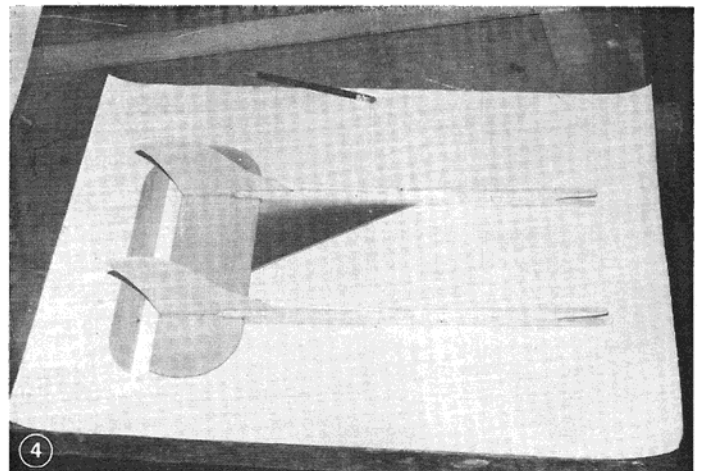
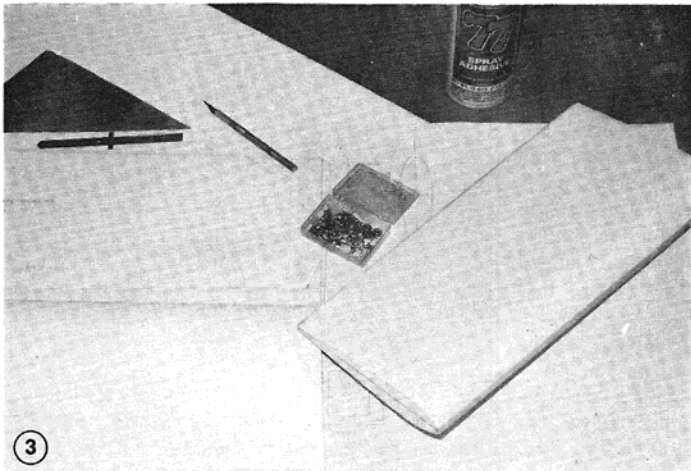
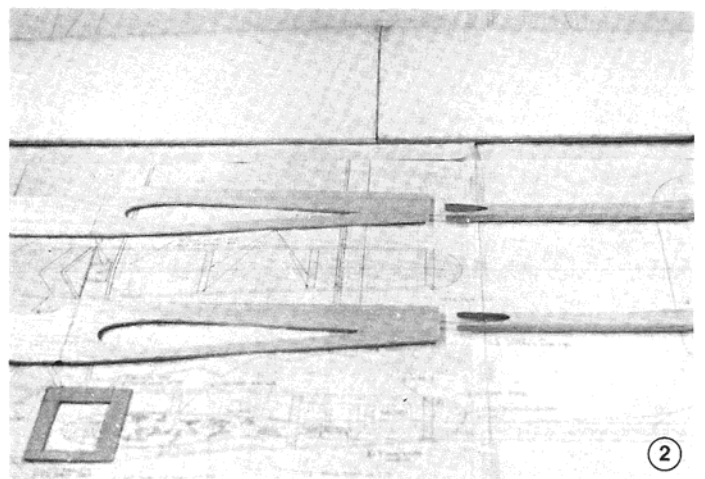
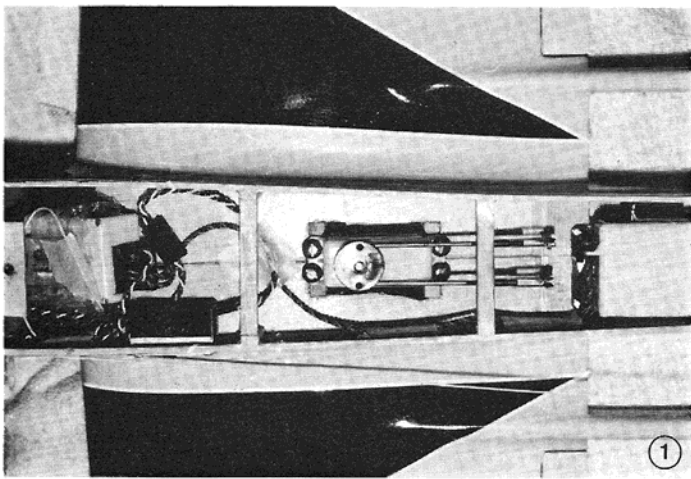
Glue on the 1" block to the end of the fuselage. While attempting to make the sides as vertically parallel as possible, Hot Stuff the sides to the wing. Chances are that you will end up with a slight gap at least somewhere along the intersection of the wing and the fuselage sides. Don't worry about it. A small fillet should be put there anyway for the purpose of strength and appearance.

