Development of the Fly-Away Rail Guides

NARAM-52 R&D Project
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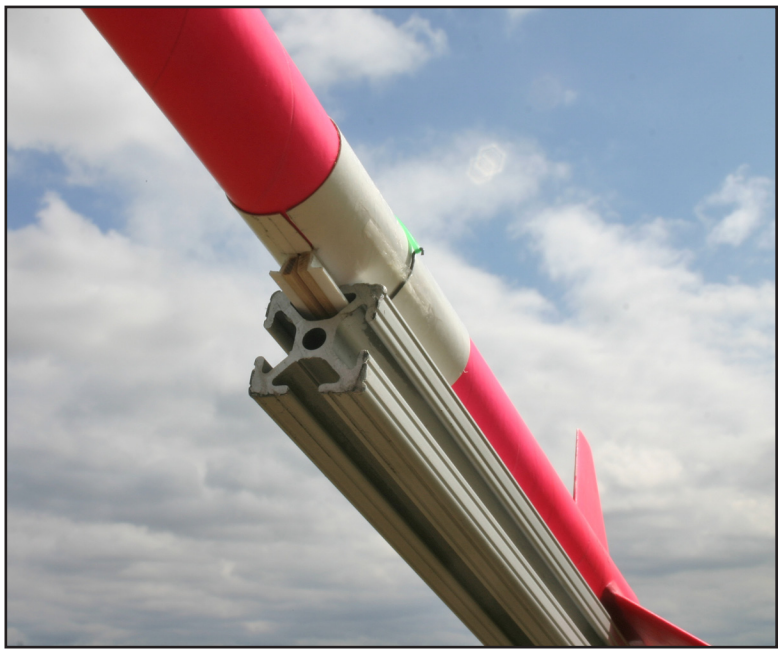
Summary



Fly-away rail guide holds a rocket for launch

The Fly-Away Rail Guides is a new device for launching rockets off a high-power rail launcher. While this report centered on competition model rockets, the device can be used on nearly any size of rocket.

The device consists of two cradles that wrap around the rocket that have tabs (called "runners") on that engage a standard high power launch rail. These runners are designed so that they slide freely up and down the launch rail, and are used to guide the rocket at lift-off. The cradles are held tight to the rocket body by a single small rubber band on the opposite side of the rocket (away from the launch rail). As long as the device/rocket is on the launch rail, it is held securely.

When the rocket leaves the launch rail, the rubber band prys open the two cradle parts. In effect, they pop off the rocket at the instant it leaves the long launch rail. They can then be retrieved and be used again on other rockets of similar configuration.

Advantages:

1. A huge reduction in the drag. Without the launch lug (or rail buttons), the rocket flies higher and straighter.
2. Allow long and delicate models, like super-rocs to be launched more safely because the entire length of the rocket can be supported.
3. The rocket leaves the pad at a higher "free flight" velocity, which is advantageous because it leads to straighter flights.
4. A reduction in the amount of ground support equipment for a modeler.
5. Cheap (less than $1), they will also save money for the modeler compared to purchasing a launch tower.

The main disadvantage of the Fly-Away Rail Guides is that they have to be custom-made at this time because there is no manufacturer that is producing them for commonly available tube sizes.

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Objective of the Work

The primary objective of this project was to develop a new way of safely launching extremely long super-roc style rockets such as shown in Photo 1 (these rockets can be in the range of 4 meters long). What came about as a result of this project was a way to support the rocket during launch nearly any type of sport model without using launch lugs or a launch tower.

Photo 1: A full-length F-Engine Super-Roc is 4 meters long and difficult to launch.

Background of the Problem

In September, 2009, I got a call from Mike Konshak, the launch director of the NARAM-52. Mike wanted to get my suggestions and any tips he could garner about the F-engine Super-Roc Altitude event.

In this event, the long rockets (up to 400 cm long) often resemble wet spaghetti noodles. They are non-rigid because they are so long and slender. Launching them is the hardest part of the event, because they are much longer than a traditional 3, 4, or even 6 foot long launch rod. A large percentage of the rocket will stick past the end of the rod and is unsupported should any wind come along. Again, because the rocket is somewhat bendable, the nose of the rocket can be pointed in one direction, and the fins in another. When launched, these models often do a loop and then kink and crash into the ground (for reasons they do this, see the article *"Why do Tall and Skinny Rockets Go Unstable?"* in Apogee Components' Peak of Flight Newsletter 239 which can be downloaded at www.ApogeeRockets.com/education/downloads/newsletter239.pdf). Some rockets don't even make it off the ground, as the thin-walled paper tube can easily kink when hit by a strong wind gust.

