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PEAK OF FLIGHT

NEWSLETTER

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Cover Photo: DynaStar Stonebreaker zooms skyward. Get your own at: www.ApogeeRockets.com/Rocket_Kits/Skill_Level_2_Kits/Stonebreaker_Rocket_Kit

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Retrofit an Engine Retainer Onto an Existing Rocket

By Tim Van Milligan

I had a customer ask this question recently, so I thought it would make a good article for this newsletter. Essentially, the customer had an Aerotech Arreaux rocket kit (www.apogeerockets.com/Rocket_Kits/Skill_Level_3_Kits/Arreaux), and they wanted to use longer motors in it. The Arreaux was designed around the 40-120 casing (www.apogeerockets.com/Rocket_Motors/Rouse-Tech_Casings/29mm_Casings/RMS-29_40-120), so the customer couldn't put the "H" size motors in it.

The Aerotech kits are the only large rockets that have a traditional engine hook in them. Most larger rockets require a screw-on retainer so that they can use long motors.

Our suggestion to the customer was to cut off the engine hook, and pound out (or sand away) the engine block in front of the motor tube. This would allow them to put the longer motors into the kit. But, how do you hold the motor in?

Figure 1: The plate retainer is too large to fit onto the Aerotech Arreaux rocket kit.

Our initial suggestion was to use the Mad Cow Plate Retainer (www.apogeerockets.com/Building_Supplies/Motor_Retainers_Hooks/Plate_Retainers_external_disks/Mad_Cow_Retainer_29mm). Unfortunately, as can be seen in Figure 1, the plate retainer is too wide for the Arreaux body tube. Also, the motor tube is recessed deep into the body tube of the rocket, making the installation of a traditional screw-on retainer (www.apogeerockets.com/Building_Supplies/Motor_Retainers_Hooks/Screw-On_Retainers/29mm_AeroPack_Retainer_L2) very difficult.

This is a very difficult situation. What are the options to retrofit the rocket?

The fourth type of engine retention system is what I call the Cosmodrome system. I give it that name because they are the only manufacturer that we carry that uses this type of retainer on their kits (www.apogeerockets.com/Cosmodrome_Rocketry).

Essentially, it is a threaded rod that extends aft out the rear of the rocket, past the end of the rocket motor. A simple washer and a nut is all that is needed to keep the

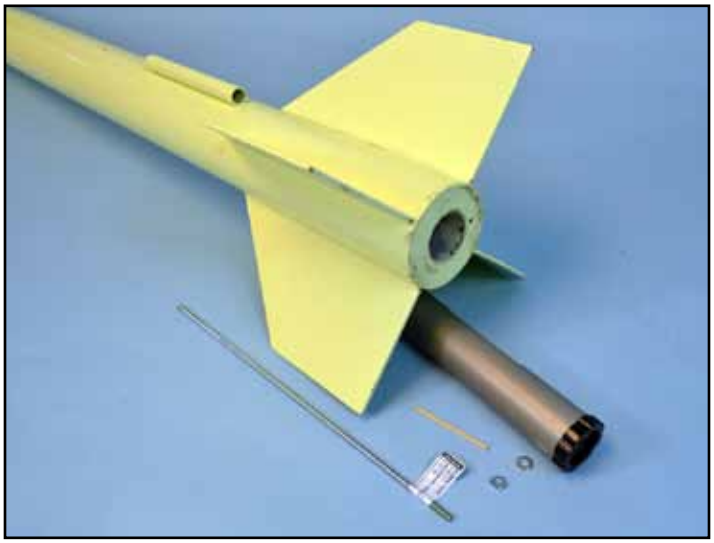

Figure 2: The parts for the retainer: all-thread rod, a nut, washer, and a spacer (made from 1/32" plywood).

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motor from sliding rearward out of the rocket.

The steps to install this in the rocket are not really that hard. But like anything in rocketry, it does require a little forethought. I'll go over the steps so that you can see what is important. Unfortunately, I didn't have an Arreaux kit I wanted to modify, so I found another rocket (shown in Figure 2) that could use a new retainer system. Even though this rocket is bigger and could use the plate retainer system, the steps to add the Cosmodrome all-thread retainer are identical.

