Nike-Apache Two Stage Conversion

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A few years ago I caught the scale bug and started building scale models of sounding rockets and manned spacecraft. But after a while it wasn't enough just to build them, I wanted my models to do something extra. I wanted them to model the flight of the real thing; in other words, if the real thing staged then my model would stage.

My first attempt at this was to modify an Estes Nike-Apache into a two stage model with a recovery system in each stage, using the capacitor/mercury switch/ flashbulb method of air-starting a motor. I felt that several things about the model would make it easy to convert; the design was stable so that no external structural changes would be necessary, and it looked like I could put the electronics inside the interstage adapter.

Construction

There are several things needed that are not included in the kit. These include:

18" of 1/8" elastic
18" of 30lb braided fishing line (or line of your choice)
1" x 10" streamer
Engine block for a BT-5
2 1/16" length of BT-5
CR5-20 and CR5-55 centering rings (1 each)
Balsa block (7/16"l x 3/8"w x 5/16"h)
Small screw eye
Expended mini-motor
Electrical components (see schematics).

Build the Nike section according to the instructions, but substitute the elastic shock cord for the rubber one. The parachute that comes with the kit is used to recover the Nike section. Don't attach the shock cord to the adapter.

Follow the instructions for attaching the fins to the Apache, but don't glue the body tube to the interstage adapter or assemble the nose cone. Use the braided fishing line attached to a fin for the shock cord and attach the streamer to it. The motor is used as the stage coupler and must stick out 1/2" from the rear of the Apache. Mark a mini-motor 1/2" from the nozzle end and use it as a guide to glue the engine block in place. With a live motor installed, add a enough clay inside the nose cone so that the CG is about 7" from the tip.

Modify the interstage adapter by cutting off the top and bottom as shown in Figure 1, then file the inside top of the adapter until a motor fits inside without being forced. The motor must slide smoothly, but not be loose. Cut off the plastic loop where the shock cord is tied, this gets replaced by the balsa block later. Drill 2 holes for the 3/32" connectors as shown in Figure 2.

The core of the adapter consists of the BT-5 tube, CR5-20 and CR5-55 centering rings, and a discarded center from one of the Nike motor mount centering rings. Using Figure 1 as a guide, glue the CR5-20 centering ring 5/32" from one end of the BT-5 and the CR5-55 ring flush with the other end of the tube. Glue the center from one CR20-55 ring on top of the CR5-55.

Figure 1.

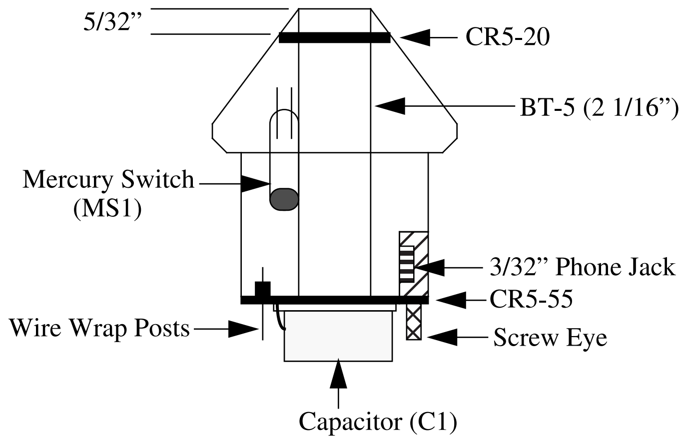
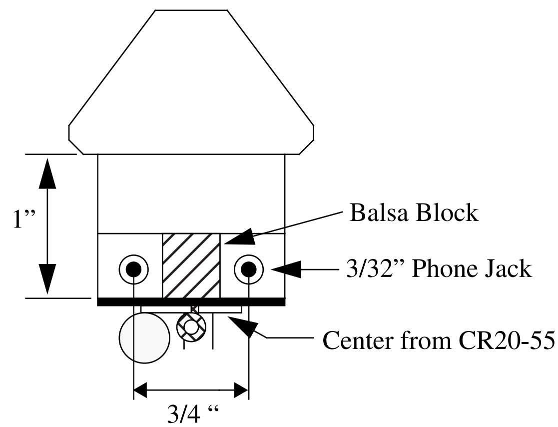


Figure 2.



The electrical components are a small mercury switch, a capacitor, and two 3/32" phone jacks (see Figure 6). I had hoped the capacitor and mercury switch would both fit inside the interstage adapter, but the capacitor was too big so I put it on the bottom of the adapter. J1 is used to charge the capacitor, J2 is used as an safing switch. When the Safing Plug is inserted into the Safing Jack the circuit is broken between the capacitor and mercury switch, preventing current from reaching the flashbulb.

