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PEAK OF FLIGHT

NEWSLETTER

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Cover Photo: Newway Space Models' Vigilangle Rocket Kit. Get one at:
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Installing An E-bay In A Nose Cone

By Tim Van Milligan

Figure 1: Short rockets, like this Phoenix missile, don't have room inside for a standard e-bay.

A question that I'm asked a lot these days, is how to install an e-bay inside a nose cone. There are many short rockets, particularly those that are scale models, where there isn't a lot of room available inside the airframe to install a standard E-bay. An example is the classic V-2 rocket and the Phoenix missile.

These short rockets are small and lightweight, so they can fly to incredible heights. Dual-deployment of the parachutes would be ideal in order to get them to drop down quickly in a small launch field.

There is room inside a nose cone for electronics, but how do you secure them tightly? In this article, I'd like to show you one method. I'm sure there are others, and if you have an alternate approach, you're welcome to submit it here as an article in this newsletter. We're all interested in learning new strategies.

While the process would be identical for any rocket, in this article, I am using a 4" diameter Phoenix kit from Mad Cow Rocketry (www.ApogeeRockets.com/Rocket_Kits/Skill_Level_3_Kits/Phoenix_Missile_4in_Diameter). To use dual-deployment, you'll also need a dual-deployment altimeter (www.ApogeeRockets.com/Electronics_Payloads/Dual-Deployment), a tether-release device (such as the Tender Descender (www.ApogeeRockets.com/Electronics_Payloads/Tender_Descender), and the assorted mounting hardware. In this article, I scrounged the threaded rods and a sled from a 4" e-bay kit (www.ApogeeRockets.com/Electronics_Payloads/Electronic_Bays/4.0_Madcow_Ebay) and used a standard electronics mounting kit for all the assorted wires, switch, and connector do-dads (www.ApogeeRockets.com/Electronics_Payloads/Electronics_Accessories/Electronics_Mounting_Kit).

Figure 2: You can use the threaded rods and bulkheads from an e-bay kit.

I chose this kit because it has a plastic nose cone. The plastic used on high power nose cones is typically polypropylene, which is durable, but it is hard to glue anything to it. A fiberglass nose cone would be much easier to use, but they are more expensive and not as common in a standard kit that you might purchase.

The first step in the transformation process is to remove the base of the nose cone. In Figure 3, you can see that I wrapped tape around the outside of the shoulder in

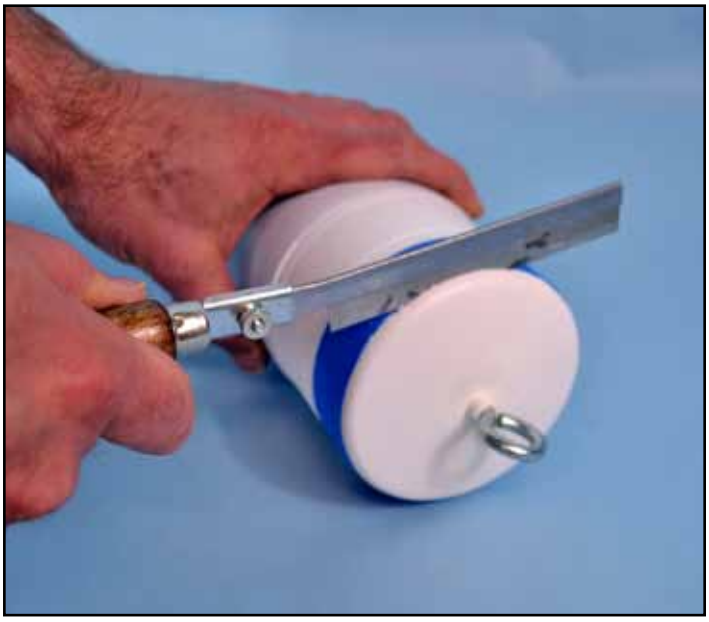

Figure 3: Cut off and discard the base of the nose cone.

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order to get a straight perimeter line. To cut through the heavy plastic, I used a razor-saw. These are available at any hobby store if you don't already have one.

The edge will probably be a little rough after removing the base, and you can clean it up with a sanding block and some rough sandpaper.

Step 2: Assemble the E-bay Sled

If you're not using an e-bay kit like I'm doing, you'll need to cobble together a sled onto which the altimeter will be mounted. You won't install the electronics yet, but the sled is used to hold the threaded rods at the right distance apart.

