# A and B Payload Design for 13mm Motors

*by Dan Wolf*

On page 9 is a plan for A and B engine class Payload rockets. "Payload" is an NAR contest event where the rocket must contain a 17.5mm diameter cylinder (fits inside an 18mm/aka BT-20 body tube) that is between 60mm and 70mm long that contains sand (the payload). The weight of the cylinder must be at least 28 grams. It is an altitude event. Altitude events are usually flown using altimeters, so the rocket must carry an altimeter also. The portion of the rocket carrying the payload must be returned. Typically the payload is then weighed to verify the weight is at least 28 grams.

A and B engine payload events are contest events that can be NRC (National Rocketry Championship) events. Each year, the NAR Contest Board selects six of the so-called NRC events to be flown all year long at NRC launches. Altitudes from those flights appear on the NAR National Scoreboard on the NAR website. Besides Payload, the other NRC events are parachute duration, streamer duration, boost glider duration, helicopter duration, eggloft duration, and eggloft altitude in different engine size classes. See the U.S. Model Rocket Sporting Code for more details.

When writing up the B Payload event coverage for *Sport Rocketry,* I was surprised that a 13mm motor two-stage payload (B payload) plan or a single 13mm motor payload plan (A payload) had never been published. I started looking after I observed that the winning flights in A, C, and D divisions were made with two-stage 13mm motor powered models. One of those was the Apogee Rocket's Midge design flown by A division winner Ashley Van Milligan. The other two were scratch built designs. My scratch built payloader was similar to those, and with the event being flown at NARAM again this year I felt it was time a plan should be published.

For A Payload, a single 13mm Estes A3-4T is used. For B Payload, a booster stage is added that uses the Estes A10-0T. While B Payload can be flown using 18mm motors, the lower base drag and lower mass of the two-stage 13mm design typically flies higher than black powder B motor powered designs. However, with the advent of the Quest B4-6, which has more total impulse than the A10-0/A3-4T combination, the advantage is not as clear cut. However, at NARAM-61, the best flights were made with the staged 13mm rockets. You mileage, er, altitude, may vary.

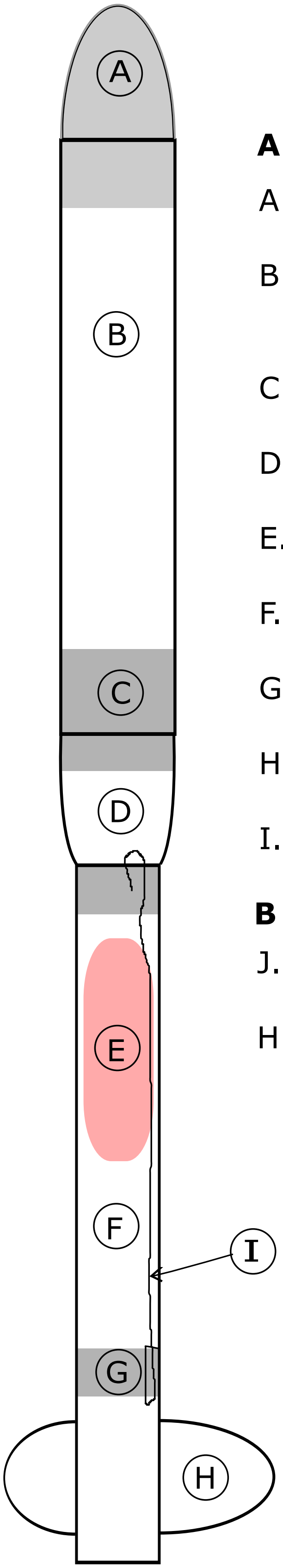
## Assembly

1. To build this rocket, first start with a 115mm (4.5") length of 13mm body tube. I used Balsa Machining Service T5. After cutting the tube to length, wick some thin Cyanoacrylate glue into the ends to strengthen the tube and to keep the tube ends from fraying when sanding. Sand off any that gets inside the tube. After that, sand the tube smooth starting with 220 grit sandpaper, then 320 grit, 400, 600, 1000, and even 1500. I find I can get a very smooth finish on the BMS tubing this way. The spiral seam could also be filled with thin CA or wood filler, but I don't usually bother. A longer tube is okay if you can't fit the recovery system. I am just able to fit an 8" chute in this tube, but it is a tight fit.