Solder wires (I used 30 gauge wire-wrap wire) to the Charging and Safing connectors, and install them into the adapter as shown in Figure 2. It doesn't matter which side you put them in, just be sure to label them once they're installed. Glue the mercury switch to the BT-5 with the leads up towards the CR5-20 centering ring. The capacitor is glued to the bottom of the CR5-55, just make sure it is offset from the center and drill a 1/16" hole near the leads for wires to pass through. Drill holes for the wire-wrap posts, then insert and glue them into place. Make the electrical connections to the cap, mercury switch and wire-wrap posts, then test the circuit before installing the core into the adapter.

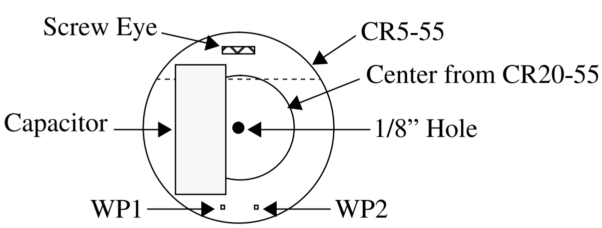
To test the circuit, short the wire-wrap posts together, install the Safing Plug, and attach the charging circuit shown in Figure 5. With the switch in the Test position the LED should slowly go dim, if it doesn't then there is a fault in the wiring. When the LED goes off turn the adapter upside down so the mercury switch is on; the LED should remain off. If it doesn't, double check the wiring to the Safing Jack and the Safing Plug. Turn the adapter upright and remove the Safing Plug; the LED should still be off. Now turn the adapter upside down; the LED should now stay on.

Once you have tested the circuit, glue the core into the adapter with plastic or super glue, making sure it is centered using the CR5-55 centering ring as a guide. It is difficult to remove the core once it is installed, so make sure that everything fits and is working before you glue it in place.

Drill a 1/8" hole in the center of the adapter bulkhead to make a path for the wires from the flashbulb. Glue the balsa block between the phone jacks and sand it flush with the shoulder of the adapter. This is be used to attach the screw eye to the adapter (see Figures 2 and 3).

Cut off the nozzle end of an expended mini-motor (about 3/8") and push it to the bottom of the BT-5 tube, nozzle end first. This is used as a bulkhead to protect the Nike recovery system from the exhaust of the Apache motor.

Figure 3.



Prepping the Model

SAFETY NOTE: Install the Safing Plug into the Safing Jack and test the circuit before prepping the model!

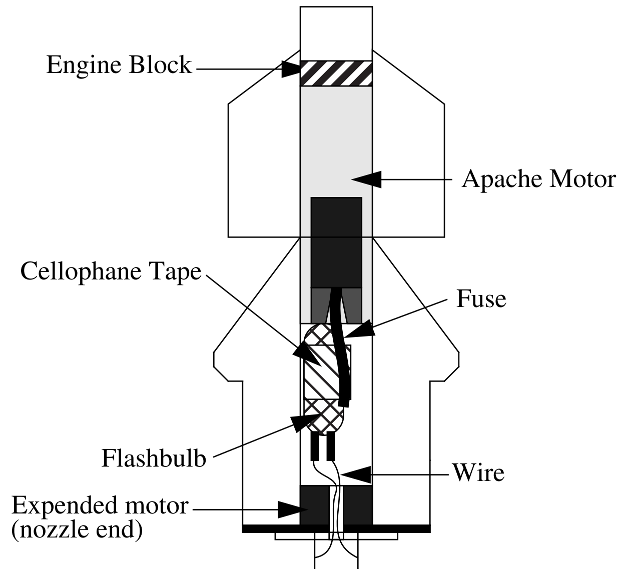
Prep the Nike and Apache recovery systems first, and then prep the motors. Wrap the Nike chute with an extra layer of recovery wadding and put a wad between the chute and the interstage adapter to prevent the Apache exhaust from scorching it. Put some powdered colored paint in the Apache to make it easier to spot, it really gets up there!

The motor for the Nike should be installed first, including the igniter. Test fit the Apache motor in both the Apache rocket and the adapter; add tape to give it a tight fit in the rocket, but it make sure it does not stick in the adapter.

Strip of 1" of insulation from both ends of a 10" length of wire, wrap one end around each lead of the flashbulb, then bend the leads up on opposite sides of the flashbulb. This prevents the leads from shorting out when the bulb is inserted in the adapter. I use flashbulbs taken from a flashcube, they are small enough to fit in the BT-5. Insert a 3/4" length of thermalite fuse in the upper stage motor, then tape the flashbulb to the fuse and to the motor with cellophane tape. Don't use masking tape, it may not melt and the Apache will get stuck, which will toast the interstage adapter. Refer to Figure 4.