Drill the firewall for all necessary holes needed to mount your engine. Add the blind nuts now if you choose to use them. The mount used on my prototype was a Cox tank mount.

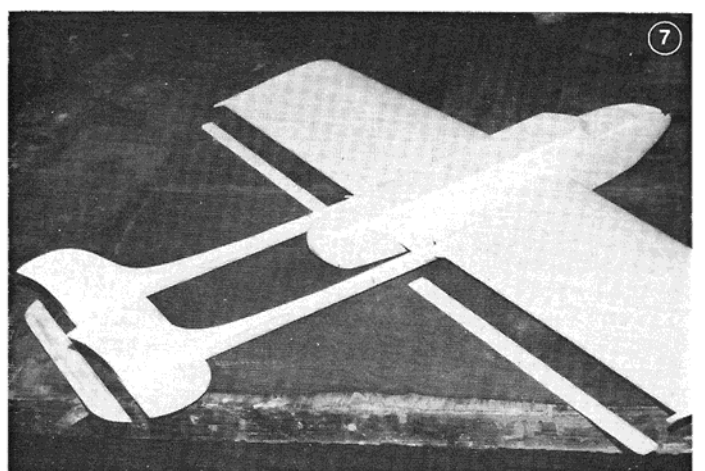
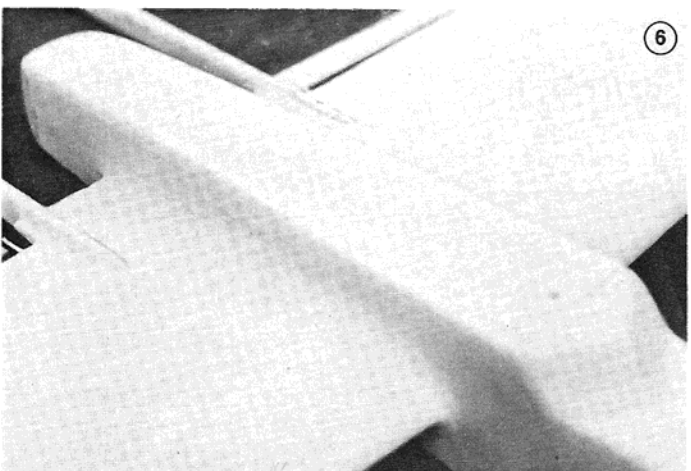
Epoxy in the firewall making sure that it, too, is perpendicular to the bottom of the battery compartment.

Glue on the 3/32" cross grain sheeting to the bottom of the fuselage up to where the grain will follow a straight pattern perpendicular to the firewall and Former 1.

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(1) Close-up of radio installation. No real problem for space. (2) Layout of fuselage sides, booms, wing and former A. (3) Foam wing panel sheeted with cardboard. (4) Booms, stabilizer and fins glued together. Check for alignment by using a 90° triangle. (5) Photo prior to addition of top sheeting and fillets. (6) Close-up view of wing and boom fillet. Fillet made from Hobbypoxy 2 and baking soda. (7) Entire model primed with one coat of K & B Super Poxxy primer and sanded.



From there up to the front edge of the firewall, the grain will go length-wise.

Glue on the 1/8" sheet top of the battery compartment, with the "V" shape cut out for the windows up to the front face of the firewall. Glue the 1/8" window top, just in front of the hatch, to the top and perpendicular to Former 1. By placing the 1/8" balsa where the window panels will be, mark off and cut the panels to size. Be careful to cut them long enough to sand in the bevel at the point of intersection between the top of the battery compartment and the window panels proper. Hot Stuff the panels in place.

Next, cut the chin block for the bottom of the engine compartment from a 3/8" block. Cut it about 1/4" longer if you are taking the dimensions from the top view. The angle that it is shown in this view makes the lines appear shorter than they actually are; they are not true length. Also plan for the bevel that will be sanded in where the block touches the firewall. The end of the block should fit snugly just in front of the firewall.

