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Build A Clipless 13mm-to-18mm Motor Mount Adapter

By James Jason Wentworth

Editor's Note: I modified James' design to simplify it, and to use standard parts that you may have in your supply box (if you don't have the parts, you can easily get them from Apogee Components web store at: http://www.apogeerockets.com/building_supplies.asp). Because of the modification of the design, I also changed the text to match. My apologies go out to James for messing with the great article that he originally submitted. -- Tim Van Milligan.

Photo 1: A motor adapter (middle) allows you to use a smaller diameter engine (bottom) in a rocket that was made to use a large diameter engine (top).

Rocketry During a Recession?

In our current economic times, many of us model rocketeers are thinking about how we can continue to enjoy our hobby within smaller household budgets. The organizations that use model rocketry as an educational tool (schools, scouting groups, summer camps, etc.), the model rocket manufacturers, and the vendors who sell their products are no doubt thinking along similar lines.

Despite the current financial challenges that all of these groups face, no one need fear for the future of the hobby as a whole. The 1930s were the years of the Great Depression, yet during those same years hobbies such as model aviation and radio building (the construction of crystal radio sets and even tube radio sets) thrived. Why? Because they were inexpensive and skill-building educational activities (which often involved parents) that kept children happy, occupied, and out of trouble.

More recently, I saw first-hand the economic resilience of hobby activities during a recession. From 1989 to 1993, I worked at the Miami Space Transit Planetarium. (My old boss, Jack F. Horkheimer of "Star Hustler" fame on public television, is the Executive Director of the planetarium.) During the economic recession of the early 1990s, the number of visitors who came and paid to see our planetarium shows hardly changed at all! Why? Because we provided inexpensive and educational entertainment for parents as well as for their children.

Also, many adults brought their children to the planetarium because they had visited it when they were children, and they wanted to share the experience with their children. Model rocketry is in the same position as the planetarium. It makes a visceral connection with adults who built and flew model rockets when they were children, and now they want to share that part of their childhood with their own children. In this way, model rocket manufacturers and hobby shops can create and nurture a multi-generational customer base just as the planetarium has.

Smaller Can Mean Less Money

One way to enjoy model rocketry on a reduced budget is to adapt models to fly on lower-cost motors. Many of the lighter single-stage rockets will give impressive, crowd-pleasing flights even on the low-impulse and inexpensive "1/2A" and "A" 18 mm motors, and they will perform equally well using the even lower-cost 13 mm mini motors. An easy-to-make and easy-to-use 13 mm motor adapter mount would be helpful to organizations that incorporate model rocketry into their activities as well as to individual model rocketeers.

In the past, I've used an old spent "regular-size" casing as the basis for 13mm motor adapters. You probably know that a 13mm motor will fit snugly inside an old engine tube, right? But because these old motor casings are thick

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walled, they are awfully heavy. They are also filled with burnt gunk and a hard ceramic nozzle that can be hard to remove. Finally, the 13mm motor has to be friction-fitted into the casing, and that is probably the least reliable method of securing a motor into a model. The advantage is that a spent motor casing is very simple - there is only one piece in the adapter. And you can say you're recycling!

But since we want to get the most performance out of our rocket using the smaller mini-sized motors, it is highly desirable to reduce the weight as much as possible. That is the purpose of this article, to show you how to make a lightweight adapter that is easy to build.

The key feature of this adapter is that it doesn't use a metal engine hook to restrain the small engine. Hence the name: "clipless." However, it is designed to be used in rockets that do have a metal engine hook, like shown in Photo 1.

Adapter Construction Steps

A simple and lightweight 13 mm tube is the key component for this adapter. The other parts you'll need are a 13mm engine block, a tube coupler for a 13mm tube and three centering rings that will center the 13mm tube inside an 18mm tube. Here is the complete parts list:

Clipless Adapter Parts list

1 - AT13/18 cut to 2.75 inches long (Apogee P/N 10063)
1 - CR10-13 (Apogee P/N 13021)
3 - CR13-18 (Apogee P/N 13028)
1 - Airframe coupler 13mm (Apogee P/N 13014)

Step 1: Mark the length of the tube coupler.