My initial thoughts on the problem led me to several possible solutions:

1. A longer launch rod. Unfortunately, a long rod (more than 6 feet long) is going to have the same problems as the long rocket. It is like long noodle that will tend to bend in the wind.

2. A thinker diameter launch rod to solve the noodle problem of the rod itself. A thicker rod will be stiffer, and therefore you can make it long enough for these super-roc type models. But the disadvantage is the launch lug hanging off the side of the model. Do you really want the extra drag? After all, the object of the contest is to fly as high as possible. I didn't think competitors would go for this solution

3. A long tower launcher. This would actually work! And this is what the hard-core competitors will take out to the range with them. The other advantage is that it eliminates the need for a drag producing launch lug on the side. Therefore the rocket is going to go higher in the air. Here in Colorado, I know that Mike Konshak did build an 8-foot long launch tower. But the expense was considerable, and since it is so large, he can only transport it back and forth to the launch range in the bed of a pick-up truck.

4. A tube launcher (see Photo 2). In this concept, you have a long tube and put the rocket inside it. Essentially, it is a type of launch tower. The tube would support the rocket and prevent the wind from trying to bend it. I've seen Norman Pfund, a member of our local club here in Colorado Springs, use this type of launcher on high-power rockets. It does work. But I've never seen anyone use it for long rockets like these super-roc competition models. The reason is that I think that this type of launcher would have the same type of problems as a tower launcher; namely, transporting it to the launch range.

However, it may be possible to build the tube in sections that can be assembled on the launch range. That would make it easier to transport, but there is still the expense of building it.

5. A rail launcher. First of all, they are long enough, and they are stiff enough to for super-roc type rockets. The other advantage is that usually the host club will have several launch rails available for the high-power fliers, so using one, when you actually want to use it (when the winds are light), is possible; and you don't necessarily have to take your own rail launcher out to the range with you.

Photo 2: Tube Launcher built by Norman Pfund.

However, when using a rail launcher in the traditional way, you have the problem of large rail buttons hanging off the side of the rocket. This is similar to having a large diameter lug on the rocket. The extra drag is going to cost you a lot of altitude.

But the possibility of using the long and stiff launch rail was really appealing to me because of the are already readily available at launches, and they can actually be spliced together to make a rail that is even much longer (the full length of the 4-meter long super-roc) as shown in Photo 39.

The only thing was to solve a few problems, which is the purpose of this R&D project.

Approach Taken

A big problem that had to be addressed by using a rail launcher was for rockets that necked down to a different diameter. Super-roc style rockets are skinnier at the top and wider at the base where the motor is. Why? Because one can reduce the weight of the rocket by using skinnier tubes at the front end and then use several transition sections to gradually increase the diameter until it is the motor diameter at the base.

Unfortunately, traditional launch rails only work with rockets that are a constant diameter, or where one of the rail buttons is mounted on a stand-off. Unfortunately, this stand-off is going to act like a single fin and cause unbalanced forces on the rocket that could cause it to veer off course. And besides that problem, traditional buttons and a stand-off is going to add a lot of drag to the rocket and reduce the altitude.

My first inclination was to make a custom rail button that fit over the head of a tiny nylon screw (like the kind used as shear pins on high-power rockets). If the button was made to split into two, it could fall off the small nylon screw and greatly reduce the drag of the rocket (see Figure 1).

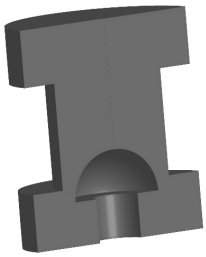


Figure 1: A design for a special two-part rail button that would fit over a nylon screw.

The problem I had was that I would have to custom fabricate a special part which would be very difficult to do. And it would be extremely hard for other modelers to duplicate if they wanted to use the same technique on their rockets. And while the button would fall away (and probably be lost in the grass beneath the launcher) there would still be a small nylon screw sticking out in the airflow generating a lot of excess drag.

It was at this point that I had an eureka moment. I remember seeing a fly-away launch lug that is sold by Jim Flis of Flis-Kits. It was basically a device that allowed a simple model rocket to be launched off a standard launch rod. It had two cradles that were rubber banded around the outside of the rocket, and held together by the launch rod

itself (see Figure 2).

