

# PEAK OF FLIGHT

## NEWSLETTER

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# PEAK OF FLIGHT

## Removable / Replaceable Fin Can System

By Samer Najia

I read Tim's article in Newsletter 439 on rear ejection systems for model rockets with great interest a few weeks ago. I've always been interested in a removable/replaceable fin-can system that I could swap in and out of my rockets so that I can have different engine configurations and payloads. A rear ejection system seemed to be an excuse to try out a few ideas along those lines and still get a way to separate the body of the rocket from the 'business' end.

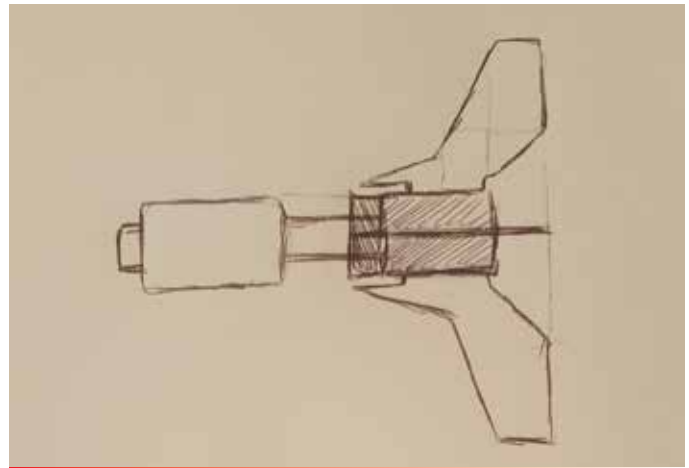
As the design evolved, I realized that I could build a rocket that isn't just able to swap out the rear fin group and engine mount, but that I could get it to fly as a rear-ejecting system as well as a traditional 'nosecone popper' rocket.

Granted this isn't an end-all solution to anything, nor does it work for scale models, but if I wanted to outfit a rocket fleet with varying missions and can have interchangeable power and payload packages, I could do a lot of experimentation with a specific 'platform' as opposed to one rocket. For example, I could have a body tube with sections that I could add (which could be secured together using couplers with built in screw mounts) and a snap-mount to attach the fin can to the tube. This means the same rocket can have different fin and engine combinations, could be made longer or shorter, and be assembled in the field out of each combination of parts at any time. Tube sections could contain different types of payloads because they would not be impacted by having to be hollow for ejection gases to flow through them. So let's look at each segment of this concept and see what we come up with:

### **Fin Capsule:**

I started out with a sketch for a fin-capsule. I wanted the capsule to be able to slide in and out of its host body tube easily. I reasoned that it

had to be fabricated primarily out of couplers and a 'stuffer' tube so that ejection gases do not damage the parachute that I planned to have wrapped around the capsule's middle. Here's my initial sketch:



**Figure 1: Fin-capsule sketch.**

I chose to use BT-80 tube couplers for this just because I had a few in my parts box. If you choose to experiment, feel free to use whatever works for you. My stuffer tube is a BT60 tube left over from another build. The shaded coupler has a pair of centering rings holding the stuffer tube, and the stuffer tube itself has the engine mount in it. I have a single 29mm engine mount in there that allows me to use larger motors. In the end, I did not use a second coupler like I have in the depiction and just had a centering ring for the top of the stuffer tube. Ejection gases get funneled up to the stuffer tube to eject the capsule. The fin capsule itself is pushing against the fin slots in the BT80 tube it is mounted in – the whole lower body tube acts in place of the thrust ring. Just in case, the centering ring at the top of the stuffer tube also pushes against the coupler joining the 2 BT80 slotted body tubes comprising the rocket body. There is enough friction to hold the fin capsule in place on the launch pad:

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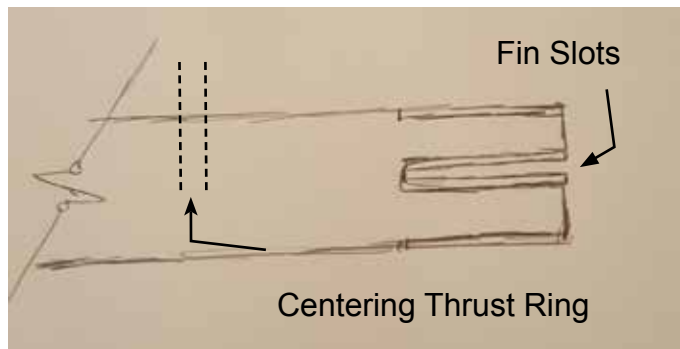
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## Removable / Replaceable Fin Can System

