Fly the

When was the last time a ½A put your B/G up for over a minute and a half?

BUMBLE BEE

For Hornet Boost/Glide

by Bob Singer, NAR 6102

The Bumble Bee is a small, light boost/glider designed specifically for Hornet competition. As a pleasant bonus it turned out to be simple and fun to fly, unlike so many other competition birds. Stuff your pockets full of ½As, take your launcher and a Bumble Bee down to the local school yard, and you can have a great time. If you use a larger engine be prepared to do some running. At a recent demonstration launch, I put a Bumble Bee up with a ½A6–2, and one minute and 45 seconds later it landed – still 30 feet up, in a tree. If it hadn't been for that glider-eating tree, I'm sure that I would have broken two minutes. In competition, the Bumble Bee is undefeated. Build one and see.

This glider was actually developed to beat the nationally published, airfoil-less boost glider, the M--TA, which, despite looks, turns out a good time with a ½A. The M--TA, very popular with a certain section in the WAMARVA area, is not too hard to beat with A or B engines in a modified hand launch glider. But for this latter type the low power of a ½A is prohibitive. Characteristically, a large glider will boost up fifteen or twenty feet and settle into a stable glide at about the same time that it settles into the ground. So for Hornet, a good glider must reach a healthy altitude, but must glide better than a 4" paper airplane ejected from a standard rocket. Lightness, low drag, good glide, and of course high reliability are important factors.

The obvious features that set the Bumble Bee apart from most other boost gliders are its small size, light weight (5 to 7 grams), and low aspect ratio wings. The wing itself is made from 1/16" balsa, but it is sanded to a good airfoil. This is more important than it might at first seem–it really reduces drag on the way up, and it keeps the glider up far longer than a flat wing ever could. In addition, it reduces the total weight of the Bumble Bee. While the wing thickness is only 4% of the average wing chord, spend those five extra minutes and make sure that the airfoil is true to the one shown in the drawing.

Spruce is used for the boom (body) of the Bumble Bee. While it weighs slightly more than balsa, it is virtually indestructable, and you don't have to use as much of it. A balsa boom of the size specified would probably break on the first rough landing.

The Bumble Bee uses a detachable pod system based on the one published by G. Harry Stine for his Flat Cat (Model Rocketry, August, 1969). Over the past few years this has been the only system that I have used. With a little care, you should never have a failure. By all means use a parachute for the pod, as shown, to eliminate the possibility of a "Red Baron".

Very few dimensions on this glider are critical. Wherever a high degree of accuracy is important it will be mentioned in the text or the dimensions will be written on the drawing itself. All other measurements and patterns can be traced or copied directly from the drawing.