This fly-away launch lug was the key item to coming up with the fly-away rail guides.

But where that used an internal launch rod to hold it together, I would have to come up with something that slid into a rail, and that could accommodate a long super-roc model. There would also be a bit of engineering involved to get the dimensions correct so that it would operate properly.

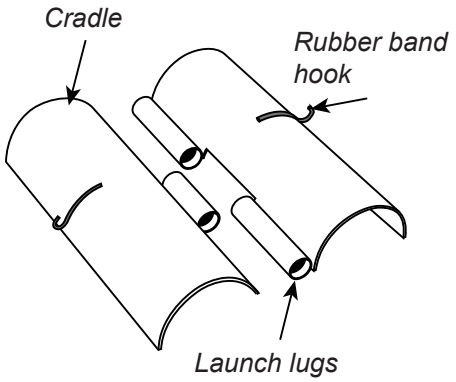


Figure 2: Fly-away launch lug sold by Flis-Kits.

Development and Construction

I started development of the fly-away rail guides by making a cradle to hold a simple rocket. I made the first one out of a 1-inch long piece of 29mm diameter tube (the same diameter as the tube used on the engine section of the F-engine super-roc model that would be common in this event.

For the rubber band hooks, I used some thin music wire that I had in my supply box. I knew I'd have to make some hooks to engage the inside edges of the launch rail, so I tried to make a single piece. I wanted it to function as both the rubber band hook on one end, and the hook that ran along the rail on the other.

Before I could start I needed a scale drawing of the cross-section of the standard launch rail. I found this data at the 8020.com web site in their catalog (see Figure 3).

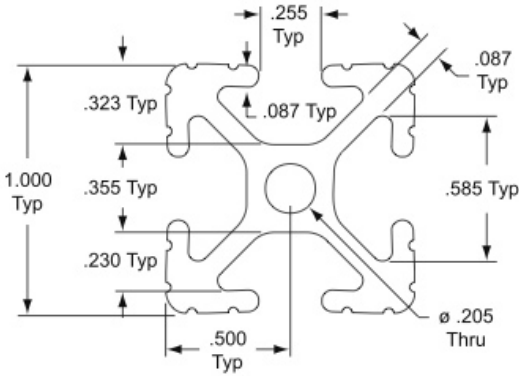


Figure 3: Dimensions of the cross section of a standard 1" sqaure launch rail from the 8020.com product catalog.

I redrew this cross section in a drawing program. On the same drawing, I drew a the rocket cross-section of the largest tube in the super-roc model (29mm dia). Surrounding this, I placed a second tube with the same wall thickness around it. This second tube would be the two halves of the cradle that would support the tube on the rail. I planned on just using the same tube as the rocket itself, and when it was split in half, it would fit around the perimeter of the tube nicely. There would of course be a small gap, because you just can't stretch a paper tube. The gap would be positioned on the side of the rocket where the rubber band hooks were located.

With the cradles in place, I then sketched a line showing how the wires would be located on the cradles. Basically, they look like a half circle, with hooks on either end (see Figure 4).

From this, I built a simple prototype device consisting of two cradles with their music wire hooks. The time making these first cradles took approximately one hour, a bit long because I wanted to make sure all the hooks were bent correctly, particularly the ends that would ride along the launch rail. I double checked the accuracy of the hooks by laying them down on the paper printout of

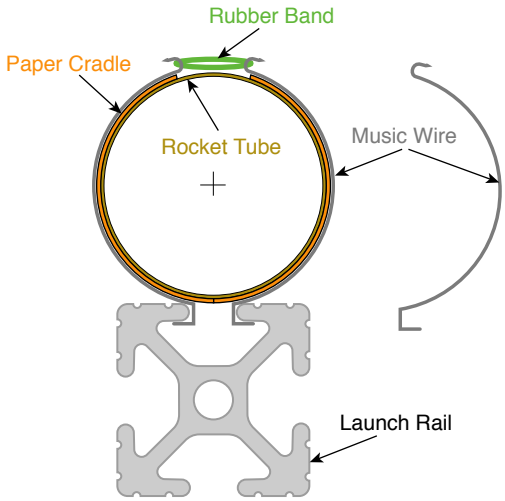


Figure 4: Full-size drawing of the cross-section of the first prototype fly-away rail guide, and how it mates to a launch rail.