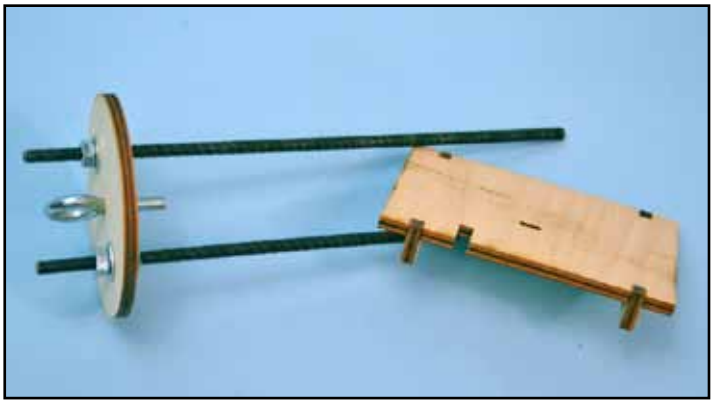

Figure 4: Assemble the e-bay sled so that you can hold the threaded rods at the correct distance apart.

You'll also need a bulkhead disk that will become the bottom of the nose cone. In the ebay kit that I used, it contained three bulkheads. One of them was sized to fit inside of a tube coupler. This was perfect for this project, because it also fit inside the plastic shoulder of the nose cone.

The plastic on the nose cone is not uniform around the perimeter of the shoulder, as seen in Figure 13 on Page 7. So I had to do a little bit of scraping on the inside of the shoulder with a hobby knife to get it to fit. But it didn't take much effort.

In Figures 4 and 5, you can see that I placed the bulkhead onto the threaded rods at this point too. Again, the purpose of this is to hold the rods at the correct distance apart.

I also temporarily installed the eyebolt in the bulkhead disk. This provides a convenient handle to hold onto as you insert the bulhead into the base of the nose cone.

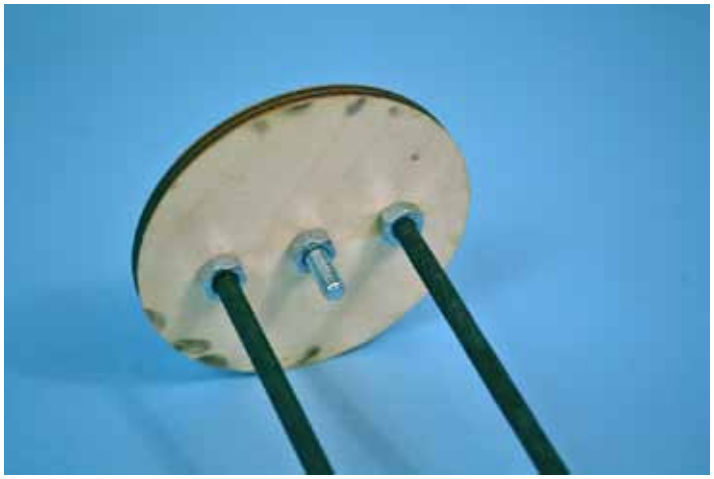

Figure 5: Put nuts on both sides of the bulkhead disk to prevent the threaded rods from sliding through.

In Figure 5, I also put nuts on the threaded rod, on both sides of the disk. I didn't want them to move around on me, because it is critical that the rods be parallel and the right distance apart.

Step 3: Adjust the location of the sled and the Bulkhead

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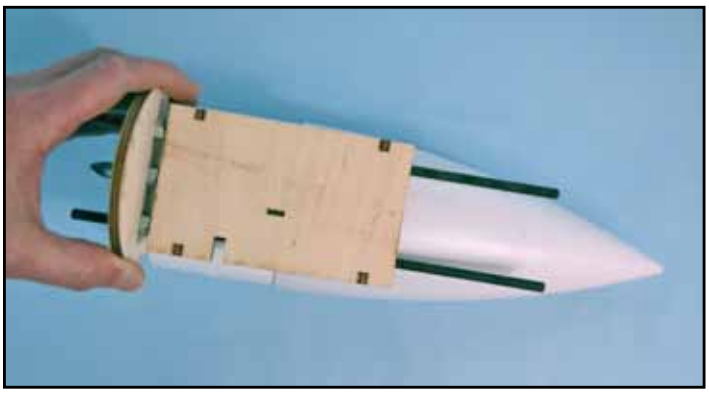

Figure 6: Adjust the position of the components on the threaded rods.

In Figure 6, you can see the next step. It is to lay the sled assembly along the nose cone to position both the sled and the bulkhead disk along the threaded rod. You want the threaded rods to go as far into the nose cone as possible, so as to increase the strength of the e-bay in the nose.