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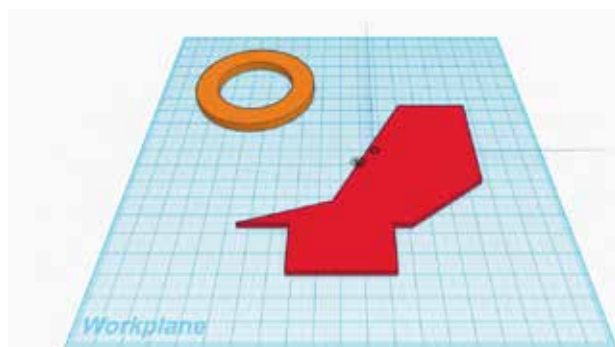
**Figure 2: Body sketch with fin slots**

### **Thruster Body Tube:**

This is the lowest part of the rocket. The fin capsule slides into the thruster body tube with the fins fitting into precut slots in the tube. I typically like to 3D print my fins for larger rockets and I keep them to 1/8" (3mm) thick so I know I can cut 3mm slots into my BT-80 section. Even though I had planned for a thrust ring originally, in the end it was not necessary. Instead, the slots themselves do the same job and the centering ring on the top of the stuffer tube pushes against the coupler holding the Thruster Body Tube and the top body tube. My shock cord goes into a bulkhead glued in the top body tube. If I wanted to add more body sections, I could add them to the top of this upper body tube because adding the nose cone is as simple as gluing or screwing it into the top body tube.

### **Design Work:**

I started putting together a fin design. Because I didn't have a suitable centering ring to put a BT-60 inside a BT-80, I fired up TinkerCAD and put together a preliminary design based on my sketches. You don't have to do this. You can cut your fins out of plywood and buy centering rings (or fabricate your own if you wish). My design puts the fins as through-the-tube, first through the coupler and then glued to the stuffer tube. I could extend the fin's mounting tabs to the engine mount, but because I wanted to be able to potentially swap out even the engine mount, I am letting the fin only go through the coupler and stop at the stuffer tube.



**Figure 3: Preliminary CAD designs based on sketches**

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### Construction:

I printed and started test fitting parts. The fin came out great and the thrust rings are perfect and exactly mirror the outer diameter of the coupler.



Figure 4: 3D Test Prints

Here is the finished module (minus the fins), ready to test fit inside a BT-80 tube. In the end, I did not need the white coupler assembly, since it just added weight and I could do with just a smaller stuffer tube. I needed 3 fins for the pre-slotted BT-80 tubes. I slid the assembly into a BT-80 tube and found the fit pretty solid.

I had to lightly sand the red coupler to make the fit a little looser. The slotted BT-80 gave me fin positions already in place. I transferred the slot locations onto the red coupler so that I can mount the fins straight and true. On the BT80 tube, you simply extend the slots to allow the entire assembly to slide backward during ejection. Here is what the bottom section of BT80 tube looks like with the fin capsule partially inserted in it:



Figure 5: Fin capsule partially inserted

And there are the 2 components separated:



Figure 6: Body tube and fin capsule side by side

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Here is a closer look at the fin capsule. Look at the small gap between the fin's top and the red coupler surface. You don't really need that, but this way, the gap allows me to slot the fin cleanly against the tab in the fin rather than the fin itself. In this image, I have installed the engine mount.