Normally, I'd give you the correct length of coupler to cut off. But you may want to modify your adapter slightly, and then the coupler length will change.

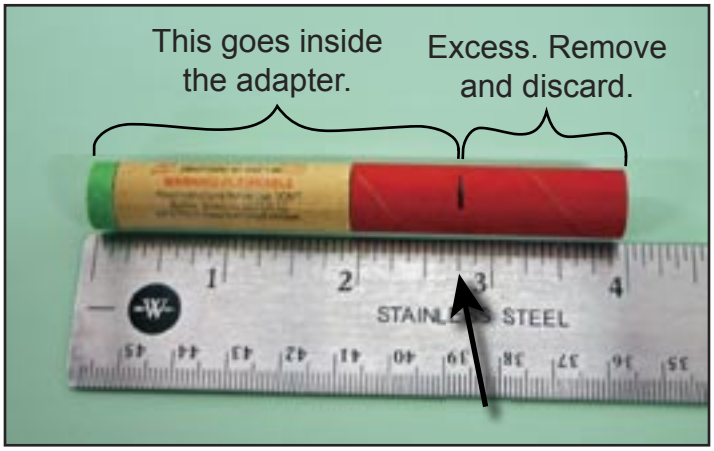

Photo 2: Mark the tube coupler so that the combined length of the engine block, rocket engine and coupler is 2-3/4 inches long.

As shown in Photo 2, line up the engine block, a 13mm diameter rocket motor, and the tube coupler. Lay a ruler next to the line-up, and mark the coupler at the 2-3/4 inches location.

Here is the modification you might consider if you make more than one of these. The engine block will be at the rear of the adapter, right next to the nozzle of the rocket motor. This will recess the nozzle into the assembly slightly, which is OK. But the drawback is that it will be harder for you to insert the igniter and the igniter plug when you are ready to launch. Ideally, you want the engine block to be wafer-thin so that the nozzle is not so deep in the adapter. You might consider sanding down the engine block to make it even shorter. But doing this will change the location of the line on

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the tube coupler. That is why I didn't give you a location for the line, since it might change in your particular design.

Step 2: Cut the tube coupler to length and discard the excess.

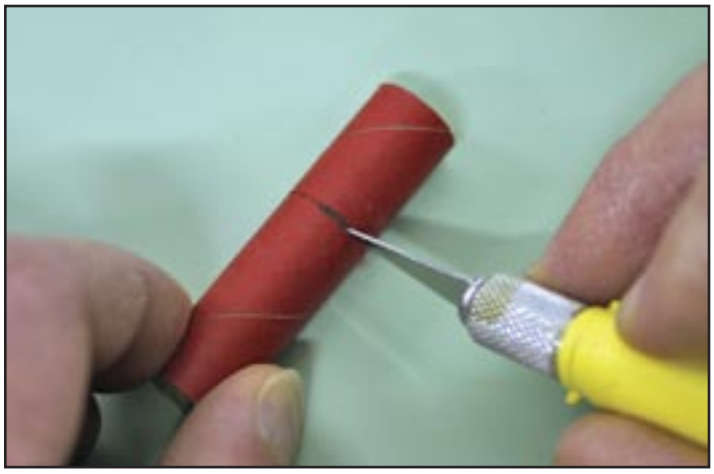

Photo 3: Cut the tube coupler to length and discard the excess portion.

As shown in Photo 3, cut the tube coupler to length. It isn't critical that the edge be perfectly square. But you can clean up the cut end with sandpaper if you want to make it look super pretty.

Step 3: Cut the 13mm diameter body tube in half.

Photo 4: Cut the 2-3/4 inch long body tube in half.

The 13mm diameter tube started out being 2-3/4 inches long, and now you'll cut it in half so you have two equal lengths. It isn't necessary that they be identical in length, so you can eyeball the measurement before you make the cut. But try to have a straight cut, so that the edges will line up if you butt the two pieces together.

Step 4: Glue two of the centering rings to one of the 13mm tubes.