You must now bend the sides and doublers around this block since it is not glued to the bottom of the fuselage sides and doublers but **between** them. Impossible you say, to make such a bend? Nah! A little water dabbed on the sides is almost a must in order to get the sides around this block. Even with the water, the front end on mine still had quite a bit of spring in it and I had no modeling clamps strong enough to hold it together tightly.

After a futile try using clamps, weights, rubberbands, and tape to try to hold the sides to the block and using most of the 45 minute curing time for the epoxy, I had no alternative but to use a vise. This worked very well. If you use the same method, the vise that is, don't worry about the dents it may form on the sides. They will be sanded off during the rounding process. When dry, drill the drainage hole in the chin block and glue 1/4" sheet to the top of the sides and doublers over the engine compartment.

Cut hatch from 1/8" balsa sheet to proper size & shape. Add 1/2" x 1/8" x 1/4" sq. cross stiffeners. Chisel in room enough to fit the 1/32" ply insert where the hatch hold-down screw hole will be placed. Glue in insert. Place a 1/8" dowel in the 1/4" sq. balsa cross stiffeners glued to rear of hatch. Line up, mark off, & drill where dowel will fit into rearward 1" block.

Glue on 1/8" ply hold-down plate & supports to Former 1. Place dowel in hole of rear block, line up hatch to desired position & drill hole large enough to accommodate a 4-40 size bolt thru center of ply insert in hatch. Remove hatch & redrill hole in hold-down plate, this time to accommodate a 4-40 size blind nut.

Add the small fillet around perimeter of wing saddle with either a mixture of epoxy & micro-balloons or Titebond & micro-balloons. Both work equally well & have good sanding characteristics. Baking soda may be used in place of micro-balloons. It is just as easily sanded but slightly heavier.

Glue on the 3/8" wing tips and sand roughly to shape.

Cut the ailerons to length and sand to fit.

Attach the hatch and sand the edges round. Mount the engine and sand the front end to flow into the engine smoothly. Note: When you are rounding the front end, you should leave about 1/16" of balsa to border around the front. Don't sand it to a knife edge. Sand the rear 1" block to the desired shape and hollow it out. While hollowing, leave plenty of room around the dowel holes.

Tail:

Cut the elevator and stabilizer in one piece from a sheet of 3/16" balsa. Sand the edges to shape and cut the elevator from the stabilizer using a sharp X-Acto knife and a straight-edge. Round these two new edges which you've just cut. Cut out the fins and frontal supports as per plans.

Booms:

Cut four of the boom sides from 1/16" balsa sheet. Cut the "V" shape in front of the sides where the boom will be affixed to the wing and cut the slots in the rear of the boom sides for the stabilizer.

Bevel the 1/4" sq. balsa strips (4) to the same angle as the boom sides where the boom/wing glue joint will be. In two of the four strips, cut a 1/8" slot in the side opposite the bevel for the fins to fit.

Pin down any one of the boom sides. Hot Stuff the top 1/4" strip along the upper edge of the boom side.

Using a piece of scrap 3/16" balsa sheet, space the gap between the strips and Hot Stuff on the lower 1/4" strip. Glue on the other 1/16" side. Repeat this process with the other boom.

If you wish to have these booms rounded, it is recommended that you sand them now because sanding evenly is difficult while trying to avoid the easily dinged tail surfaces. The rounding not only adds to the appearance, but eliminates some dead weight without removing a great amount of strength.

Mark off on the leading edge of the stabilizer where the booms will be affixed.

Using a right angle, glue the booms to the stabilizer at the marked positions. Be certain that it's square.

Glue the fins into the slots already cut into the boom tops. Use a right angle to get them square to the stabilizer. Glue on the frontal fin supports.

Find a scrap balsa stick that is fairly stiff. Cut this to the **exact** length of the distance between the two booms just in front of the stabilizer. Rubberband this stick between them about halfway from either end of the booms to keep them parallel to one another during the gluing operation. They should be held together just tight enough to hold the stick in place but not so much as to dig into the wood.

Mark off the distance from the center on the trailing edge of the wing where the booms and tail assembly will be attached.

If everything was cut and built exactly as per the plans, you should end up with zero degrees incidence between the stabilizer and

wing. You should check this by the use of an incidence meter; however, if one is not readily available to you, you may check it by this method.