What you'll need for this are:

1. All-thread rod. These are found at your local hardware store. A rod about a foot long will cost a few dollars. They come in different sizes, so try to pick one that seems size appropriate for your model. I choose a #10-24 size for my project.

2. Nut and washer to fit the all-thread. My local Ace Hardware allows you to buy by the piece, so I got one of each, for a total of 25 cents.

3. A spacer - I used a 1/32" thick piece of plywod. It was 3 inches long by 1/8 inch wide.

4. Epoxy - I chose the RocketPoxy (www.apogeerockets.com/Building_Supplies/Adhesives/G5000_RocketPoxy_Pint_Package). The reason is that it is thick and stays in place when you lay it down. This will come in handy when the all thread it inserted into the rocket.

The tools you'll need are:

1. Drill and drill-bit. The size of the drill bit should be bigger than the diameter of the all-thread rod, but small enough to fit the gap between the motor tube and the body tube of the rocket. For the Arreaux rocket, which has a small diameter tube, the drill bit will have to be 1/4 inch or less.

2. Hacksaw to cut the all thread to length.

3. Vise - to hold the all thread while you're cutting it.

4. Mixing cup and stir sticks to mix the epoxy in.

5. You may also need a scale to weigh out the epoxy if it is sensitive to its mix ratio.

Step 1: Drill the Hole

To me, making the hole was the hardest step, because the drill bit wanted to walk around on the aft centering ring. Place the hole so the edge is right along the outer surface of the motor tube. You don't want to damage the motor tube if you can help it. It just makes for an ugly rocket if you do.

When your done, the hole should look similar to Figure 4 on the next page.

It is not necessary at this time to smooth out the edge

Figure 3: Drill the hole just outside of the motor tube.

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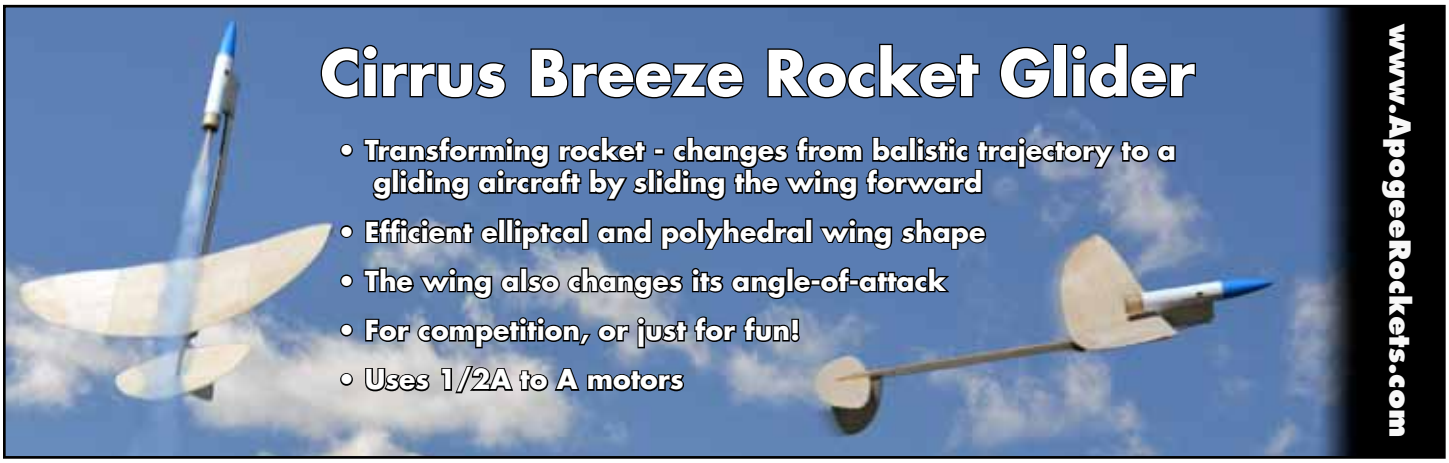

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Figure 4: Put the hole next to the motor tube.

of the hole. They can be cleaned up after the all-thread has been bonded in.

Step 2: Cut the All-Thread To Length.

Slip the all-thread rod into the hole and feel for the forward centering ring in the rocket. You only need about 4 inches of the all-thread rod inside the tube. In my rocket, the centering ring was about 8 inches deep. So I'm happy to know there is plenty of room inside the rocket for sufficient bonding of the epoxy to the tube. You'll need about 3/4 inch (19mm) of the rod to stick out of the back end of the rocket. So mark the all thread with a marker or crayon.

