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Build A Better Floating Head Piston Launcher

By Chan Stevens

{Editor's Note: Chan Stevens is part of the Neutron Fusion competition team. Over the last two years, they've been breaking altitude records at NARAM using a modified version of the floating head piston launcher. Now we get to learn his secrets...}

I'd been using the fairly common floating head piston (http://www.apogeerockets.com/Launch_Accessories/Pis-

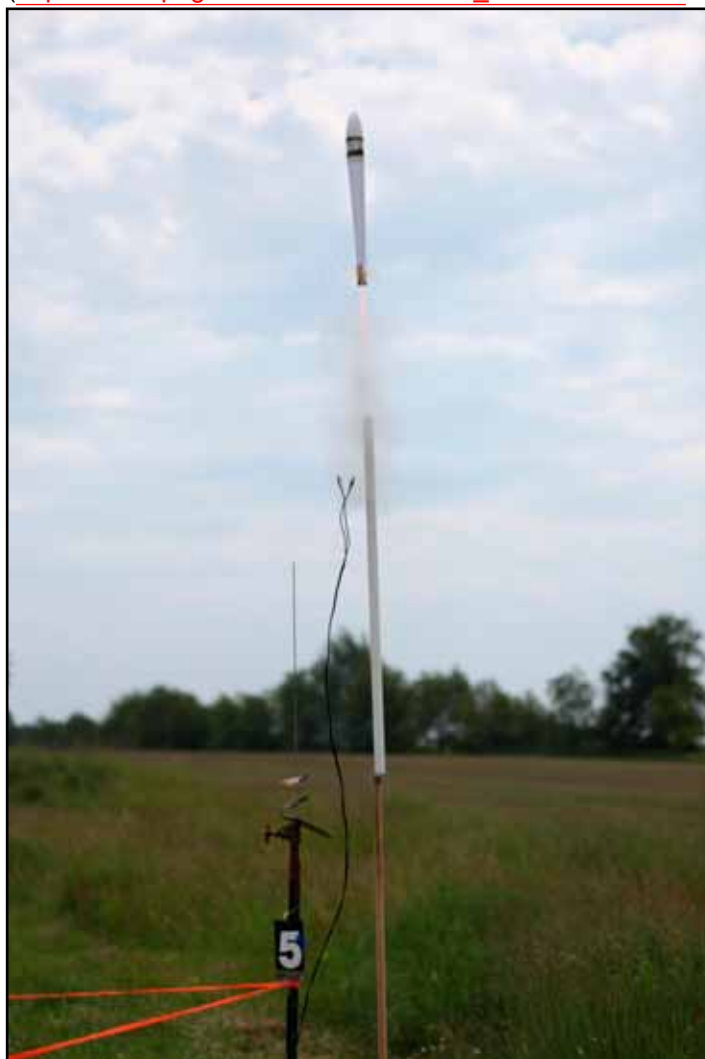


Figure 1: An egglofter rocket leaves a piston launcher. Note how far the launcher clips traveled upward.

[ton Launchers](#)) approach to launching competition models for a few years, when Jon Stenberg was testing out a new camera and sent me a great photo of one of my egg lofters just leaving the piston tube (Fig. 1). There are two basic setup features worth noting. First, like most piston users, I slipped the igniter leads outside the tube and clipped the leads externally. Second, I was flying “naked” without any guidance. While Apogee has thankfully reintroduced commercially available towers (http://www.apogeerockets.com/Launch_Accessories/Launch_Pads/Apogee_Competition_Launch_Tower) to the hobby, these are still not very helpful when dealing with longer piston lengths for heavier models such as the 34” piston in the photo because the piston extends beyond the reach of the tower. Now let me describe how that photo has changed my piston methodology forever.

Notice the leads falling away? That piston tube, just clearing the inner support rod, tops out at about 80” off the ground, so the leads got pulled up to 6’. That was about the end of their stretch, and you can see the piston tube has been pulled very slightly away from vertical as a result. That particular flight was fine, but I was concerned about the potential risk of tip-off and the potential performance and safety issues.

I’d seen a few designs that use internal wiring, but they tended to be complex and use expensive or custom components. I’m a big fan of flying using affordable and accessible materials, so set out to design something simpler and effective. The result is my internally wired “naked” piston system. *{Naked means the rocket doesn’t use a launch rod or tower to stabilize the lift-off}*

The main design change is in the piston head. It may not be obvious, but the piston head barely moves during normal operation—it starts out resting on the inner support rod while the rocket and piston tube move upward around it. It’s what happens when the piston tube has moved all the way up that makes internal wiring tricky, because at that point it pulls the piston head up with it, and since we don’t

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want a tug disrupting the movement, the piston head needs to come unplugged from the wiring quickly and smoothly. John McCoy tipped me off to some tiny and affordable strip connectors (<http://www.alliedelec.com/search/productdetail.aspx?SKU=70206360>) that work perfectly.