Bend the wire from the flashbulb and feed it carefully through the bottom of the adapter. Gently slide the upper stage motor into the adapter, making sure you don't dislodge the fuse. Cut the wire in two and wrap the ends on wire-wrap posts. The model is now ready to be put on a pad for launch; the final prep is done at the pad once the Nike motor is hooked up to the launch system.

Figure 4.



Charge the capacitor using the circuit shown in Figure 5, with the switch in the Test position. When the LED stops glowing, switch to the Charge position and wait a few seconds. Remove the Charging Plug first, then carefully remove the Safing Plug and gently lower the adapter into the Nike. If you drop or tilt the adapter too far the Apache will ignite, so be careful. The model is now ready for launch, and should be launched as soon as possible to prevent the capacitor from losing too much charge.

I recommend using a B6-4 and 1/2A3-4T combination for the first few flights to get used to flying the model. Use B6-4 or C6-5 motors in the Nike, and 1/2A3-4T or A3-6T motors in the Apache. Don't use an A3-4T motor in the Apache, the delay is too short and it will probably shred the recovery system. If you have really good eyes, try a D21-7/A3-6T combination.

You may be wondering why long delay motors are used in the Nike booster instead of a normal 0-delay booster motor. The first reason is that the Nike motor isn't used to ignite the Apache motor, that's what the electronics are for. The second is that the Nike is stable by itself and will continue to climb even after the Apache has separated. A normal booster is unstable by itself and begins to tumble almost immediately. If the delay is too short the recovery system will shred, as I found out when I used a C6-3 in the Nike.

My staged Nike-Apache made it's first successful flight at NARAM 33, and I've flown about 7 times since then with the B6-4, 1/2A3-4T motor combination. From the experience gained doing the Nike-Apache, I decided to build a 1/5 scale Nike-Tomahawk. The finished model is over 5 1/2 feet tall and weighs about 2 pounds at lift-off. I used the same basic techniques with this model as I did with the Nike-Apache, and the results were quite spectacular!

Even though the Nike-Apache is out of production, you may be able to find them at hobby shops or through out-of-production dealers. Other kits like the FSI Nike-Tomahawk and the Estes Terrier-Sandhawk are good kits that may be turned into staged models. I find that "modeling the flight" is much more satisfying than just "flying the model"!

Figure 5 - Charging Circuit

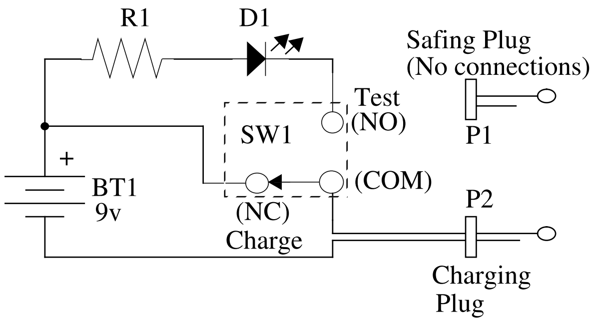
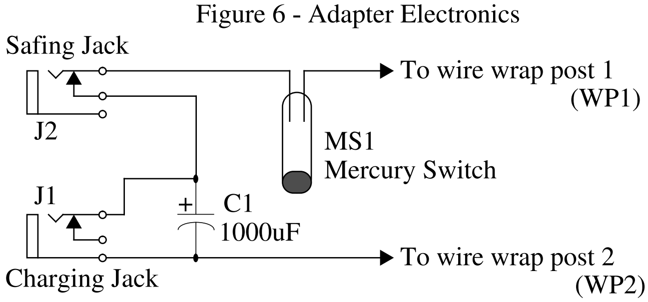


Figure 6 - Adapter Electronics



Part No.	Description
BT1	9v Battery
C1	1000uF, 16-25v Capacitor (RS 272-958)
D1	Red LED (RS 276-041)
J1,J2	3/32" closed circuit, open frame phone jacks (RS 274-292)
MS1	Mercury switch (RS 275-040)
P1,P2	3/32" Phone plugs (RS 274-290)
R1	220 Ohm, 1/4 watt resistor (271-1313)
SW1	SPST switch (RS 275-613)
WP1,WP2	Wire-wrap posts (RS 276-1987)
	9v Battery Clip (RS 270-325)
	Case for charging circuit