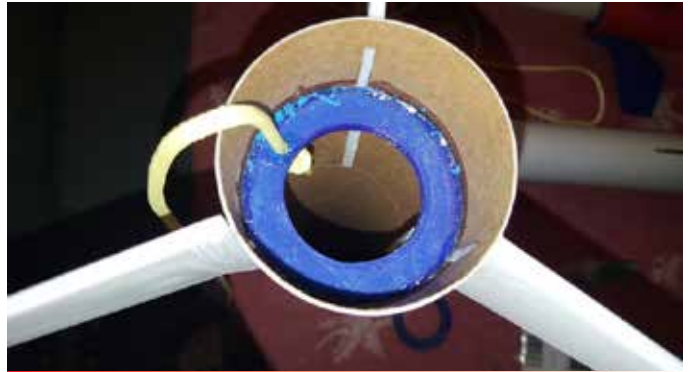
**Figure 7: Notice the gap from the fin to the tube**

Here is the upper BT80 tube. I installed another set of fins and secured them with epoxy. Because there is no engine mount here, I mounted another bulkhead that holds the fins in place and allows me to have an anchor point for the shock cord.



**Figure 8: Upper tube**

I drilled a small hole and pushed in my BFSC (Big Fat Shock Cord) and put in a knot to hold in place. Some glue makes sure it's not going anywhere.



**Figure 9: Drilled a hole into the centering ring.**

Make sure the shock cord is long enough to go through the lower body tube and have some more slack beyond that. I next mounted my coupler so that I can complete the main rocket's body. Here are 2 pictures, first with a coupler to join the 2 BT80s and then the completed main rocket body:



**Figure 10: Coupler to join the the two body tubes**



**Figure 11: Both tubes attached**

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Now from there, I drilled a hole in the bulkhead at the top of my fin capsule:



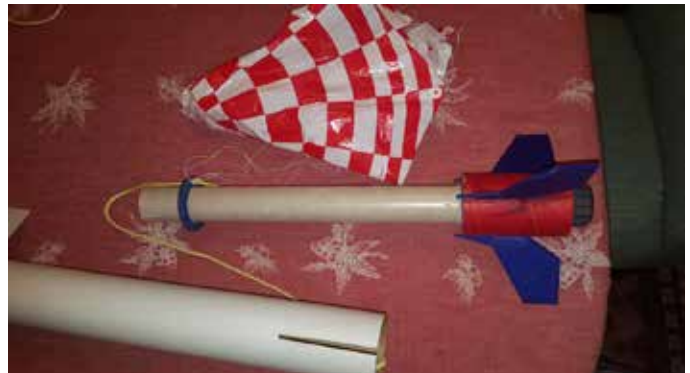
**Figure 12: Drilled a hole in the bulkhead**

And then mounted the other end of the shock cord to it:



**Figure 13: Attaching the shock cord to both pieces**

I had a spare 26" parachute so I went ahead and mounted that to the end of the shock cord on the fin capsule side:



**Figure 14: Attaching the parachute**

I wrapped the shock cord around the top of the stuffer tube and the parachute around the stuffer tube between the blue upper bulkhead and the red coupler. The parachute would never see any ejection gases this way – no wadding needed! Here is the rocket fully assembled:



**Figure 15: Fully assembled**

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My nose cone can now be secured with screws if I want a payload bay, or the nose cone can just be glued in place. In either case, the ejection gases will come up against the nose cone but exit out once the fin capsule gets ejected.

While this rocket has not flown, I am confident it will succeed. The ejection charge should force the fin can out without any issue. I plan to launch June 10th, when I finally get to my field now that the weather has finally gotten warmer.

### Additional Features:

One of things I can do is drill 2 or 3 holes through lower BT80 tube and into the fin capsule. Then, a set of plastic rivets can hold it in place and you can have the rocket eject the traditional way. You just have to remember to undo the knot at the top of the fin capsule and pass the shock cord (and parachute) back up to the nose cone. Now, your rocket can fly in either mode, and you still can have all the (lower) fin styles you want and any of a variety of engine mounts. Your imagination (and CG and CP) is the limit.

Just one thing: this rocket is heavier than most, so you will need bigger engines and maybe some nose weight to keep your CP and CG where they need to be.

### Concluding Thoughts:

I have intentionally left some of this to the imagination. As you have surmised, I can make

as many of these as I want and use and re-use the same rocket body. I can have fin cans with any of a variety and number of fins to suit my purposes. For balance, I can add different nose cones and nose weights. Even if I did not want to go with rear ejection, it's not hard to create replaceable fin cans. Just make sure you have a suitable thrust ring or some other way for the fin can to push against. I hope this article inspires you to try interesting approaches with your builds. help form a more symmetrical canopy.

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