To build the piston head, I start with basic coupler stock, but instead of gluing a disk on for the head, I stick it on a piece of masking tape centered around a pair of those sockets (plug one into another to make them taller) and pour about 1/8"-1/4" of epoxy into it. It's critical to avoid get-



Figures 2-4: A piston head is made by pouring epoxy around a Straight Strip Socket. Be sure that no epoxy enters the holes or covers the pins.

ting epoxy on the socket leads, which is why I use a tall pair rather than just a single one. Getting the epoxy into smaller 18mm and 13mm heads can be tricky, so I either use a syringe or drip it in using a toothpick. See Figures 2-4 for a closer look.

The female end of the socket is flush with the top of the piston head, and the igniter leads plug into this. The male/pin end of the socket points aft, though does not extend out beyond the back of the piston head, and the internal wire leads plug into this. You can extend the life of the piston head by plugging the igniter into an extra socket connector, then plugging *that* connector into the piston head, which keeps the motor gunk from corroding the connection surfaces. I find it's a lot easier to throw out a cheap socket each flight than recast a piston head every 5-10 flights.

The other main change I made was the inner support rod. I had been using a regular dowel, which doesn't leave any room to slip wires up the piston tube, and also tended to be so loose the piston tube could wobble a bit on the way up. I had to switch to a hollow tube, and preferably one that fits a bit more tightly to eliminate the wobble.

As it turns out, standard 3/8" copper tubing fits perfectly into the BT-20 coupler stock (www.ApogeeRockets.com/Building_Supplies/Body_Tube_Couplers/Standard_Couplers/AC-18_BT-20_Coupler) I used for stop rings inside 18mm piston tubes, and 1/4" brass tubing would work for 13mm pistons (with coupler stock stop rings), though I happened to have some 0.370 fiberglass kite spar tubing handy that works fine too. For 24mm pistons, I use CR 18-24 centering rings (www.ApogeeRockets.com/Building_Supplies/Centering_Rings/Low_Power_Centering_Rings/Centering_Ring_18-24) as stops so that I can stick with the 3/8" copper tube for my support rod. Just make sure the support rod is longer than the longest piston tube you'll

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use—4-5 feet is a decent working length.

The internal leads are the only aspect of this that requires even a small amount of skill. I needed to connect a length of lamp cord or similar gauge wire to one of those tiny socket connectors so that I could plug the leads to the back of the piston head. That meant soldering. Prior to this I'd managed to avoid learning that skill in life, but after investing about \$15 for a basic soldering kit and 30 minutes of a few YouTube videos, I felt up to the challenge. I soldered a connector to the end of a 6-foot length of wire, then wrapped electrical tape around it to seal it and hopefully keep it from breaking when the piston head pulls off. See

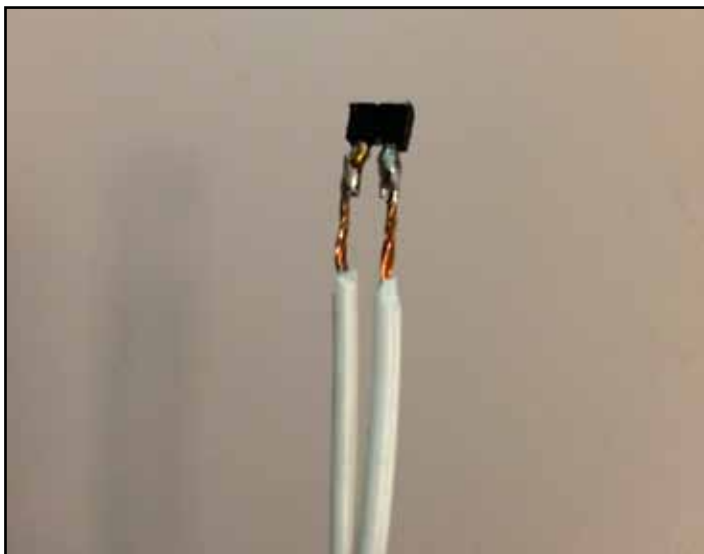


Figure 5: The leads inside the piston are topped off with another Striaght Strip Socket that is soldered to the wires.

Figure 5 for a close up. Strip off an inch or so of insulation from the other end for connecting to pad power.



Figure 6: A music stand used to support the copper tube of the piston launcher.