All the cutting is now done, and it is time to start gluing things together. Start by taking one of the 13mm tubes, and glue two centerings on the outside. The first one is glued so that the edge is flush with the end of the 13mm tube. This will be the rear end (nozzle end) of the engine mount adapter.

The second cenetring ring is glued approximately 3/4 inch from the rear end, as shown in Photo 5.

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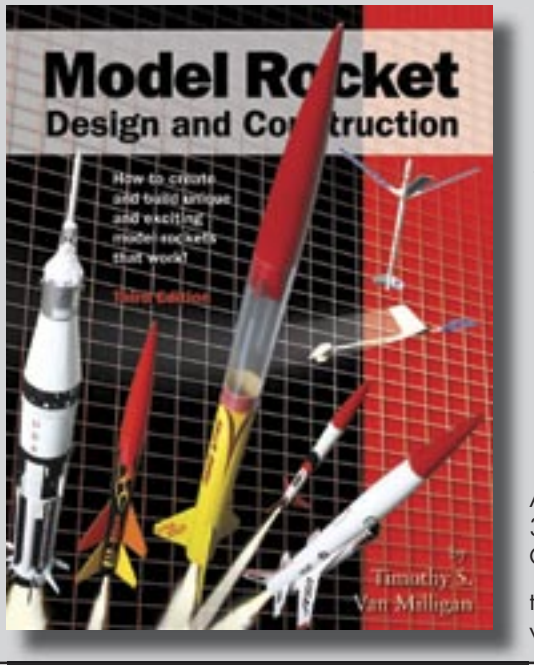

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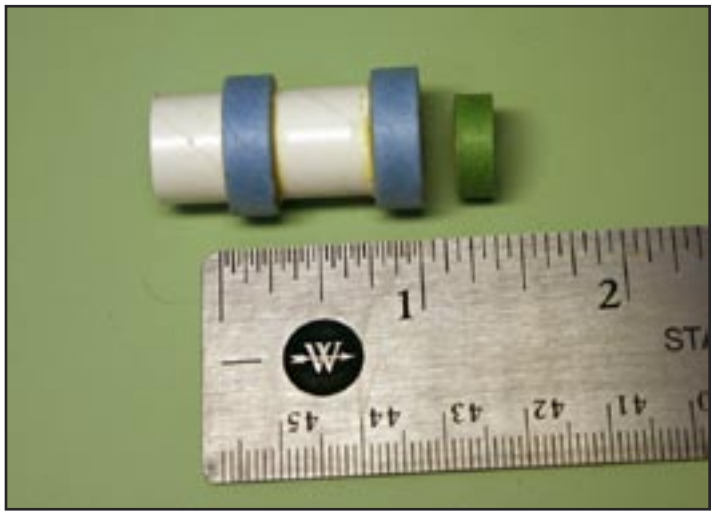

Photo 5: Glue two of the centering rings to one piece of the 13mm diameter tube.

After those rings are glued into place, you can glue the engine block into the 13mm tube. It should be positioned so it is flush with the end of the tube as shown in Photo 6. If any glue oozes into the tube, make sure to wipe it off, as this will prevent full insertion of the rocket motor.

Step 4: Glue the tube coupler into the forward end of the adapter.

Photo 6: Glue two of the centering rings to one piece of the 13mm diameter tube.

Inspect the tube coupler that you cut earlier. Ideally, you want to put the cut end (which might be irregular) toward the foward end of the adapter.

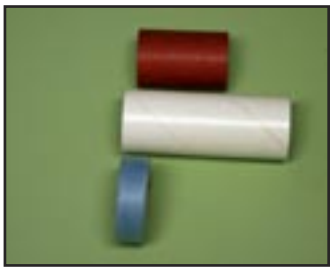

Photo 7: The ends of the three parts are aligned flush.