Figure 5: Cut the all-thread with a hacksaw.

Cut the all-thread rod with a metal-blade and hacksaw. I put it into a table vise to hold it while sawing it in two.

Step 3: Attach the Spacer to the All-Thread

The spacer is needed to get the all-thread rod off the surface of the motor tube. Usually when you put the motor in, the aft engine block diameter is slighter larger than the

Figure 6: The spacer is tacked onto the all-thread rod using thick super-glue.

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diameter of the motor tube. So if the all-thread simply lays along the tube, you wouldn't get the motor fully inserted into the rocket.

What you need is a thin spacer to raise the all-thread off the tube just a little bit. It doesn't take much, just 1/32nd of an inch (0.9mm). I used a piece of thin plywood as a spacer. This can be tacked to the all-thread using thick CyA adhesive (superglue). See Figure 5.

This end of the all-thread rod is going to be covered in epoxy, so you don't have to use a lot of CyA. Just a little bit to get it to stick.

Before you put epoxy on it, double check to make sure your spacer is thick enough to allow the thread to clear the engine block on the back end of the rocket motor (see Figure 7).

Be careful not to tip the rocket downward, or the all-thread will slide inside the rocket. Trust me, it is a chore to get it out when it does slide in. I wish I had a skinny magnet.

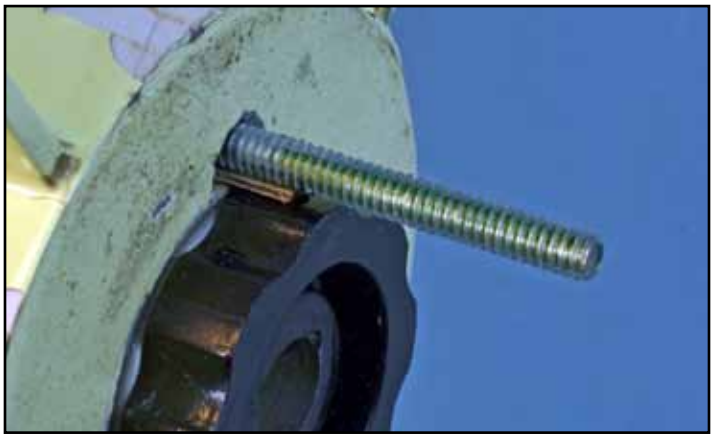

Figure 7: Test fit the all-thread rod in the hole. Make sure that the threads clear the engine block built into the rocket motor casing.

Figure 8: The RocketPoxy prior to mixing.

Step 4: Mix up the Epoxy

As mentioned before, I recommend the RocketPoxy from Glenmarc for this application. It is thick like peanut butter, so it stays in place when you put it on the parts. But it has just enough flow that it will make a good bond to the tube. You won't need much, I mixed up a batch of 12 grams total, and that was too much.

After mixing the epoxy really well, I put in a couple of drops of the black pigment. I added it and mixed it again. The advantage of this is that when you get a uniform color, you know the epoxy is mixed thoroughly.

Step 5: Coat Epoxy Onto The Assembly

Now you want to put a thick coat of epoxy over the spacer and the all-thread rod. Leave the bare threaded end uncoated (see Figure 9).

Now insert this into the hole in the bulkhead, so only the bare thread is exposed.

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Figure 9: Coat the spacer-end of the all-thread with a thick layer of epoxy.

As you put it in, some epoxy might ooze out. Have plenty of paper towels handy to wipe this up. It is easier to clean this up now than to wait until it is hard.

Now orient the rocket so that the all-thread rod is at the 12-o'clock position with the rocket laying horizontally. You may have to hang the rocket over the edge of the table so fins don't interfere. You want gravity to do its work and pull the epoxy toward the tube.

This is the hard part -- wait for the epoxy to cure before you touch the all-thread rod. If you're like me, you'll be tempted to tug on the rod to see how strong it is. But wait until the epoxy has fully cured to do this. Use the excess epoxy in the mixing cup as a gauge of how hard it is.

When the epoxy is hard, you can now put a rocket motor in, and put on the washer and the nut on the all-thread. The washer will catch the edge of the motor, and prevent it from sliding out.