2. Next cut the fins from 10 mil G10 fiberglass. If building the two-stage B class rocket, cut six fins, three for the upper stage and three for the booster. Sand the fins smooth with progressively finer sandpaper as was done for the body tube. Also sand and round the

*Continued on page 14.*

# A and B ENGINE PAYLOAD ALTITUDE

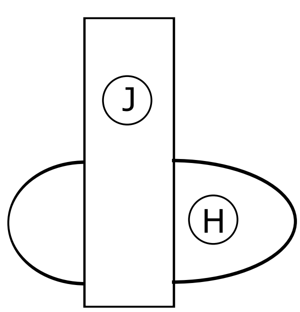



**A PAYLOAD / B PAYLOAD UPPER STAGE - PARTS LIST**

A. Nose Cone, thin polystyrene or balsa
Balsa Machining BNC-20A shown
B. Payload Tube
Balsa Machining T20 or other 18mm tube
96mm or as long as needed to fit payload
C. Body Tube Coupler
Balsa Machining C20, 20mm length
D. Transition
Apogee VF Transition 13-18mm
E. Recovery System
200mm (8") Plastic Chute or 30mm x 600mm mylar streamer
F. Booster Tube
Balsa Machining T5 or other 13mm tube, 115mm
G. Engine block/shock cord mount ring
Balsa Machining CR520-P
H. Fins, 3 required, 10mm fiberglass
Aerospace Specialty Products G10 - 010
I. Shock Cord, 70 to 100 lb Kevlar, 50 to 70 cm

**B PAYLOAD BOOSTER STAGE - PARTS LIST**

J. Booster Tube
Balsa Machining T5 or other 13mm tube, 44mm
H. Fins, see H for upper stage



*Continued from page 8.*

edges. I do not try to add any airfoil on such a thin fin. I can't image it makes much difference. The key to the fins is to make them smooth and flat.

3. Mark the body tube for three fins. I love the Estes "pancakes" and marking tool for this. Make a mark about 6mm (0.25") from the bottom of the tube on each fin line. This is where the trailing edge of the fins will go.

4. The next step is gluing the fins to the body tube. If you have the Art Rose fin jig, or access to one, that is the best method of attaching the fins to insure they are straight. If you do not have a precision fin jig, see the accompanying article for how I attach thin G10 fins.

5. The engine block comes next. Tie the Kevlar shock cord to the engine block ring and glue it at the fin end of the main tube so it is 36mm from the end of the tube (engine should extend 1/4"). That concludes construction of the main body tube.

6. The Apogee vacuum formed 13mm to 18mm transition comes with a short 18mm cardboard centering ring that is meant to be glued into the large open end of the transition. Discard that centering ring and instead glue the 20mm long Balsa Machining C20 tube into the open end of the transition.

7. The payload section assembly is next. Follow the same process for finishing the 18mm tube as described for the main tube. Once that is done, glue the nose cone into the payload tube. If the nose cone is a balsa cone, it should be finished to a smooth finish, and the seam between the nose cone and the payload tube should be filled and smoothed as well. The idea is to have the nose cone/payload tube unit be as smooth as possible to keep the airflow laminar down to the transition. Any discontinuities will cause turbulence and drag. Ideally, the airflow will stay laminar until the 18mm/13mm transition, but it's more likely to become non-laminar here, so the payload and altimeter are inserted into the rocket there.

8. The last step in assembly of the payload section is to add vent holes in the top of the transition. These can be three pin holes spaced 120 degrees apart around the top of the transition.

9. If building the B engine class version, the booster needs to be built next. Follow steps 1 through 4 to build the booster.

## Flight Prep

1. To fly, add wadding to the main tube and add the recovery system.

2. Tie the transition attachment cord to the main tube Kevlar shock cord.

3. Insert the payload into the payload tube, all the way to the top.

4. Put the altimeter into the inside of the transition section (don't forget to turn it on first). The dimensions in this design should allow the payload section to hold a 60mm long payload and fit a MicroPeak altimeter in the transition section. It is likely that a Firefly or ALTBMP would also fit, but do some testing before cutting the payload body tube.

5. To secure the payload section to the transition section there are a few options. Option 1 is to friction fit the two together. This option may be the most aerodynamic, but also the most risky. Option 2 is once the transition and payload section are connected, place a piece of Mylar tape or other thin smooth tape around the joint to insure they are firmly attached.

6. If flying single-stage, secure an Estes A3-4T in the rocket, and launch it from your tower and/or piston launcher.

7. If flying two-stage, friction fit an A10-0T in the booster stage so it is tight. Then remove it. Take a piece of cellophane tape and wrap the booster motor to the upper stage motor (Estes staging method). Then carefully push the booster stage up onto the booster motor.

8. Now load it up into your tower and/or piston launcher and have a great launch.