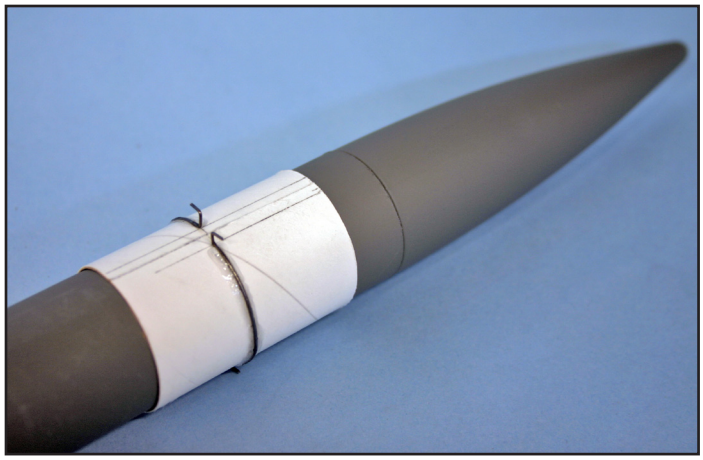


Photo 3: First prototype fly-away rail guide showing the hooks that mates with the launch rail.

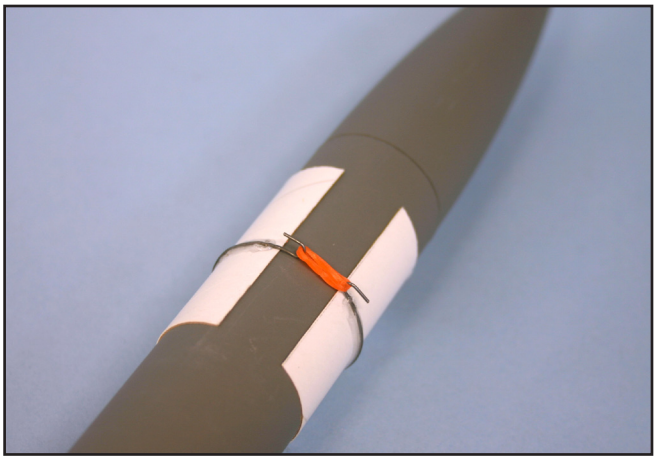


Photo 4: First prototype fly-away rail guide showing the rubber band hooks.

the drawing that I produced earlier. This technique of checking worked surprisingly well.

The unfortunate thing was that at the time I did not have a launch rail to make a real physical check with a rocket. But I was pleased enough with the results (See Photos 3 and 4) to go ahead and build a complete set for a 29mm diameter super-roc with four different diameter body tubes (29mm, 24mm, 18mm, and 13mm).

At this point, there is only one last small problem to work out. "How do we handle the situation where the rocket is skinnier at the top than at the bottom?"

First I thought of a balsa-wood stand-off of some sort. But where would I mount it? I looked at a cross section of a launch rail to see how it would have to engage the extrusion. Like a regular rail button, the device really needs to touch both the inside edge and the outside edge of the rail at the same time. If I put a balsa stand-off on the device, that would solve the problem of the invention touching the outside of the rail.

Then it hit me. If I just extended the music wire a little longer, it would have the same effect as a balsa stand off. And it would mean one less part to fabricate to put this thing together. Then if I could bend the wire just right, I could have it touch both the inside and the outside of the rail at the same time (see Figure 5). I was quite pleased with this approach because it was so simple.

The manufacturing process was similar to making the cradles that held the 29mm tube snugly up against the rail. The only difference was that the center of the tube was now further away from the rail.

In effect, the only things that changed was that the cradle was made from a smaller diameter tube, and one hook on the device was elongated (see Photo 5).

As before, I built prototype parts to see if the design was feasible. I knew I had only an 8 foot long rail available at the club launch, so instead of making four cradles for each tube diameter, I just made a set for a 24mm tube. I was hoping for a calm wind day so that the rocket would be straight when I launched it.

The first test launch was on September 5, 2009 at the Pueblo launch site of the SCORE club in Colorado.

