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NEWSLETTER

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Tips for Constructing Electronically Staged Mid-Power Rockets

Cover Photor: Mad Cow Rocketry's Nike-Smoke scale rockets.
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2-Stage Electronic Ignition for Mid-Power Rockets

By Robert A. Morstadt

During the course of flying 2-stage mid-power rockets, I have found several things that are either required or increase the chance of success. In general, if something works, I stay with it. In this article, I'll go over some of the main tips I have learned that have led to success with several 2-stage rockets, including a modified The Launch Pad (TLP) Standard Missile, a Bumper Wac using the 4" Dia. Estes V-2, the US Rockets Piston Stager, and the Neubauer 4" Dia. Redstone with an escape tower.

My first attempt was the TLP Standard Missile and I decided to convert it to electronic ignition with the G-Wiz LCX flight computer (www.ApogeeRockets.com/G-Wiz_flight_computers.asp) which uses an accelerometer to determine when to stage. The good thing about electronic ignition with an accelerometer is that the device must sense a steady acceleration for some given amount of time in order to arm the electronics. This prevents accidental ignition, say from dropping. This also means that you "must" read the directions to find the threshold acceleration and its duration. The G-Wiz LCX flight computer requires 2.5 g's for 0.5 sec *(You need to read the directions for other information, too)*. If the rocket does not reach this threshold, the second stage will not ignite.

It is best to weigh the rocket and then do a simulation or appropriate hand calculation to determine the required first stage motor. It is best to have too much acceleration, then too little. Deviation from the vertical on lift-off can reduce the g-load.

As I modified my Standard Missile (using LOC Precision 3" tubing - www.ApogeeRockets.com/Hi-Power_tubes.asp, 3/32" plywood fins, etc.) the weight grew to the point that I needed a G79-4 AT SU motor in the first stage. I still had a failure with good acceleration, so I made a sling device to test the G-Wiz as shown in Figure 1.

I swung the G-Wiz device with an Estes igniter in about a 3-foot circle at about 1 revolution per second for about one or two seconds and the igniter did ignite. This gave me confidence that the G-Wiz was working. Both the G-Wiz and the PerfectFlite Mini-Timer 3 (www.ApogeeRockets.com/Staging_Timer.asp) manufacturers indicated to me that rechargeable NiCad 9V batteries would increase my chance of success. The NiCad batteries have lower internal resistance and therefore deliver more power to the igniter. I've had good success with the NiCad batteries such as Sony, Harbor Freight, and Radio Shack as shown in Figure 2 and have stayed with them ever since.

Finally, I made two models of the second stage for the Standard Missile. One had the G-Wiz, one had the PerfectFlite mini-timer and both used NiCad batteries. But suc-

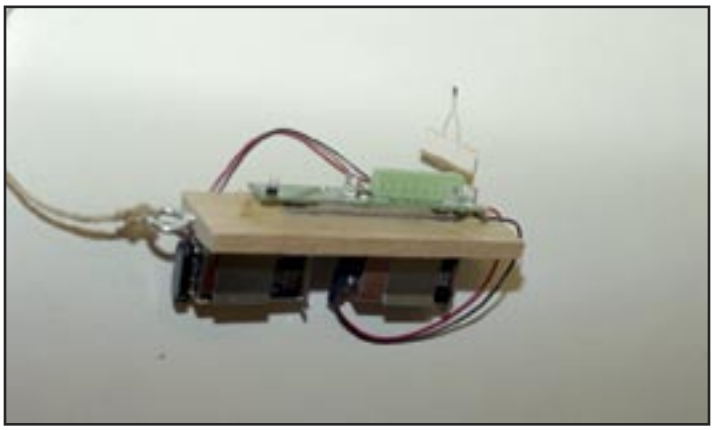

Fig. 1. Sling Test fixture for testing G-Wiz LCX flight computer for ignition.

Figure 2. Rechargeable NiCad batteries

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cessful ignition of the second stage of the Standard Missile still did not work. I had an Estes E9-4 (www.ApogeeRockets.com/estes_items.asp) in the second stage and the model went unstable and was destroyed.

My only explanation was that the thrust of the E9-4 was too low for stable flight. For the next flight I used an AT reloadable F39-6 (www.ApogeeRockets.com/Aerotech_Reload_Motors.asp). This option worked and I have now had 2 successful Standard Missile flights in a row. There appears to be an accuracy problem with the delay time of the F39-6, so I always drill a few seconds off the delay time. For the second stage igniter I use a QuickBurst e-match dipped in QuickDip pyrogen. When I assemble the F39 motor I thread the e-match through the grain slot and then through the nozzle before attaching the end closure. You might want to clear this procedure with your RSO. The e-match will then instantly ignite the second stage for a good flight.

The G-Wiz LCX flight computer requires one battery for computer and one battery for the igniter. I have since gone to the PerfectFlite MTG3, because it is smaller and requires only one battery, but I still apply the same principles that I learned with the G-Wiz. In all models it is good to have an on/off switch and one must be creative in building the space to hold the electronics. The electronics can be wholly contained in either the first stage or the second stage. For the Standard Missile I put the electronics in the space between the stuffer tube and the airframe as shown in Figure 3 through 6.