For my externally wired pistons, I normally just pounded the support rod/dowel into the ground, but for the internally wired approach this won't work, so I needed some type of stand to secure the support rod which would also allow the wire leads to remain exposed for hookup. For those of you that don't happen to have a music stand you

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Figure 7: A cheap alternative to the music stand holder is a flag pole mounting bracket. These can be found at hardware stores.

can repurpose (Figure 6), I'd suggest a flagpole mounting bracket (Figure 7) that can be found at most big box stores for around \$5-10 and mounted to some scrap wood or even a PVC stand (www.ApogeeRockets.com/



Figure 8: The silver mylar tape is the end of the motor that will go into the piston tube.

[education/downloads/Newsletter235.pdf](http://www.ApogeeRockets.com/education/downloads/Newsletter235.pdf)).

OK, so let's put it all together and go through flight setup. First, you'll need to make sure you've got a nice snug fit between the motor and the piston tube, which usually means a wrap or two of something like mylar tape around the aft end of the motor. You'll need to friction fit the motor into the model, or use a small bit of tape *forward* of the last 3/8" or so of motor that has to fit into the piston tube (Figure 8). Once satisfied with the fit, remove the model for now.

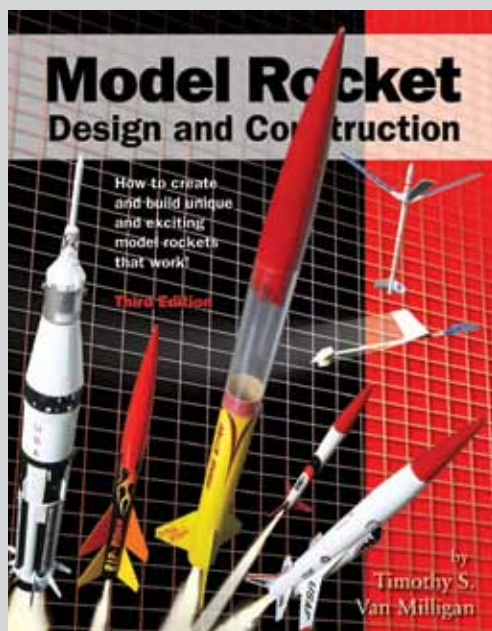
Next, slide the wire lead through the inner support rod, socket end up. Place the inner support rod into the stand/holder, slipping the stripped leads through the bottom (Figures 9 & 10). Slide the piston tube over the support rod.

Next, "plug" the socket on the end of the wire lead to the



Figure 9 & 10: The hollow tube is secured in the stand, and the socket end is fed upward and out the top.

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By Timothy S. Van Milligan

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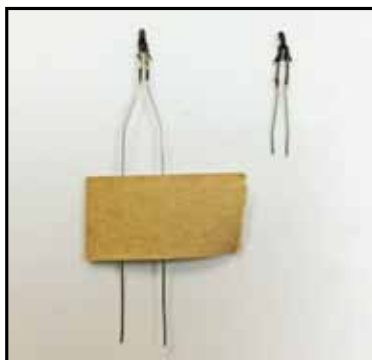
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Figure 11: A flag pole base with the internal tube inserted and the ignition wires coming out the bottom.

pins inside the back of the piston head and slip the piston head into the piston tube, resting on the inner support rod. At this point, you'll want to make sure you don't accidentally tug at the aft end of the wire lead and unplug the head, so I tape the leads to the support rod while I'm working.

To connect the igniter to the piston, I usually use a



Figures 12 & 13: The igniter is trimmed, and then inserted into the Straight Strip Socket connector. Note that an extra socket is inserted into the top of piston head. This sacrificial part will get covered in exhaust residue. Swapping it out between flights allows the piston head to be reused.

regular Estes igniter, with a little bit of prep. First I remove the paper strip, then I trim the leads back to about an inch (thumb width for most of us). I then plug the igniter leads into the sockets. Since you don't want the leads bending or twisting into each other causing a short, this usually involves a little adjustment with a toothpick or needle nose pliers to make sure the leads stay comfortably apart (see Figures 12 and 13).

Finally, mount the model/motor to the piston tube. The easiest way to do this is to slide the piston tube down until the piston/igniter are just barely poking out the top, then

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bring the model/motor down to line up over the igniter (Figure 14), then slip the piston tube back up, friction fitting it around the exposed section of the motor.

Hook pad-side power to the exposed leads near the base of the stand, and fire away. With a decent floating head piston, you should be getting 40-50% more boost than non-piston flights, and I'm finding switching to internally wired pistons I get another 10-15% benefit. More importantly, I've got a much more reliable and consistent method of piston launching.



Figure 14: Set the rocket on the igniter, and slide the piston tube up over it.



Figure 15: Rocket on the piston launcher at NARAM-56.



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