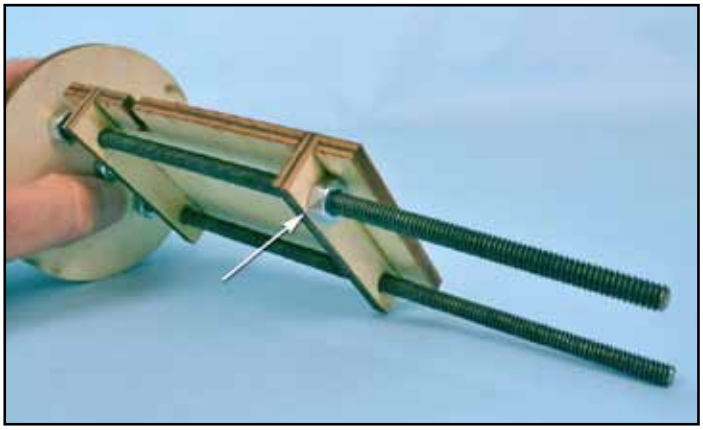

Figure 7: A nut on the forward side of the sled will prevent it from sliding too far into the nose cone.

You can control the position of the sled along the threaded rods with a single nut on one of the threaded rods, as shown in Figure 7. The location of the sled isn't too important, but you don't want it sliding around.

The bulkhead should just slide into the base of the nose cone, as shown in Figure 8. Even though you'll remove this bulkhead later, it is important that it be positioned

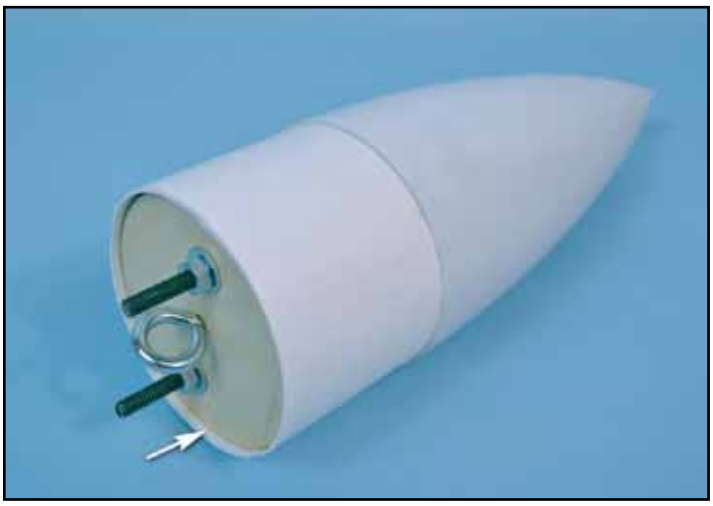

Figure 8: Adjust the nuts so the bulkhead slips just inside the base of the nose cone.

inside the nose cone right now, so that the rods aren't canted inside the nose cone.

So if everything is positioned correctly, the two threaded rods will just be touching the inside curvature of the nose cone, and the bulkhead disk will be inside the back edge of the shoulder.

You may notice that the threaded rods are sticking out well past the base of the nose cone. You can cut them off to reduce weight if you wish. I left mine long, because I

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was too lazy to cut them shorter.

When it is positioned, mark on the outside of the nose cone, with a pencil, where you believe the forward ends of the threaded rod hit the nose cone. You can remove the sled assembly and lay it along the outside of the nose cone, as shown in Figure 6, to double check.

Step 4: Install a Dowel Through the Nose Cone

If you're using a fiberglass nose cone, you can skip this step. The epoxy, which will be used to bond to the ends of the threaded rod, will stick to the fiberglass if it is scuffed up. But nothing sticks to the polypropylene plastic. So we need to make a mechanical support to fix the threaded rods into the nose. This is done with a wooden dowel passed through the wall of the nose cone.

Figure 9: Cut a hardwood dowel to be wider than the diameter of the nose cone.

The diameter of the dowel should be as large as possible. The bigger it is, the stronger the joint will be. But it is going to depend on the largest drill bit in your toolbox. The largest one I had was 1/2-inch diameter, so that is what size wood dowel I will use here.

Cut the length of the dowel to be at least the diameter of the nose cone (as shown in Figure 9). You'll be trimming it down later, so don't worry about the actual length too much. A rough cut is fine for now.

The dowel should pass through the nose cone, rearward from where the ends of the threaded touch the inside of the nose cone. In other words, once the dowel is through the nose cone, the threaded rods will slip past and be closer to the tip.

How far back can the dowel be positioned? I'd say make it a minimum of 1/2 inch back from the front edge of the threaded rod. Further back is fine, but you can't put it

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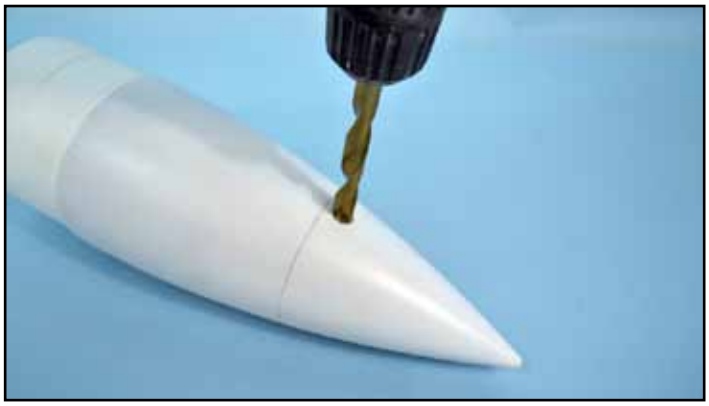

Figure 10: Drill a hole through the nose cone for the wood dowel.

so far back that it would interfere with the e-bay sled. That is the limiting factor.