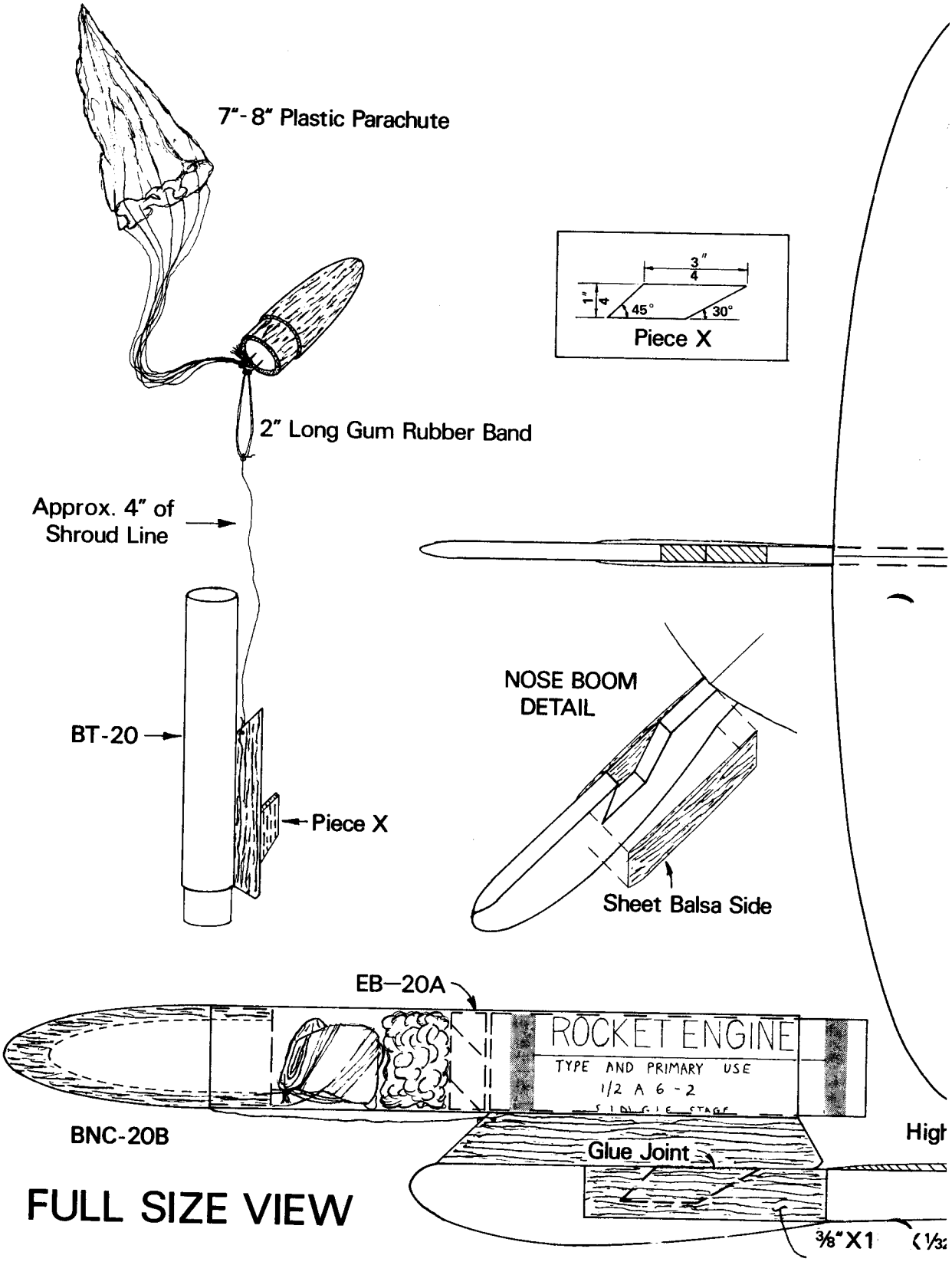
For all parts of this glider except the pod assembly I suggest that you use an acetate cement, such as Testor's Formula B, Aero Gloss, or Ambroid. These are much lighter than white glue or Titebond, and faster drying. For a glider the size of the Bumble Bee they are plenty strong. Be sure, however, to preglue all pieces one or two times before you join them. On the pod I use Titebond just to be sure of plenty of strength.

Start construction with the wing. Choose a good sheet of 1/16" C-grain balsa from which to cut the panels. C-grain is the cut of wood that is most resistant to warps and is the sturdiest. You can recognize it by its flaky appearance. If you think that this description is a little vague, ask your friendly local hobby shop owner to show you a piece –I think you'll see what I mean by "flaky". The lighter and whiter the sheet, the better.

Sanding the airfoil may seem a lot more forbidding than it actually is. It isn't really that hard- but don't do a "half-way" job on

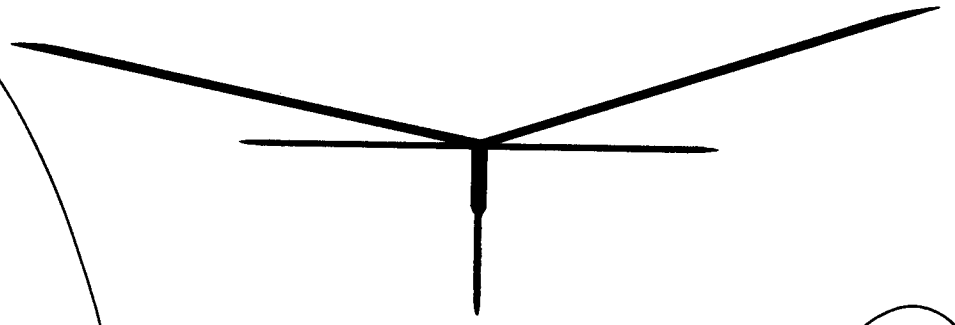


Author holds a finished Bumble-Bee. The color scheme was put on with felt tipped markers, adding very little to the total weight.