To my delight, when I slid the rocket and the rails onto the launch pad (see Photo 7), everything fit perfectly. The fly-away rail guides slid beautifully along the rail without much friction at all. So I completed the assembly of the rocket

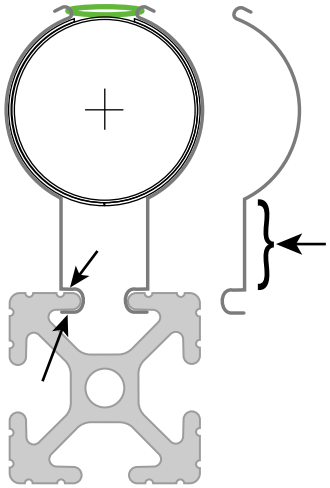


Figure 5: Stand-offs could be created by extending the wires. When stand-offs were added, the wires must touch the inside and outside of the rail launcher.

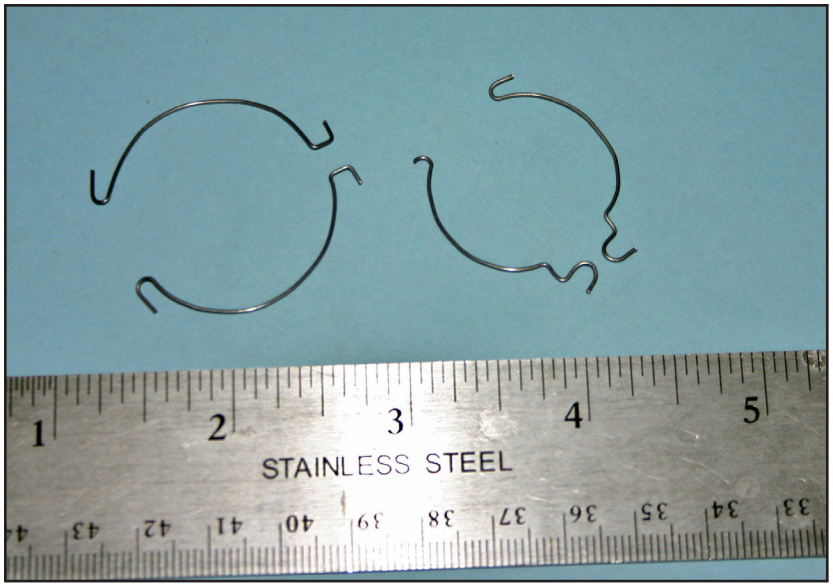


Photo 5: Music wire hooks for a 29mm diameter rocket (left) and a 24mm diameter rocket (right). The 24mm set has short stand-offs built into them so that the rocket could have a smaller diameter at the top and a larger diameter at the bottom.

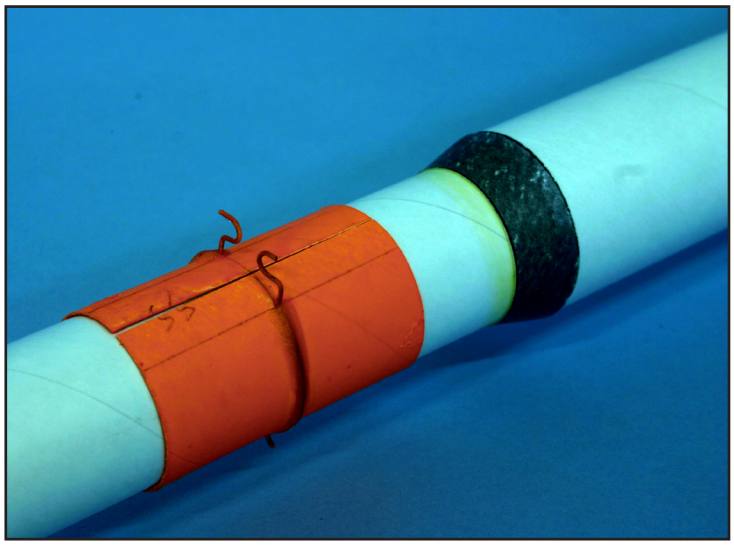


Photo 6: Completed fly-away rail guide for the 24mm diameter tube, shown next to a reducer and a 29mm diameter tube. When this photo was taken, I still had not test-fitted the device onto a real launch rail because I did not have one.

Photo 7: The first time the prototype fly-away launch guide was test fitted onto a launch rail. It was the morning of the launch, and everything fit perfectly. I thought there would be some adjustments needed, but none was required. This photo shows the 24mm diameter fly-away rail guide with the short stand-off built into it.

Photo 8 (above): Sliding the super-roc onto the launch pad. Note that the top of the rocket sags because it is not supported by the rail.