This is a nice retro-fit if you need a motor retainer for a rocket that is already constructed. If you make any modifications, please let us know what they are, so we can share them with other readers of this newsletter.

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.

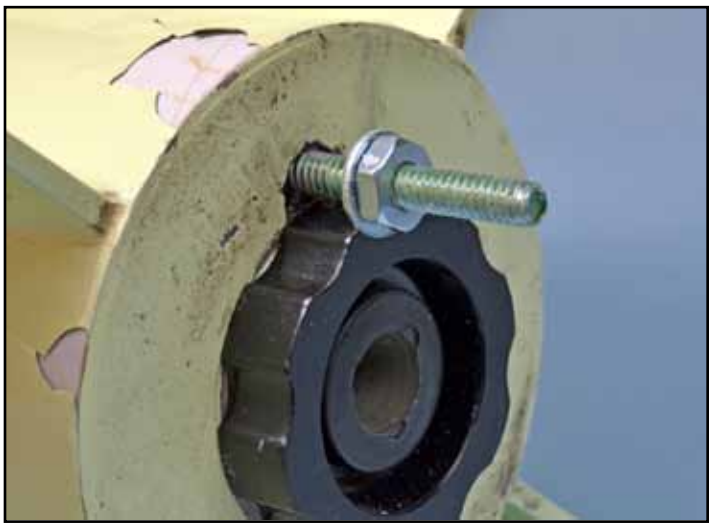

Figure 10: The finished retainer holds secure.

Minimum Diameter Through-The-Wall Fins?

By Tim Van Milligan

Can you use through-the-wall fins on minimum diameter rockets?

The advantage of through-the-wall fins is that they are harder to knock off the rocket during a hard touchdown. I found that even on minimum diameter rockets, where the engine fits snugly into the tube, it is worth the effort to use through-the-wall fins. They are much stronger than surface mount fins.

The one issue you might have is that the tab on the root edge of the fin is too deep, and interferes with the motor. The solution is to sand down the tabs from the inside using a dowel with sandpaper glued onto it (Figure 2). But wait until the glue on the outside of the rocket is fully dried, so you don't knock them off during the sanding process.

You can find video instructions on cutting slots at: www.ApogeeRockets.com/Advanced_Construction_videos/Rocketry_Video_3. One other tip that I have is to cut the tabs a little bit shorter (length-wise along the root edge) than is shown in Figure 1. The reason is so you have more gluing surface of the fin onto the outside edge of the tube. The other thing is to use some extra heavy-duty fin fillets, and make sure the gaps along the tabs are fully filled.

It doesn't take long, and is definitely worth the effort.

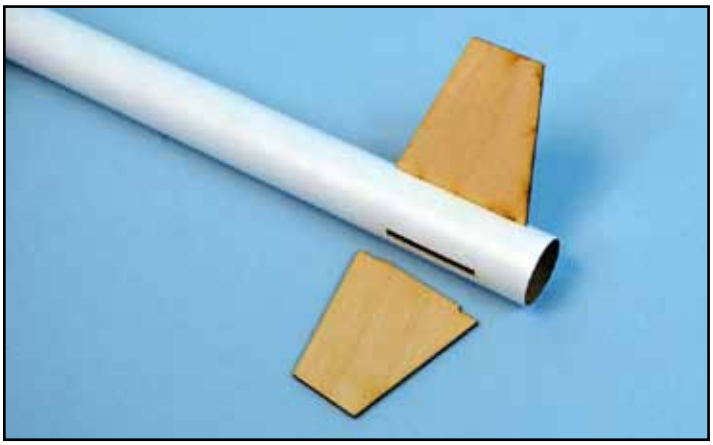

Figure 1: Make the tabs a little too deep, so that it is easy to get them into the slots of the tube.