(1) Place pins on the exact center-lines of the leading and trailing edges of both the wing and stabilizer.

(2) Block the fuselage/wing assembly up so that the measure from each pin on the wing to the building board is the same.

(3) With the booms added (not glued yet), the measure should be the same from either pin on the stabilizer to the building board in order to achieve zero degrees incidence.

The measurements of the wing and the stabilizer should not differ because they are built on a common center-line.

Once you are sure that the incidence is correct, epoxy the entire assembly onto the wing. Get it square to the trailing edge by use of a right angle.

Hinge and glue on the control surfaces.

Finishing:

Of course everyone has their own favorite way of finishing their planes, but for the benefit of those who are interested, I will go through the process of finishing that I used.

First of all, everything was sanded with 220 grit sandpaper. It was then primed with a light coat of K & B Superpoxy primer. It was then sanded with 320 grit sandpaper to knock off the fuzz. Another light coat of K & B primer was sprayed on and then sanded with 400 grit sandpaper.

A base coat of K & B bright yellow paint was sprayed on with two light coats. This bright yellow was achieved by mixing two parts yellow to one part white paint.

The black trim is Sig Supercoat dope. There are two coats of the black trim on. All primer and paint was sprayed on.

After the paint was dry, I pinstriped all the joinings between these two contrasting colors with 1/16" white pinstriping tape.

After you have completed the finishing, you should put some kind of protection against scuffs on the bottom fronts. A piece of MonoKote trim sheet will work fine.

Put on the wing tip skids and then the 1/16" wire boom skids. These are necessary to prevent any part of the plane from catching the ground and possibly cartwheeling on landing.

Flying:

Upon completion, I was naturally anxious to try out my unique bird, as I'm sure all weekend designers are. I took it to a club meeting and asked some advice of some of the more experienced members. The only favorable comments I received were that the throw looked about right and the balance seemed just about right. Many members believed it was too heavy for a 1/2A job and showed it by gritting their teeth while picking it up.

With my confidence nearly shot, I still waited for D-day. I was plagued with terrible weather though, and began to think I'd never get a chance to fly it.

Days kept creeping by until only 10 days remained until the due date. I finally

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decided to sink or swim. Although it was warm, the wind was fairly gusty. My buddy Tom and I carried the field box, plane and transmitter to the local flying field and prepared for the uncertain results. We ran the engine one or two times to make sure it was at peak performance and fueled it up for its maiden flight. I range checked it and all systems were go. Tom started up the screaming T.D. and quickly got into "plane-chucking" position. I nodded for him to throw it. The powerful T.D. pulled it out of his hands and it flew into the wind at about a 10° incline. A gust of wind suddenly pushed the nose up into a missile launching attitude. "That's it," I thought to myself as my life flashed before my eyes. Fortunately the engine had more than enough power to get out of that predicament. It made a quick right turn and I suddenly realized the controls were too sensitive. I had to command its direction ever so slightly lest I have an instant kit.

The "Sonic Booms" speed fulfilled my wishes. I believe the fact that it has no landing gear to catch the air is largely a contributing factor to its speed. It may not be as fast as the latest pattern ship bearing a newfangled kind of porting, pump and pipe, but it's quick for its size. It penetrated the wind better than I had expected and going downwind it was unbelievably fast.

After the fuel ran out, I had gained sufficient altitude to glide around for a while. At this point I felt I shouldn't press my luck; after all, the controls were much more snappy than I was used to and I wanted to get it down quickly to adjust the sensitivity of the controls. I did a Split-S and made the landing approach. Luckily I had a long approach because from a 200' Split-S the "Sonic Booms" was flying just short of warp 7 (give or take a mph). It gradually slowed down and began to float just like my old Kadet did. Quite frankly, at the speed it was flying, I thought it was going to land like a Lear jet. This, fortunately, was not the case.

After altering the throw to a lesser degree, with the ailerons 1/8" either way and the elevator 3/16" either way, the ship became much more docile.

The "Sonic Booms" is an excellent flyer but you aren't going to believe me unless you try it yourself. Give it a try, but don't fly it too high or else you've got to watch it very closely. The small fins and the absence of wheels can make it difficult to tell which side is up. You may also have to get used to the oohs and ahhs from the crowd as you flash your unique little craft past them. Happy flying!