Photo 9 (top): The super-roc attached to the rail with two sets of fly-away launch rail guides. At this point, there was no wind which can be seen because the rocket's top is not bending to the side.

on the pad using the 24mm rail guides on the top part of the rail launcher (See Photos 8 and 9).

The wind did pick up that day, and the rocket did go unstable. But the first test of the rail guides was suburb. They slid effortlessly up the rail, and detached from the rocket as soon as they cleared the rail. That was what I wanted to see in this first test flight.

Photos 10 through 15 on the next page were taken from video footage of the first launch. As the photos show, as soon as the cradle passes the end of the launch rail, they detach from the rocket. They continue moving upward because they were given some initial momentum by the accelerating rocket. Note also that the rocket was starting to bow (shown in Photo 10) prior to lift-off because the upper portion of the rocket was not held rigid by the launch rail (since the rail was too short).

After the launch the cradles were picked up after a few minutes of searching. It does help to paint them a bright fluorescent color so that they stand out on the ground. The only damage to the cradle was that one of the music wire pieces had snapped off and was lost. But that was easily replaceable with another piece of wire.

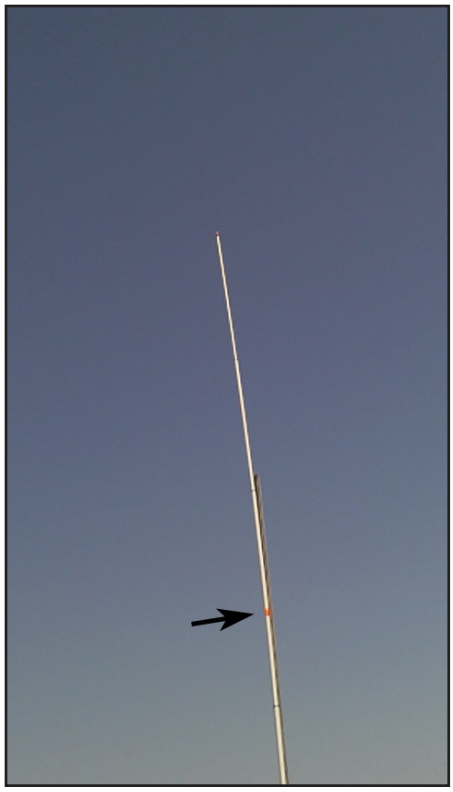


Photo 10.

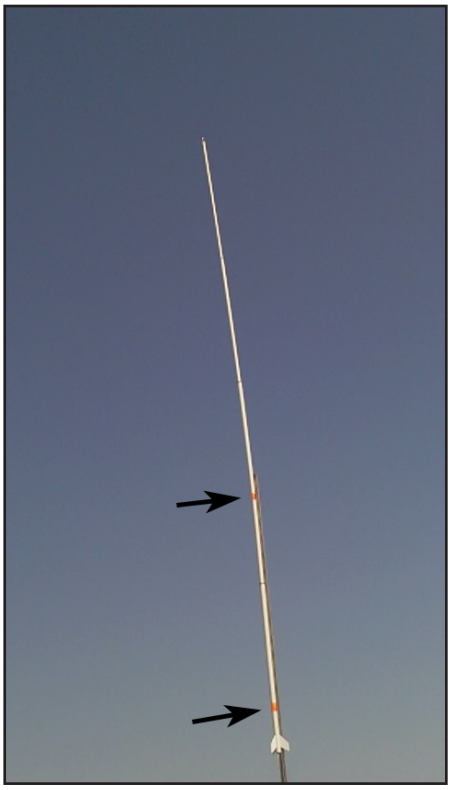


Photo 11.

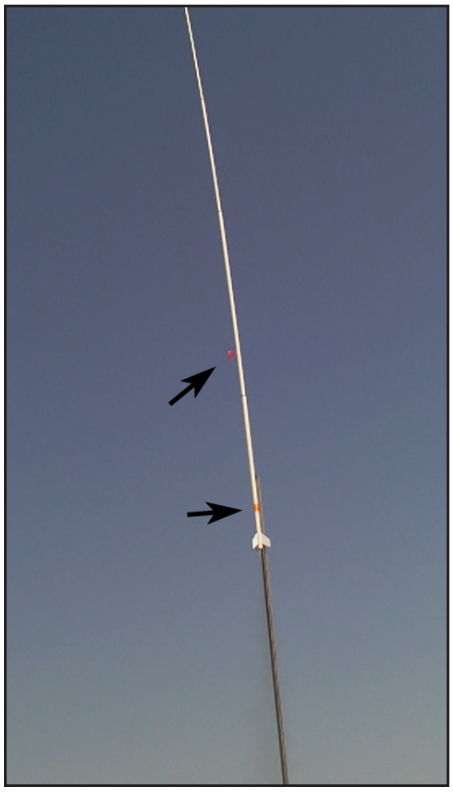


Photo 12.