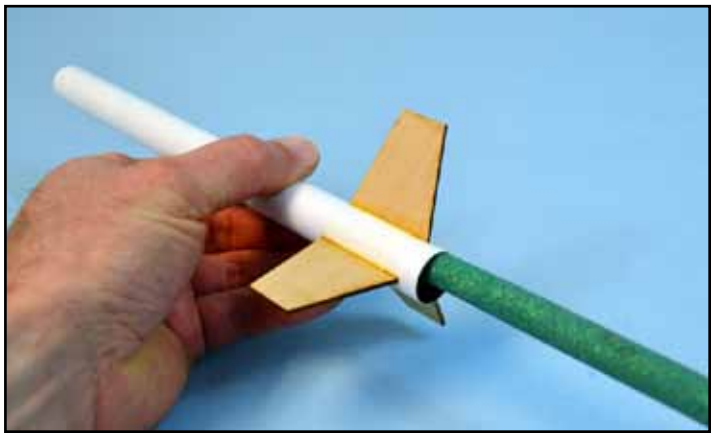

Figure 2: After the glue has dried, sand down the tabs from the inside of the tube using a dowel wrapped with sandpaper.

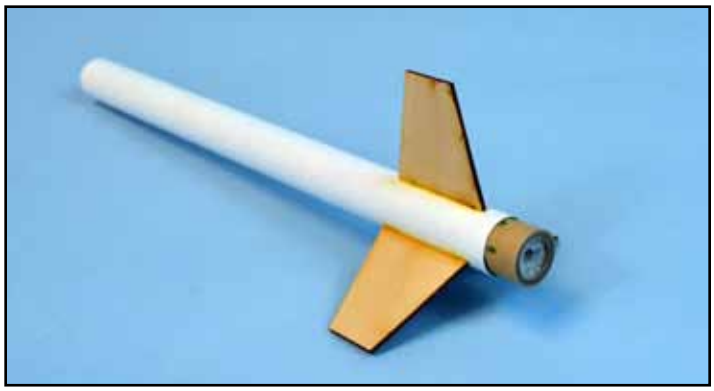

Figure 3: The finished minimum-diameter rocket with a motor installed.

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If you're not getting enough sales, let's talk.

Make Your Own Engine Hooks

By Alessio Zlatich

Living in Italy, where the hobby of model rocketry isn't very diffused, I had (and have) to improvise some piece for launching my models because there's only one shop in all the country.

One of the most important piece of a model rocket is the motor hook that, if it is almost taken for granted when you buy a kit, it becomes complicated to build and especially do not make it look sloppy.

One day walking in town I saw a long, narrow strip of metal dropped on the ground. Intrigued I picked it up and I thought immediately that, properly folded, would be a great replacement for the motor retainer. I still had to figure out from where it came from. After asking a bit around I managed to understand that the metal strip came from a wiper blade; I immediately thought: "Great! An easy and free method for having a motor retainer!".

For making the motor retainer I simply take the metal strip and bend it with bare hands and a pair of pliers, using an old motor as a measure, then I cut it with the nippers. After the cut I round the sharp edge with a file and the piece is ready. As you can see from the photos it looks very similar to the motor retainer from an ordinary kit and has a weight of 1.55 grams (0.05 ounces). I hope that this little tip could help you in the future, I wish you all good launches.

Figure 1: The metal strip from the wiper blade and the tools used to make the motor retainer.

Figure 2: The finished motor retainer.

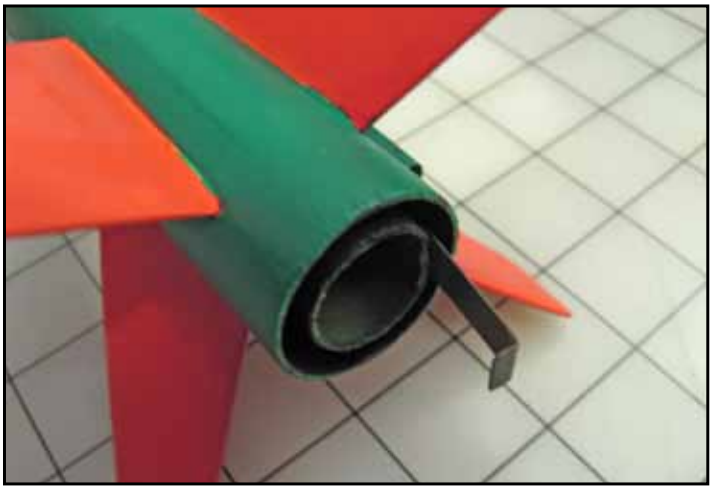

Figure 3: An old motor retainer made some years ago. Note that the edge, despite having been filed, may still cut because it is sharp.