Also, the further back you position it, the more epoxy you will use up bonding everything in place. So keep that in mind as you decide where to put the dowel in the nose.

Once you decide where to position the dowel, drill a hole clear through the nose cone (see Figure 10). There is a video on our web site on doing this step, which you can find at: www.ApogeeEockets.com/Advanced_Construction_videos/Rocketry_Video_84.

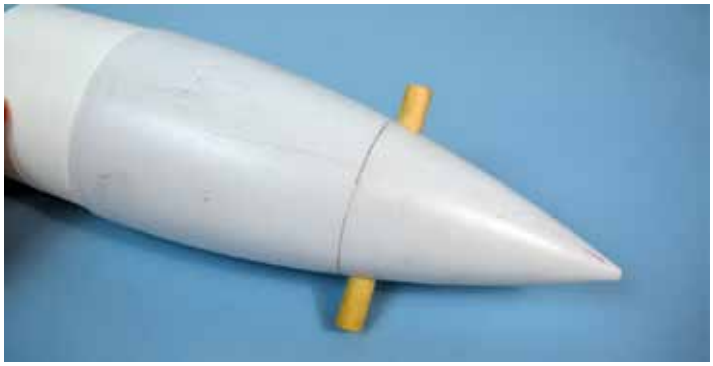

Figure 11: Test fit the dowel through the holes.

After cleaning up the edges, test fit the wood dowel by passing it through the holes so that the wood sticks out both sides of the nose cone. The fit should be tight. Then remove the dowel.

Step 5: Create An Epoxy Dam

Note: This step is optional.

In order to minimize the amount of epoxy in the nose cone, you can make a simple dam by cutting out a cardboard disk and placing it in the tip of the nose cone.

The diameter of the disk needs to be slightly smaller than the distance between the threaded rods (Figure 12).

This disk is glued into the nose cone using thick superglue. The glue won't hold the disk for long, since nothing sticks well to the plastic. The purpose of the glue is to create a barrier that prevents the epoxy from running down into the tip of the nose.

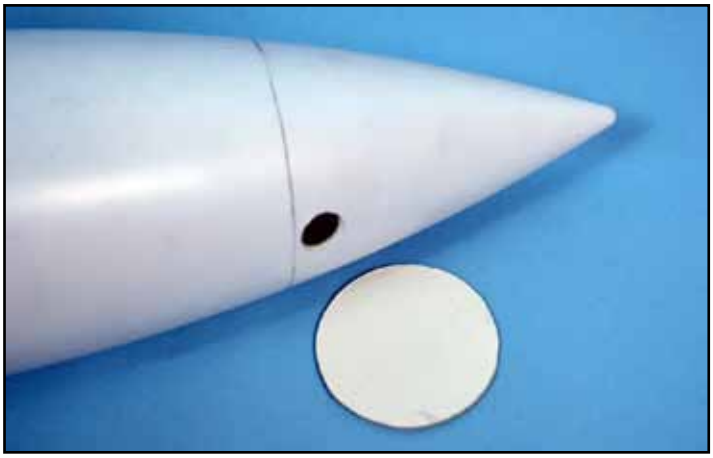

Figure 12: A cardboard disk will be used to prevent epoxy from going to the tip.

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Figure 13: Seal around the edge of the disk with thick super glue to prevent epoxy from pooling in the tip.

If your rocket needs nose weight in order to make it statically stable, you'd probably leave this epoxy dam out and just completely fill up the tip of the nose cone with epoxy. You can also put metal BB's into the epoxy to add even more weight, which was shown in the video mentioned previously.

My rocket didn't need extra nose weight for stability purposes, so I wanted to minimize the amount of epoxy. There are a couple of reasons for this. First, epoxy is expensive, so using less means you save money on your rocket.

Second, epoxy is exothermic when it cures. That means it gives off heat from the chemical reaction that causes it to harden. The more epoxy you use, the more heat is generated. This can be significant in a large diameter nose cone. And since the nose is made of plastic, too much heat can possibly cause the plastic to soften and deform. You could end up with an oddly shaped nose cone if you're not careful.

Figure 14: Test the sled assembly into the nose cone. Note that the steel rods are perpendicular to the dowel.