FULL SIZE VIEW

DIHEDRAL DETAIL–See Text



Wing Panels (2)
Cut from 1/16" Balsa
"C" Grain

FULL SIZE VIEW

Grain

Grain

THE
BUMBLE BEE
Designed and Drawn by
Bob Singer

Cut Stabilizer and Fin
from Sanded Down
1/16" Sheet "C" Grain
See Text

Fuselage Section AA

Point

Airfoil
at Root

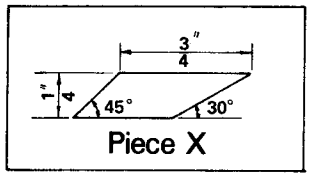
A

A

" B Sides
aired

Cut Body From 1/8" Spruce

Grain



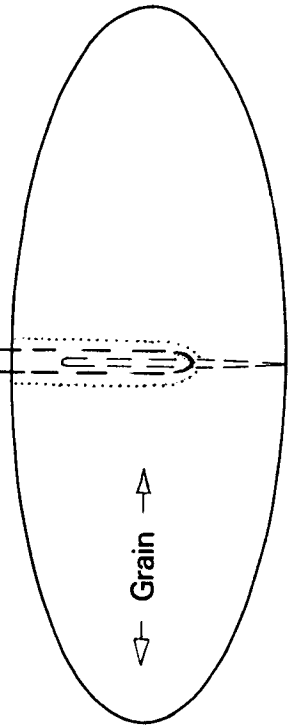
Piece X

Gum Rubber Band

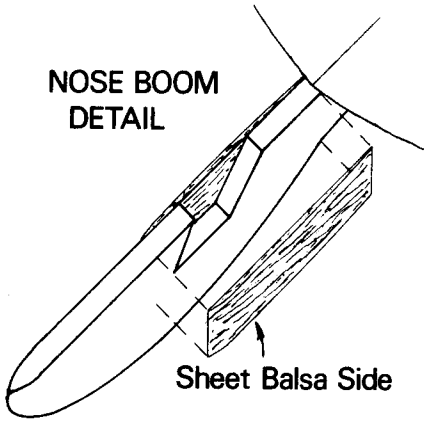
page 24/25 overlap (1 of 2)

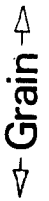
Wing Panels (2)
Cut from 1/16" Balsa
"C" Grain

