Competition ROCKETRY

Flex-Wing Gliders by Dan Wolf

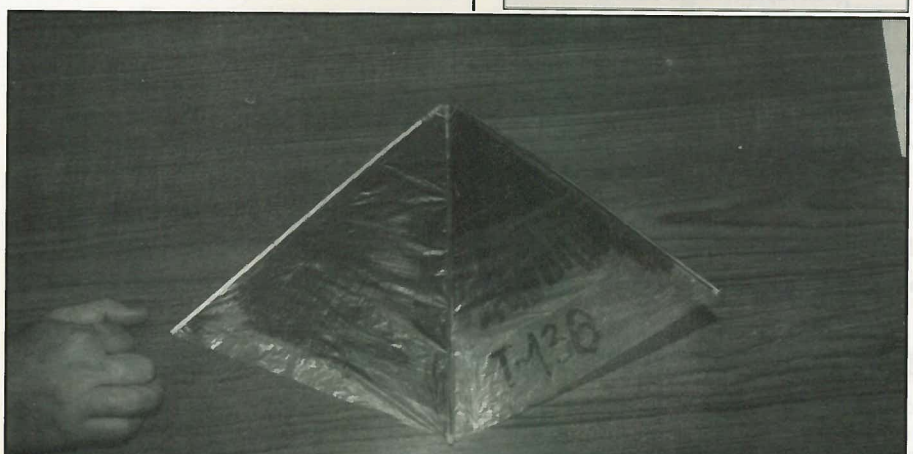
This is the first of a series of articles on competition rocketry. Each article will cover a particular event, sometimes centering on a specific engine class of a contest event. This time, we'll look at 1/2A and A engine class Flex-Wing Boost-Glide duration. A Flex-Wing glider looks like a Rogallo wing hang glider. The glider consists of a wooden spar framework made of spruce or balsa and covered with plastic or mylar. If plastic, the glider is usually colored with a permanent marker to aid visibility. The glider has a spring at the "nose" end formed out of music wire. Before flight, the glider is folded up so that it will slide down inside the booster, usually a piece of BT-5. See photos 1 and 2 for pictures of a typical flex-wing and it's booster. Flex-Wing gliders are flown in NAR competition as a separate Pink Book event, and are not allowed to be flown in the conventional (rigid wing) boost glide event.

During the 1980s, two excellent articles were published on flex-wing B/Gs. One by Craig Byers, in the December 1980 issue of the Model Rocketeer. The second article by George Gassaway, in the September 1986 issue of American Space-modeling. If you are serious about building and flying flex-wings you should get and read these two articles. For back issues or copies of these articles, contact Terry Barklage at 5521 Newell St., Zachary, LA 70791-2616. Since it's been eight years since George's article appeared, it seemed appropriate to provide this information on flexies, especially with A Flex-Wing being a NARAM 37 event.

To build a flex-wing glider for the 1/2A or A engine motor class you will need the following:

1. Spars - Make from 1/16" x 3/32" spruce (or use very hard balsa)
2. Spring - Make from .015" diameter music wire
3. Wing material - Use thin plastic or 1/4 mill mylar (for plastic, use a dry cleaner bag or very thin drop cloth)

The first step, and one of the hardest, is to make the spring. For this step, I asked John Viggiano to detail his technique. At the Finger Lakes Fall Classic IV open meet flown last fall,



A typical flexie suitable for 1/2A and A flex wing. This glider maxed twice in 1/2A flexie at FLFC IV

This booster for mini-engine class flexies is made from a full 18" length of BT-5

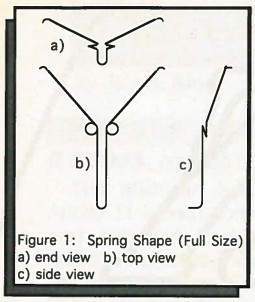


Figure 1: Spring Shape (Full Size)
a) end view b) top view
c) side view

John took first place in 1/2A Flex (MR) with three consecutive "maxes". While following John's procedure, refer to (Figure 1) for a sketch of the spring viewed from three different angles.