If you don't use an epoxy dam, and the tip starts to get hot, submerge the tip in a bucket of cold water. This will soak up some of the heat and keep the plastic from deforming. But it also means you could get water in the wood dowel, and possibly into the tip of the nose cone. But that is more acceptible than a deformed nose cone.

Step 6: Epoxy the threaded rods into the nose.

With the disk in place, you can now reinstall the wood dowel. Test fit the sled one last

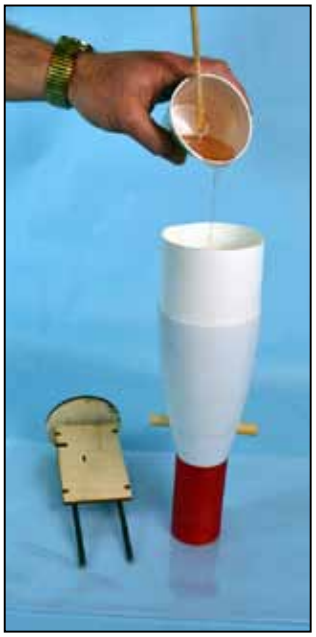

Figure 15: Pouring the epoxy into the nose.

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time into the nose cone. In Figure 14, note that the rods are oriented perpendicular to the wood dowel. Remember, the threaded rods will extend past the wood dowel into the nose cone.

At this point, you'll want to stand the nose cone upright, so you can pour epoxy into the tip. I found that a short length of tube works fine as a stand for the nose cone (see Figure 15 on the previous page).

Figure 16: Pour enough epoxy to cover up the wood dowel. Any extra only adds excess weight.

Mix up enough epoxy to fill up the nose cone, and pour it into the tip as shown in Figure 15.

Fill up the nose until the wood dowel is completely covered (Figure 16). Any extra will only add excess weight. However, if your epoxy is leaking past the dam or out around the hole, then you should put in more epoxy to account for the seepage.

While the epoxy is still in its liquid state, you'll place the sled assembly back in the nose cone, Try to agitate the assembly slightly to get epoxy into all the groves of the threaded rod where it is submerged. Be careful though, don't tilt the nose or get epoxy onto the sled itself, or you'll never be able to get it out of the nose cone.

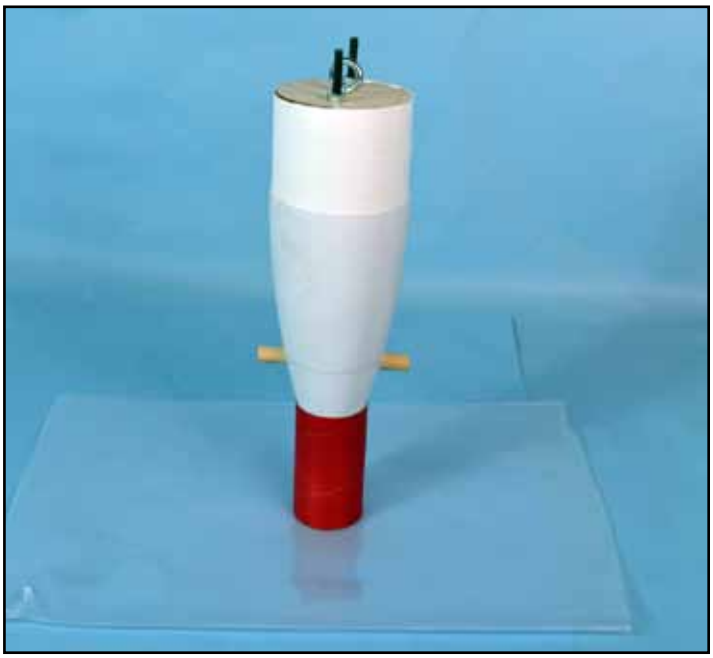

Figure 17: Dunk the sled assembly back into the nose cone. The liquid epoxy will cover the tips of the rods.

Figure 18: Epoxy drip.

I'd let the epoxy fully cure overnight before taking off the bulkhead and removing the sled.

Also remember to cover your table with some plastic. It is possible that the dowel or your holes were not completely circular, and