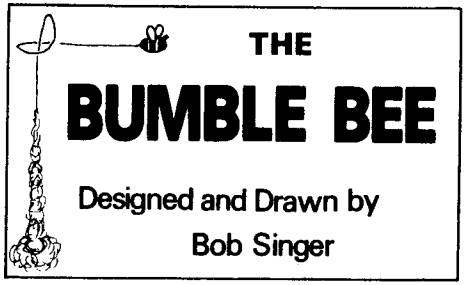
FULL SIZE VIEW



NOSE BOOM DETAIL

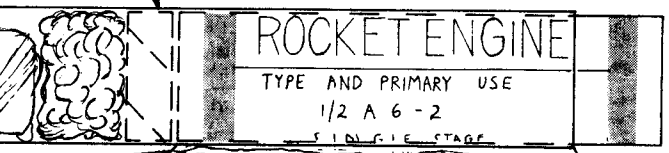






Cut Stabilizer and Fin from Sanded Down 1/16" Sheet "C" Grain See Text

EB–20A



Fuselage Section AA

High Point

Airfoil at Root

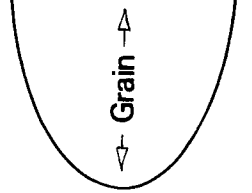
Glue Joint

A

A

Cut Body From 1/8" Spruce

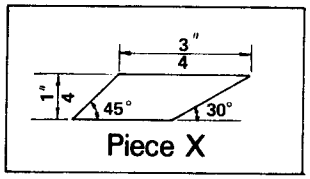
3/8"X1 1/32" B Sides
Well Faired



arachute

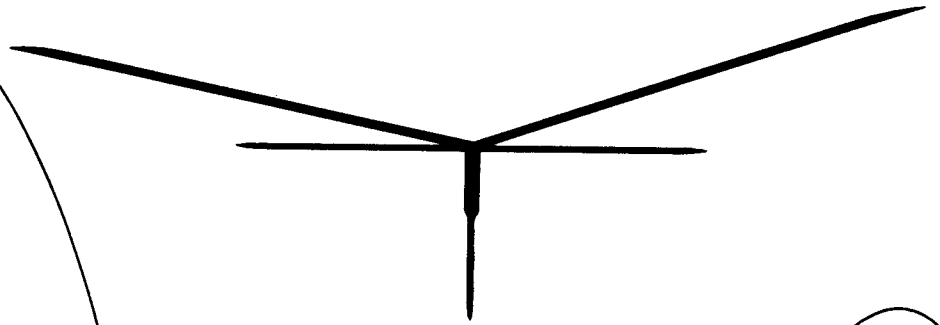
um Rubber Band

X



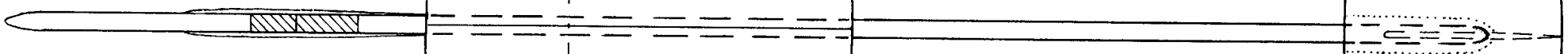
Piece X

DIHEDRAL DETAIL–See Text

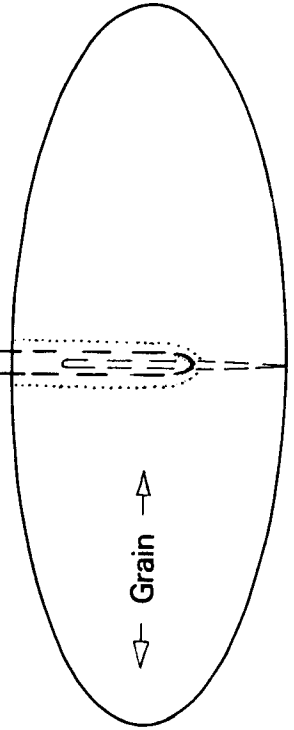


page 24/25 overlap (2 of 2)

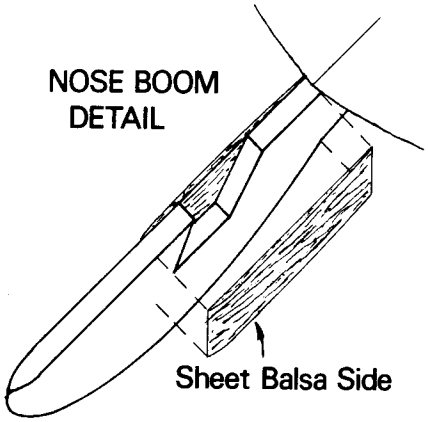
Wing Panels (2)
Cut from 1/16" Balsa
"C" Grain

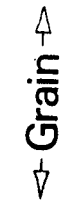


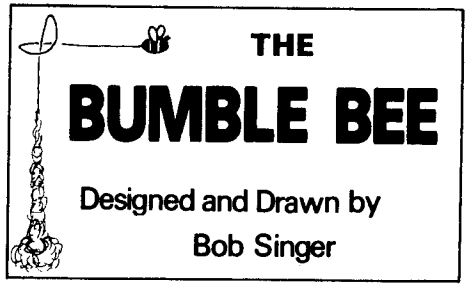
FULL SIZE VIEW



NOSE BOOM DETAIL

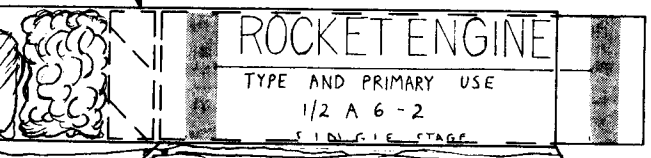






Cut Stabilizer and Fin from Sanded Down 1/16" Sheet "C" Grain See Text

EB–20A



Fuselage Section AA

High Point

Airfoil at Root

A

Glue Joint

it. Don't settle for a fat airfoil. The only place where the finished wing should still be 1/16" thick is along the high-point line, shown in the drawings. If you want to, lightly mark the high-point on the balsa with a soft pencil to aid in sanding. The airfoil is almost straight back from there to the trailing edge but not quite flat.