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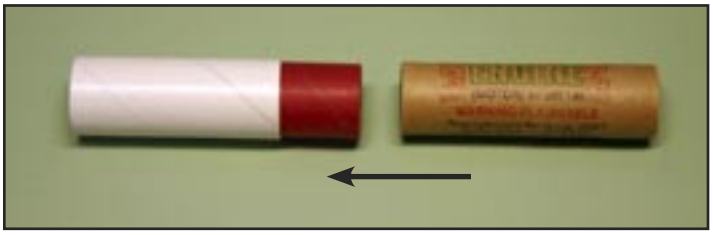

Photo 8: Use a rocket motor casing to push the tube coupler all the way into the 13mm tube.

The same goes for the cut end of the remaining piece of 13mm tube. What we want is for the two most jagged ends to go together.

Now glue the tube coupler into the 13mm tube using wood glue. Use an old engine casing to push it all the way in until it is fully inserted and the two jagged ends are aligned flush. Wipe off any excess glue that oozes into the tube. The tube must be must be completely free of glue, or you won't be able to insert the motor for flight.

Step 5: Glue the last centering ring on the tube.

The last centering ring in now glued onto the forward end of the 13mm tube as shown in Photo 9. This is the end

Photo 9: The last centering ring (left side) is glued so that it is flush with the forward end of the tube.

where the inside tube coupler is also flush with the end of the tube. After the glue has dried, your new motor adapter is finished.

How to use the motor adapter

The 13 mm motor is loaded, nozzle end-first, into the rear portion of the assembly and is pushed backwards until it butts against the rear thrust ring.

The forward end of the motor will stick out of the tube, and acts as a tube coupler joining the two sections together. That real tube coupler that you glued in during Step 4 actually acts as a forward engine block. Bet you didn't see that coming... If you want to shave additional weight off the

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Photo 10: A piece of tape over the joint line holds the ends together.

assembly, you can actually replace the tube coupler with an engine block.

Once the assembly is put together, you can put a piece of tape over the joint line to keep it connected. The reason we didn't put the middle centering ring all the way to the front of the tube is so that we could tape the parts together as you are doing now.

The tape is actually non-structural, which means it is not needed for the device to work. But it makes handling it easier while you are inserting the adapter into the rocket. And it really helps a lot when you are removing the adapter after the flight is over. Otherwise, the forward section will remain inside the rocket as you pull the back end out.

Inserting the adapter into the rocket is the last step. The front two rings go inside the engine mount tube of the rocket. That middle centering ring is critical to the alignment of the assembly in the rocket. It must be inside the tube. If

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Photo 11: The completed motor adapter inserted into the rocket and held in place by the metal engine hook.

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your particular rocket has the engine hook that really sticks out the back of the rocket by more than 3/4 inches, then you may need to make another adapter specifically for that rocket. Personally, when I make my rockets, I like the engine to stick out the back of the tube by 1/2 inch. Interesting tidbit: this is the reason that RockSim uses a default of 1/2 inch for the engine overhang.

Not every rocket that is capable of holding an 18mm motor would be a candidate for the mini-engines and this adapter. In general, you should use it in lightweight rockets that have a small diameter. By small diameter, my instinct tells me up to a 24mm diameter tube size (BT-50).

If you are looking at pre-made kits, I'd say that any rocket kit that recommends the Estes A8-3 or the Quest A6-4 might also be able to use the adapter and the A10-3T and maybe the A3-4T motor.

To be really confident, you should run some preliminary launch simulations using the RockSim software (www.ApogeeRockets.com/rocksim.asp).

The actual process of selecting a motor is described in full in Apogee Technical Publication #28. I typically charge for this report, but I want you to learn the step-by-step process so I'm going to give it to you free of charge (just remember Apogee Components and this gift when it comes time for you to buy rocket supplies). You can download this awesome report right now at: www.ApogeeRockets.com/education/downloads/Tech_Publication_28.pdf

About The Authors:

James Jason Wentworth is a rocket modeler living in Alaska. You may recognize the name, as he is the former proprietor of Nova Rocketry.

The construction portion of this article was written by Tim Van Milligan, 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. In the late 1980's, he worked on the Delta II rocket that launched satellites into orbit. 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 or by sending an e-mail to: ezine@apogeerockets.com with "SUBSCRIBE" as the subject line of the message.