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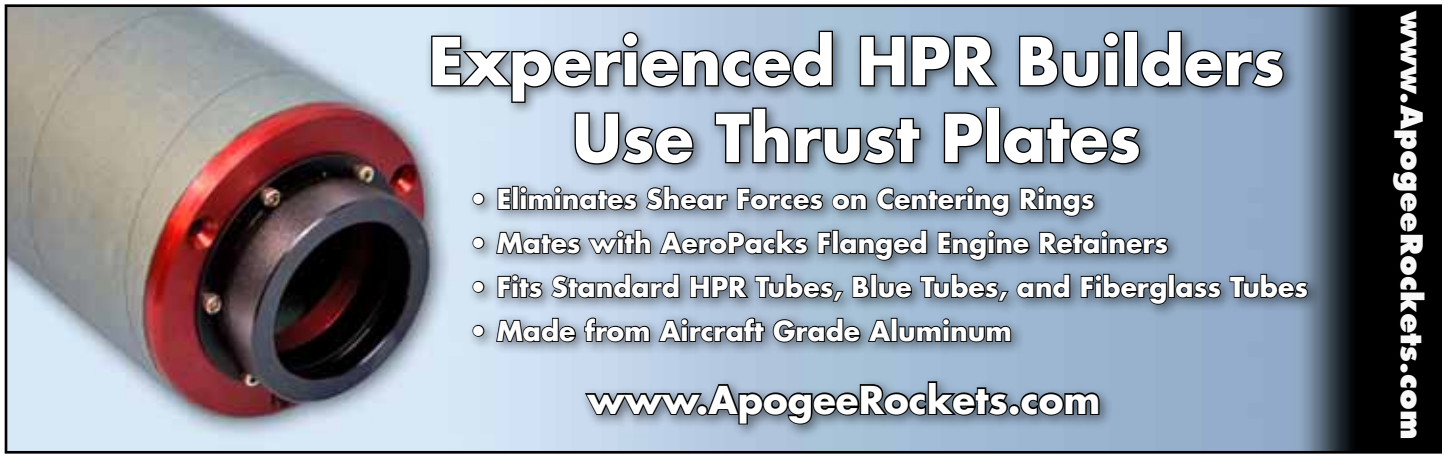

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Figure 19: The rods are now permanently captured in the hardened epoxy!

epoxy could seep out and drip down on the table.

When the epoxy is cured, you can remove the aft bulkhead and pull out the avionics sled. The threaded rods are now permanently captured in the epoxy and should be free-standing, as shown in Figure 19.

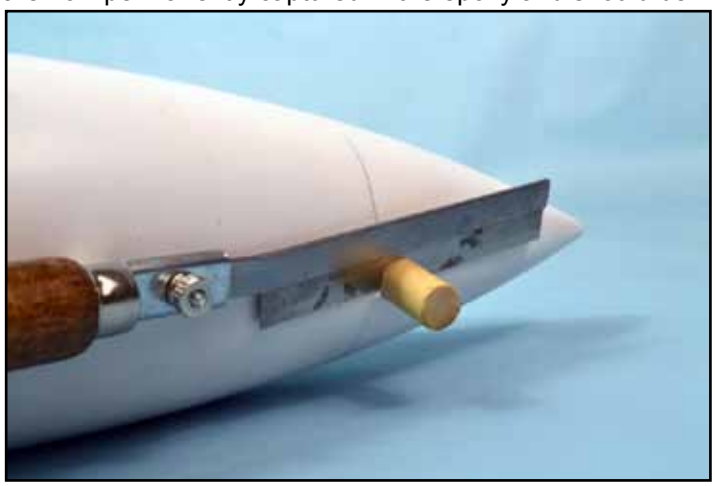

Figure 20: Trim off the excess dowel with a razor saw.

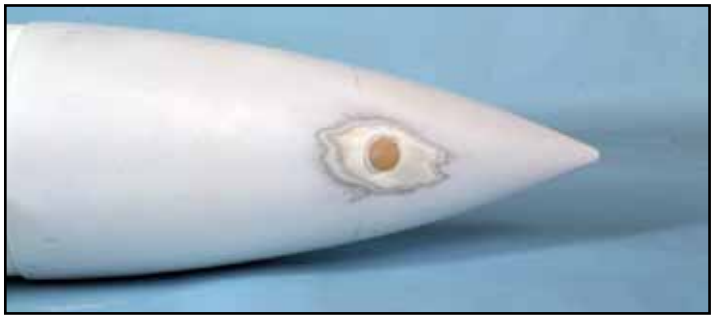

Figure 21: Sand the dowel to match the curvature of the nose cone, and you're ready to paint.

Step 7: Trim Off The Excess Dowel

Now you can trim off the excess wood dowel that overhangs the edge of the nose cone with a razor saw.

Then using a sanding block and some medium grit sandpaper, shape the dowel to match the surface of the nose cone (see Figure 21).

Step 8: Install The Electronics on the Sled

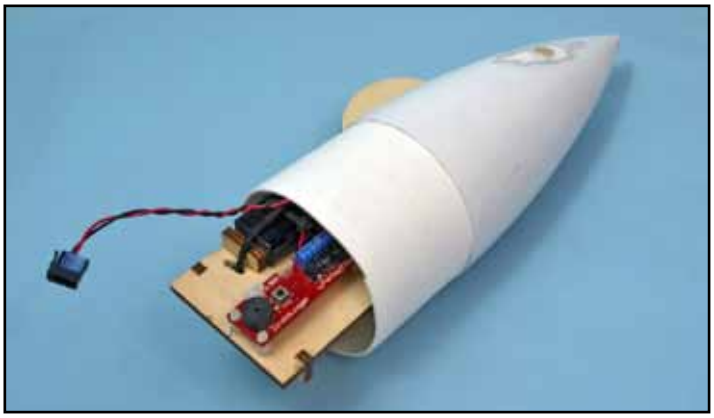

Figure 22: The altimeter installed on the sled and inserted back into the nose cone.