Use 400 grit or maybe 320 grit sandpaper for shaping the sheet balsa. Anything rougher will inevitably leave deep scratches. If it seems that your paper is getting smooth, it is probably still good, but just filled up with balsa dust. Get an old toothbrush and scrub it (under the faucet if you have waterproof paper, such as 3M TRI–M–ITE WET OR DRY). Most likely your paper will be as good as new.

One of the biggest problems I have had with sanding fins and wings is gouging and oversanding the trailing edge, giving it a scalloped appearance. About half a year ago, though, I discovered that sanding the work when it is flat on a worktable makes it much easier to get an even, sharp trailing edge.

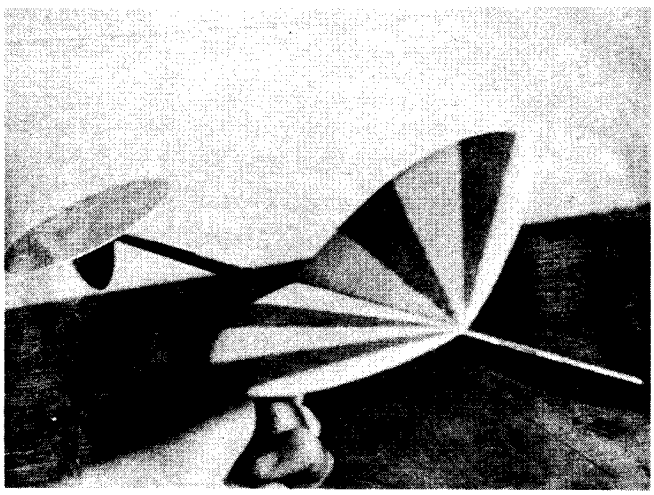
About the last ¾" or so of the wingtip tapers smoothly from maximum chord at the root to virtually nothing at the tip. It follows that the less tip there is, the less tip vortex generated. When you are done sanding the wing, the leading and trailing edge tapers should blend smoothly into the tip taper. After all, they are all part of the same curve.

The dihedral is 1" under each tip. You may have noticed that in the front view drawing the wings seem crooked. This will be explained later- disregard it now.

Find a side on a board or worktable that has sides perpendicular to the flat surface. Prop one wing panel up with a block of wood or piece of scrap so that the tip is 1" above the flat surface of the board, and with the *bottom* of the wing root edge lined up exactly with the edge of the board. Notice that the *top* of the root, which is sanded to an airfoil, is very slightly overhanging the edge of the table. Run a sanding block back and forth over the root, using the side of the board as a guide, until all the overhanging balsa is sanded away. Repeat this procedure on the other wing. Now, with the proper amount of dihedral, the two root edges will butt together perfectly.

Glue the dihedral in the following manner: First preglue both wingroots one or two times. Then lay a piece of waxed paper or Saran wrap on your worktable, and pin one wing panel down flat in the middle of it, airfoil side up. To that panel glue the second one, with the tip of the second panel propped up 2". Set this in a place where no one will set a book on it or kick it, and build the rest of the Bumble Bee while the glue is drying.

The stabilizer and fin should ideally be cut from 1/20" thick balsa. However, this size is quite hard to find, so you can use the 1/16" sheet left over from the wing, sanded down.



Ready to glide weight of the Bumble-Bee is only about 6 or 7 grams. If there's a thermal around this glider will catch it.