"Here is my spring fabrication technique. This was an acquired skill. It took some practice. I threw out a half dozen or so before I got one I could use. Here's what I did:

1. Mount 3/32" drill, pointy side down, in vise
2. Cut an 11cm length of music wire
3. Grip wire in pliers 2cm from end, make 1 1/4 wraps around drill, tighten with another pair of pliers. As you do this, put some dihedral into the spring.
4. Grip other end of wire in pliers 2cm from other end and repeat Step 3. Make sure the loops both face the same direction, and coil upwards. (One will be a right-hand coil, the other a left-hand coil).
5. Center a pair of needle nose pliers between the coils. Grip the wire so the axis of the coils are parallel to the major axis of the pliers, and the width gripped is the width of the spar (3.5mm in this case).
6. Bend both sides of the wire so the coils just touch. You'll now have something that looks somewhat like a "Y".
7. Put a bend in the very base of the Y. I like to bend this up (in the same direction as the dihedral) so the crossbar at the base of the Y sits on top of the center spar.
8. Put a small bend in the ends of the arms of the Y. The bends made in Steps 7 and 8 help keep the spring from twisting about the spars."

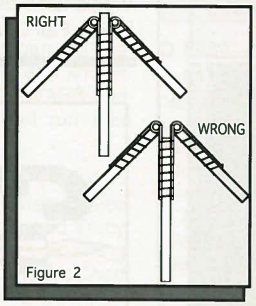


Figure 2

Next the spars are cut into equal lengths, 12" being about the right length for 1/2A Flex, 12" or 14" for A Flex. Once the spars are cut, the spring is attached, first to the center spar, then to the left and right spars. In George's article he made a very important point about the spring attachment. See figure 2 for the correct spring attachment position. Here are John's comments on this step.

"To attached the spring, I used 30cm of thread for the center spar, and 35cm for each of the outer spars. I tied a Surgeon's Knot (like a square knot, but with an extra loop on the first hitch) around the outer spars, then slipped the spring under. I wound the thread towards the front, lingered there a couple of wraps (where the bending moment is greatest), then worked my way towards the back. I made several criss-crossing wraps over the bend in the end of the spring, then tied the end of the thread to the free end from the beginning. For the center spar, the procedure was the same, except the thread was tied to the crossbar at the bottom of the Y. I used a light layer of white glue over the threads to keep them in place." Note: CA works well for this too.

The next step, taken from George's article, is to make a building/cutting board out of a piece of cardboard. The board needs to be the size of the largest flexie you are going to make. In this case, a little over 14" square. Draw lines on the board that represent the outline of the flexie and also the center spar. Figure 3 shows a cutting board with the outline for a flexie with a 90 degree nose angle. This is the type that John and the rest of the MARS members have been flying. Others prefer a 110 degree nose angle. Now the covering material is temporarily attached to the cutting board with double-sided tape. The side facing the covering material must first be touched a few times or partially covered with talc to reduce the stickiness so the glider may later be removed without tearing the plastic. Once the plastic is attached, an X-acto knife can be used to trim away the excess. A helpful step I sometimes forget is to use a felt-tip marker to mark the center spar line on the plastic.

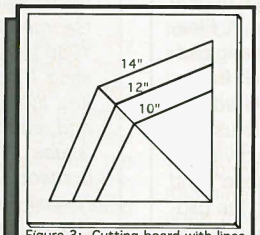


Figure 3: Cutting board with lines drawn to show spar and plastic locations for various size flexies.

Take the framework and bend the outside spars back to the proper angle (90 or 110 degrees) Take a thread and tie them temporarily in this position. Now comes another crucial step, attaching the covering to the framework. Here is John's technique for this step.

"After affixing the covering to the building board with double-coated tape, I applied a very light coat of contact cement to each spar line. I also applied contact cement to the tops and outer sides of the outer spars. These were allowed to dry thoroughly, which is the correct procedure for using contact cement. The spars were pressed, one at a time, onto the spar lines, leaving some room at the front (the spars don't intersect at the front, so leave a half cm or so). The "top" of the center spar (which is upside down on the building board) was given a light coat of contact cement, allowed to dry, then pressed onto the covering over the center spar line."

Personally, I prefer George's technique of using contact cement thinned with dope thinner and brushed on as you have time to adjust the plastic before it sets. Another of our club members, Jeff Ryan, has had some success using double stick tape. This procedure takes practice and you'll probably have to try it a few times to get it right. George suggests that you remove the glider from the board after attaching the left and right spars and attaching the center spar off of the board. John attaches all three while on the board. Either way, be careful when pulling the glider off of the board. Also, don't forget to remove the thread that was temporarily holding the wings in position.

The low glide speed and low sink rate allow for flexies to tested and trimmed indoors. This one is still floating slowing along a few seconds after released as John Viggiano and Ferenc Roka look on.