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The mounting of the sled into the nose cone is done! At this point, it is only a matter of installing the dual deployment altimeter onto the sled in the rocket and getting it ready for flight.

Obviously, you have to paint the nose cone, and you also need to drill a vent hole for the altimeter to sense the air and for the power switch to turn it on for launch.

Figure 23: View looking into the rear of the nose cone with the sled and avionics installed.

The location of the vent hole will depend on the type of altimeter you use and your goals for the flight. Really, you only have to worry about the location if you want to record the speed of the flight, and your altimeter only has a barometric sensor. A barometric sensor (used to measure speed) needs the hole on the straight portion of the tube. Air flowing over the nose cone will have a lower pressure, giving the rocket a false speed reading. It will make it appear to fly faster than it really did.

If you have an altimeter with an accelerometer sensor on board, it will measure the speed based on the acceleration of the rocket. An accelerometer doesn't even need a hole to measure the speed.

If you are only performing dual-deployment so you don't have to walk so far, then putting the hole on the exposed part of the nose cone is fine. As the rocket ascends, it loses speed, and the air pressure inside the nose cone will equalize rapidly. Then the altimeter can accurately sense the apogee point of the flight.

It is possible to put the vent hole through the shoulder of the nose cone. Obviously, that will require you to drill a hole through the air-frame tube to allow the vent to get into the nose cone. This will work fine, and allow you to get the pressure port lower than the joint where the nose meets

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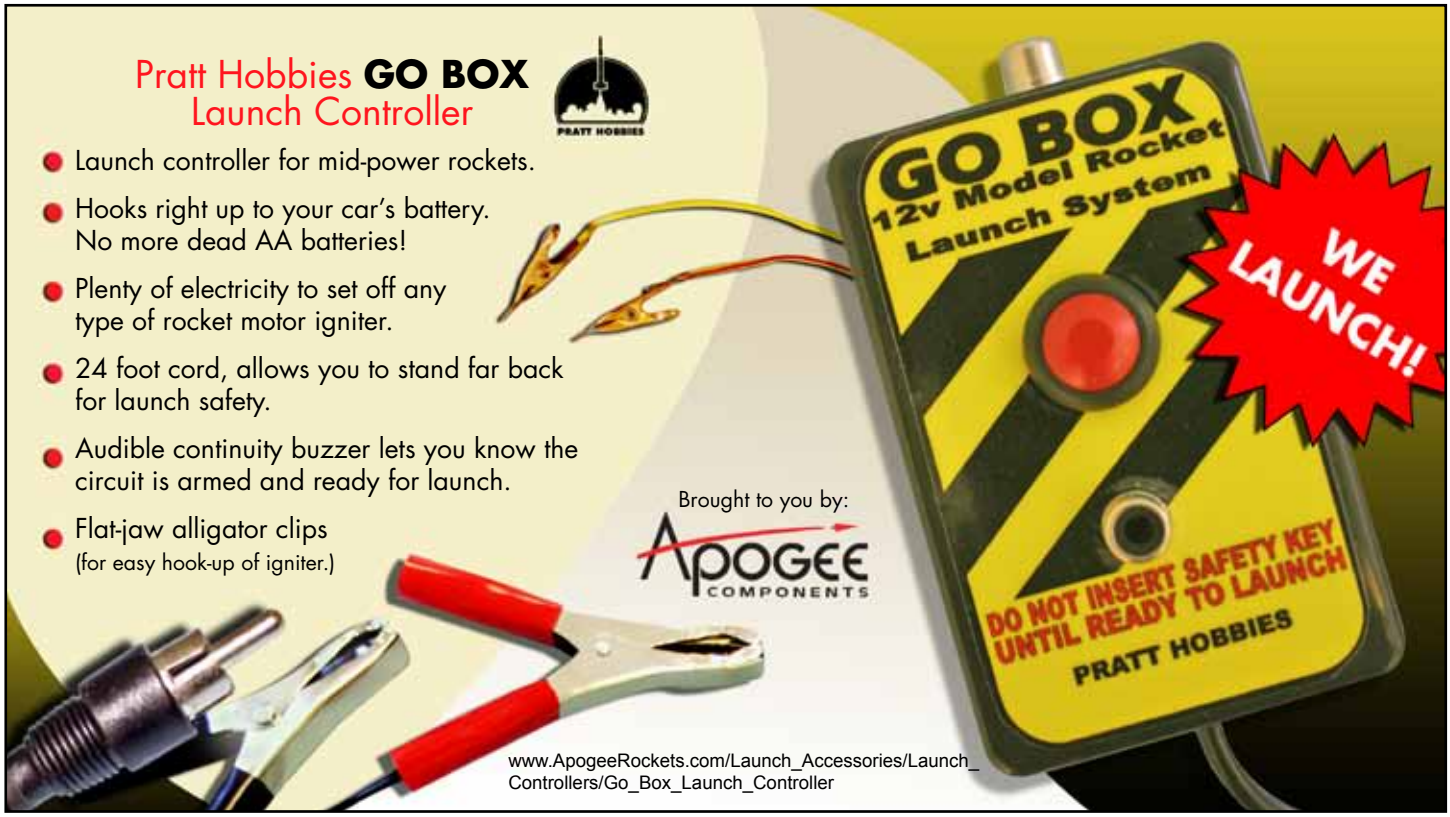