The G-Wiz uses indicator lights for indicating status while the MTG3 uses audible tones.

The blast deflector benieth the upper stage motor

Figure 3. Electronics with indicator light portholes on hatch so you can see it's armed before launch.

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Tips for 2-Stage Electronic Ignition

Figure 6: The parachute compartment slides over the battery compartment and is attached with 4 screws to the main airframe.

Figure 4 (above): G-Wiz LCX flight computer in the space between the stuffer tube and the air-frame.

Figure 5 (Left): Forward Battery Compartment has barely enough room for two batteries

consists of a thin aircraft plywood disk with Durham's Water Putty on top. In my first launches I used microclips, but I have also simply twisted wires together for connections. Twisting wires and then covering with masking tape can save space and be more convenient.

The US Rockets *Piston-stager* is unique in that it has an in-flight piston housed in the first stage. However, the plans do not give any instructions on how to ignite the second stage. I decided to improvise and put a Mini-Timer 3 (www.ApogeeRockets.com/Staging_Timer.asp) in the first stage as shown in Figures 7 and 8. There is a bulge

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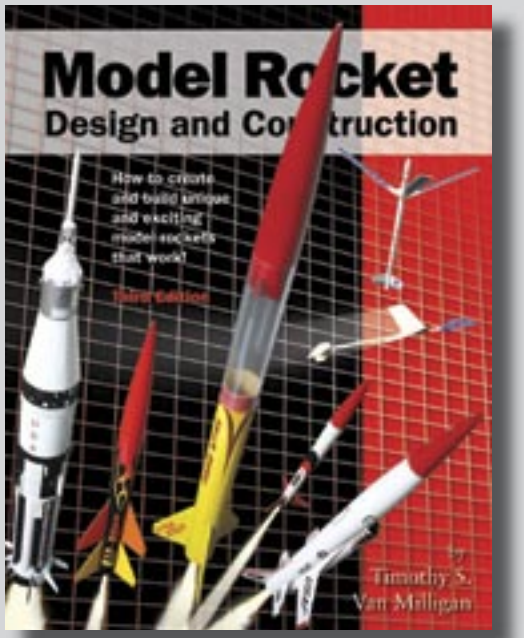

Model Rocket Design and Construction

By Timothy S. Van Milligan

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Tips for 2-Stage Electronic Ignition

Figure 7: When there isn't room inside the rocket for the electronics, you can put them into a compartment on the outside of the rocket, as shown here in the US Rockets Piston Stager with Electronics in the 1st stage transition section.

Figure 8: The two stage Piston Stager on the pad ready for launch.

for the 9V battery compartment, which is unsightly, but my past experience tells me that this battery works. The Mini-Timer3 compartment is on the opposite side.

When you have a big nose cone, you can house the electronics internally, such as what I did for the escape tower on the 4" diameter Neubauer Mercury-Redstone shown in Figure 9 and 10. The electronics still need to be mounted vertically, so you'll see a vertical plate and gusset for support. Also note that the shock cord is attached internally in the nose cone, so it must go through the open slot in the base plate of the nose. The base is secured with three screws, shown in Figure 9.

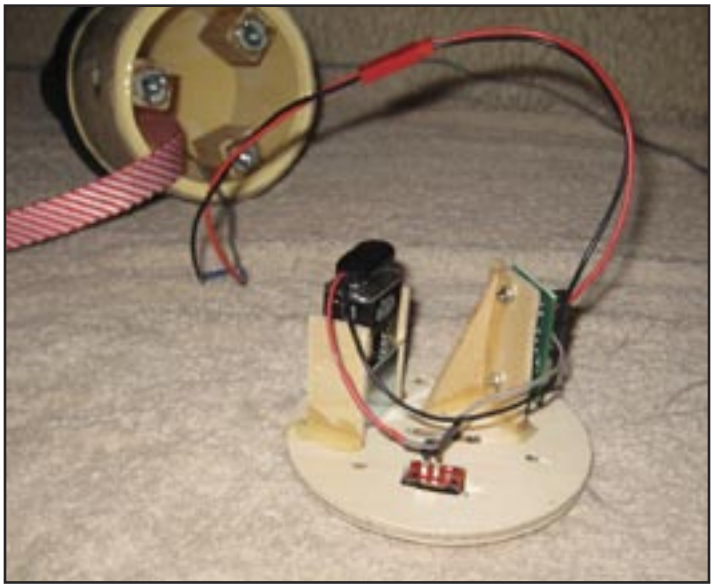

Figure 9 (above) and 10 (lower right): Mercury-Redstone electronics for escape tower jettison.

The flight configuration is shown in Figure 10. This rocket used a G79-4 motor in main body and a Estes A10-3T in the escaper tower. The escape tower had a small parachute for recovery.