First copy the stabilizer and fin patterns from the drawing onto the 1/16" sheet. Cut them out and, with a sanding block, sand each piece flat until it measures 1/20" (if you don't have a suitable ruler try to match the maximum thickness shown for these parts in the side and top views). Here again, don't be lazy - 1/16" balsa is just too thick and heavy to use for these parts on a glider of this size.

After you have sanded the stabilizer and fin to the proper thickness sand both to a good symmetrical airfoil. (NOTE: Do not sand the part of the underside of the stab within the dotted line - this is where the stab is glued to the body, and to insure good alignment it must be flat.) Taper the stab tips and the tip of the fin to a point, as shown in the front view. This helps reduce the tip vortices on these surfaces. Set these parts aside temporarily while you cut out the body. The body, or fuselage, or boom or whatever you want to call it, is cut from 1/8" spruce stock, as was mentioned earlier. Trace the shape directly from the drawing. Use a factory cut edge for the top, because it must be straight to hold the pod, wing, and stabilizer perfectly in line. Spruce doesn't cut as easily as balsa so you may have to do a little whittling and rough sanding. When your boom matches the drawing in shape, round all the edges except the *top* , and taper the nose and tail as shown in the top view.

Carefully draw the piece X onto the boom as shown in the side view, using the exact measurements shown. Now, carefully, cut it out of the boom, in *one piece*. Save it for later. I have found that a razor saw is good for cutting out this part.

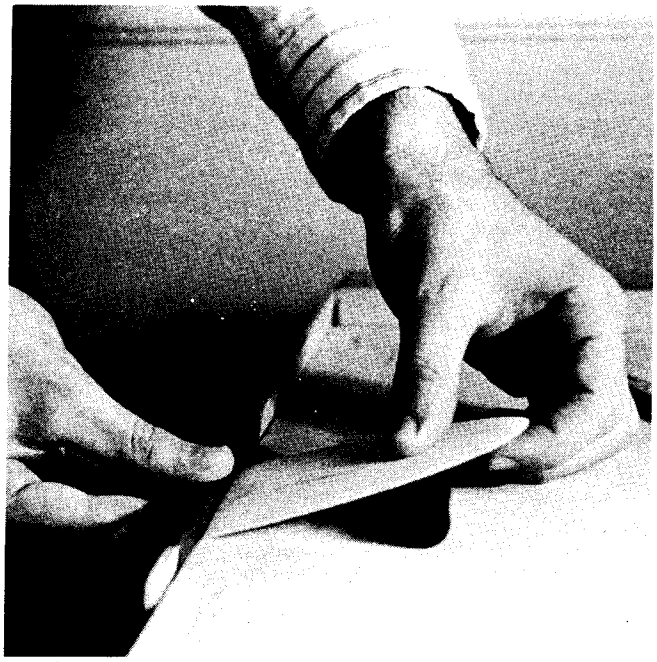
Cut out the two side pieces for the boom from 1/32" balsa sheet, or sanded down 1/16" sheet. Fair (airfoil) them well, as shown and glue them to the body. While they are drying, build the pod.

I built my pod from Estes BT-20, because it is lighter and of a slightly smaller diameter than the comparable Centuri tube. If you really feel strongly about it, though, use Centuri parts (attn: Leroy and Doug). Cut the body tube to the length shown, and glue the engine block in place so that the engine sticks 1/2" out the back. The pylon on which the tube is glued is cut from 1/8" balsa, or two sheets of 1/16" balsa laminated together. Streamline the pylon well, but of course leave the top and bottom flat. First glue the piece X to the pylon as shown and then glue the pylon securely to the body tube as you would a thick fin. Glue the launching lug on one side or the other in the corner formed by these two parts.

While the pod is drying finish building the body. Cut a 3" long shallow V-groove (refer to fuselage section AA on the drawing) where the wing will be attached. If anything, make the groove slightly deeper than is shown, to insure that the wing will sit properly. Now glue the stab and fin onto the body, making sure that everything lines up squarely. Support this unit somehow so that no pressure is put on the tail surfaces until they are quite dry. I usually stick the nose of my gliders between two books.