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the tube; which is good for barometric based readings for speed. But you have to use care when setting up the rocket for launch. If you accidentally twist the nose cone on the pad, you will block off the vent hole. This would be bad for the flight, as the altimeter would not get a launch detect or a good reading on atmospheric pressure on the ground.

If you put the pressure port in the shoulder, I'd recommend adding some shear pins (www.ApogeeRockets.com/Building_Supplies/Misc._Hardware/Nylon_Shear_Pins_20_pack) to hold the nose cone in the right position so it can't be accidentally twisted prior to launch.

Making It Stronger

You will find this method of installing electronics in the nose cone to be pretty strong. But if you want to make it stronger, the way you would do it is to use multiple dowels stacked in the nose cone. Figure 24 shows an end-view, looking down into the nose cone (similar to Figure 19 on page 9).

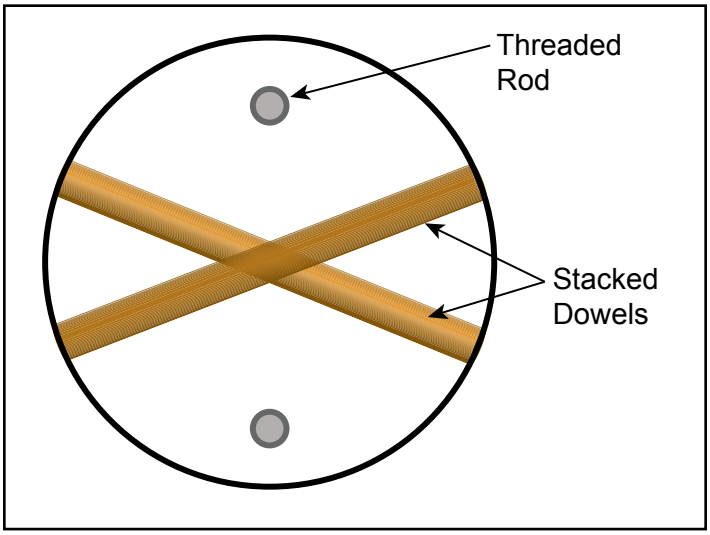

Figure 24: Multiple dowels can be stacked up in the nose cone to increase the tear-out strength.

The dowels would be arranged in a criss-cross fashion, so that it is still easy to dunk the threaded rods into the epoxy. Obviously, this will require more epoxy, but it will give greater tear-out strength for the dowels. Remember, it is not the epoxy sticking to the inside walls of the nose that provide the strength. The plastic is so slick that the epoxy doesn't really grip at all. The only thing holding the electronics in is where the wood dowels pass through the wall of the nose cone.

The worst case situation would be if the plastic nose cone swelled up like a balloon, and the dowels slipped through the holes. That isn't likely, but if it happened, the whole electronics assembly will come free of the nose. The electronics would remain attached to the rocket, but the shell of the nose would free-fall to the ground.

About The Author:

Tim Van Milligan (a.k.a. "Mr. Rocket") is a real rocket scientist who likes helping out other rocketeers. Before he started writing articles and books about rocketry, he worked on the Delta II rocket that launched satellites into orbit. He has a B.S. in Aeronautical Engineering from Embry-Riddle Aeronautical University in Daytona Beach, Florida, and has worked toward a M.S. in Space Technology from the Florida Institute of Technology in Melbourne, Florida. Currently, he is the owner of Apogee Components (http://www.ApogeeRockets.com) and the curator of the rocketry education web site: http://www.ApogeeRockets.com/education/. He is also the author of the books: *"Model Rocket Design and Construction," "69 Simple Science Fair Projects with Model Rockets: Aeronautics"* and publisher of a FREE e-zine newsletter about model rockets. You can subscribe to the e-zine at the Apogee Components web site.

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