At this point, I like to give the glider a few light tosses across my basement to get an early indication of how it glides before the glue sets. Check for sharp turns, diving, and stalling. A good flexie usually has the plastic stretched tight in front while it is loose in the rear. If the rear is too tight, the glider may be prone to death dives. If too loose, it may stall. George suggests mylar tape strips to pull the front in which makes the rear covering more "billowy" or loose. Small pieces of spruce, the same size as the spars, can be "cyanoed" to the front or back of the center spar as trim weights. See George's article for more good tips on trimming. Here are some additional comments from John about the final steps in the glider construction.

"The building board is crucial to a taut covering, which is, in turn, crucial for a good glide. Why build a glider that won't glide, when you can invest 15 minutes and a piece of corrugated cardboard, and make gliders that float? Take George's advice and make that board! In the Hornet (1/2A) class, I have not found it necessary to stitch the covering to the spars, though I have made two flights at most on any given glider (and lots of hand launches). This may be because I have not really stressed the gliders, or it may be attributed to my allowing the contact cement to dry before attaching the covering to the spars (as opposed to George's recommendation of attaching them while wet). Something I noticed while working with balsa spars: any warpage of the spars affects the trim of the glider. Spruce will have less tendency to warp than balsa. I was nevertheless able to make trim adjustments in spruce-sparred gliders, so wanted warping can apparently be arranged. Double-coated tape is readily available at stationery and office-supply stores. It is a good alternative to the loops of tape recommended in George's article. Things stayed nice and flat that way. Touching the up-side a few times after sticking it to the board killed the excess tack that is fatal to the thin covering material. Another obvious thing to do is to powder the covering, just as you would a chute. Before flying it, rub lots of baby powder into both sides of the covering. The glider will open quickly, and loose less altitude after ejection. It is hard to hand launch these things while they're open. I've heard that, all other things being equal, a glider in a stable, even glide will travel with a velocity proportional to the square root of its wing loading. Because these gliders have such low wing loadings they glide much more slowly than their rigid-winged counterparts. Toss it hard and it will just pitch up and stall. I've tried just releasing them into gentle winds with mixed results. Here's something that I have found more useful: Close the glider and roll it as if you were going to put it into its booster. Toss it up hard, and it should open and glide nicely. Watch out for other people when doing this, though. As a variation on the last idea, I have put the rolled-up glider in a tube of the same diameter as its booster, and blown in out, like a dart from a blow-gun. I've gotten a little more altitude out of these launches, and you can also leave the glider rolled up inside for a few minutes to simulate what it will encounter in a contest. If it doesn't open after one of these launches, you can avoid the problem before flying it in a contest." John provides some excellent advice. His performance at FLFC IV certainly proves he knows what he is talking about.

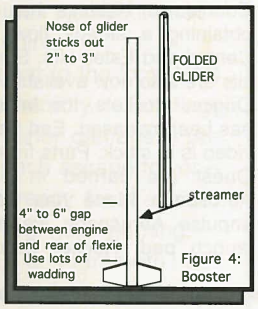


Figure 4: Booster

The booster for the 1/2 A and A engine sized gliders we've been discussing is a full 18" piece of BT-5 (see figure 4). To fly, a large amount of wadding is inserted, the streamer is then inserted, and finally, the glider is folded up and inserted in the tube, with the nose of the glider protruding 2" to 3".

Flying strategy is perhaps just as important as building skill. At FLFC IV, after seeing his first flexie glide away, John "de-trimmed" his second one slightly to get a returned flight. This strategy worked well as John was able to recover the glider on both the second and third flights and still "max out". Test flying of course is always important. It's surprising how many competitors show up at a contest with new models that are unproven. Given the performance of these flexies, use John's technique of blowing the glider out of a tube first. It's always a good idea to build several gliders, 3 or 4 being a good choice. Test flying will let you determine the good and poor performers.

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★ NAR ★ *Official Announcements*

Association Meetings Announcements

NAR members will be given two opportunities to bring official business before the Association this year. Association Meetings will be held in conjunction with both the National Sport Launch, Saturday, May 27, 1995 in Amesbury, MA and at NARAM-37, Monday, July 24, 1995 in Geneseo, NY. Each Association meeting will be preceded by an informal NAR "Town Hall" meeting with members of the NAR Board of Trustees and Committee volunteers. For details of either meeting, please contact:

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