By now the pod assembly should be dry enough to work with. Install the recovery system as shown in the drawing. Notice that it is attached to the pod through a small hole in the front of the pylon. Make the hole with a straight pin or simply thread the line through with a needle. Tie the knot and smear a little glue around the hole. The parachute itself can either be cut down from a commercial one or cut from a plastic cleaner's bag. I like to use octogonal 'chutes 'because they can be made easily by folding the sheet of plastic in half, and then in half again, and then again, and cutting along the base of the isosceles triangle formed. Space inside the pod is at a premium, so don't make the parachute any bigger than necessary to qualify. Seven or eight inches across is a safe size. Use a U-shaped piece of paperclip instead of a screw eye. Press it into the side of the hollowed-out nose cone, as shown, and smear glue around it.

Next glue the wing assembly on. Notice that in the front view drawing the wing is at an angle to the body and the tail surfaces. This will put your glider into a flat, tight circle, which will keep it in a thermal and in sight longer. The glider will turn towards the lower wing. I personally like right-hand circles. Whatever, try to match the degree of tilt to that shown in the drawing.



Each wing panel is sanded to the proper dihedral bevel at the root to insure a strong wing joint.

Your Bumble Bee is now finished except for a few details. Put a few coats of glue on the bottom of the fin to help keep it from getting scraped up. Check the fit of the pod - this is very important. It should not be too loose or wobble but, fully loaded, it should fall off the glider by itself or with a gentle tap when the glider is held straight. Sand the piece X if necessary, checking the fit frequently.

Everybody has his own theory about the best finish, or lack of finish, for a boost/glider, but no one has any conclusive data (it's R&D time, guys). I would recommend leaving the Bumble Bee bare wood, colored with magic marker. This aids visibility but adds very little weight. A glider this small built out of spruce and C-grain balsa shouldn't warp unless you fly it into a swimming pool or store it in the shower.

Wait for a calm day or evening to trim your glider. Add weight to the nose until it just slightly stalls when you give it a gentle level toss. I use thin lead, such as from an old glue tube, for ballast. You don't need very much on a glider this small. Then take it down to a park or schoolyard and really wring it out. Watch as it slows down and settles into a glide. Add weight bit by bit, throwing it each time, until your Bumble Bee hangs just on the verge of a stall, but never actually does. This is the best trim for endurance. For windy weather, add a little nose weight until you get the best glide. I have found that masking tape is plenty heavy for the job, and is very convenient when I am out on the flying field.

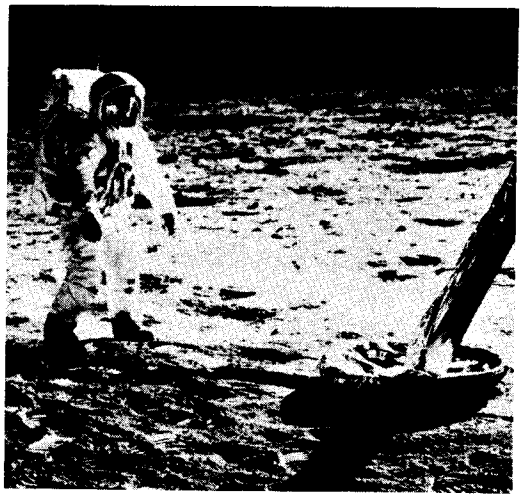
Flying the Bumble Bee is almost as simple as flying an Astron Alpha. Wrap some masking tape around the launch rod about a foot up from the pad. This holds the pod up so that the glider won't fall off before launch. If this precaution isn't necessary on your glider, then the pod fits on much too tightly. Load the pod like a regular rocket, taping the engine up for a very tight fit in the body tube. Cram the wadding and the recovery system in place. It may be a tight squeeze, but this helps blow the pod off properly. The nose cone shouldn't fit too tightly, but it should stay put when you shake the pod upside down. Now put the pod on the rail, attach the clips, and hang the glider on. Out of common courtesy be sure to remove the masking tape from the rail after your launch if somebody else is going to use the pad.

I think you will find this glider great in Hornet competition, and a lot of fun to build and fly. Don't be discouraged by all these instructions - it took me a month to write this article, but only two nights to design and build the B/G!

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