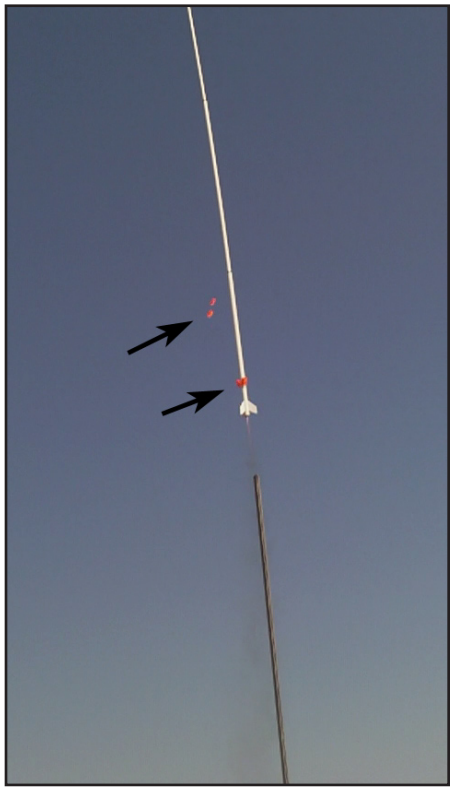


Photo 13.

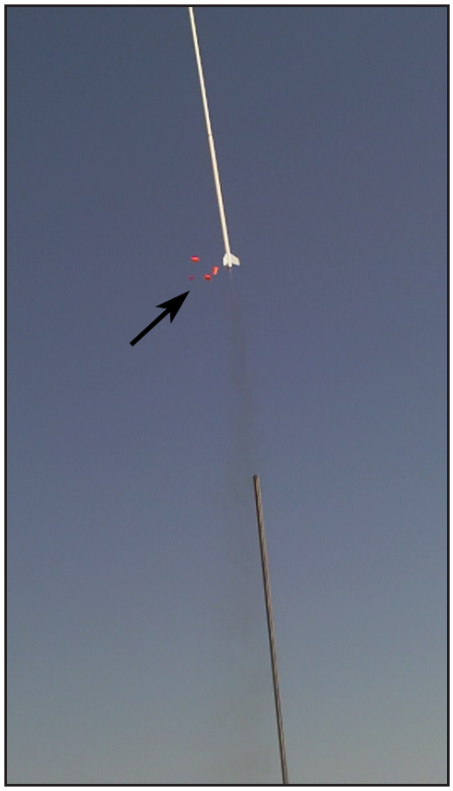


Photo 14.

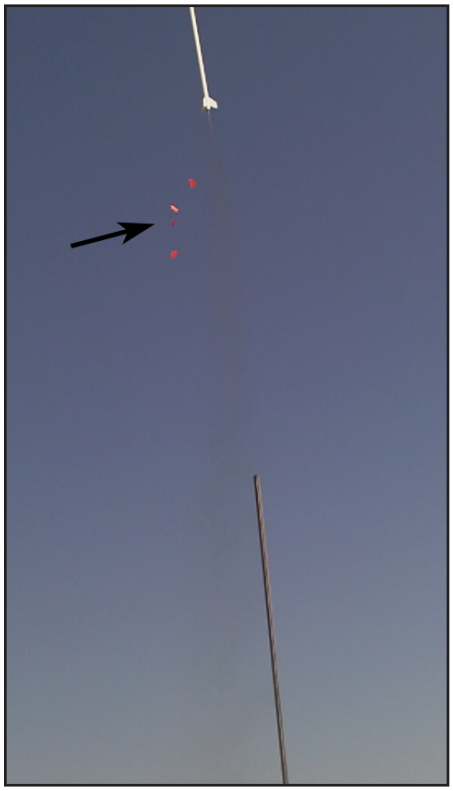


Photo 15.

Photo 10-15: These images were taken from video footage of the first fly-away rail guide launch (60-frames per second). The arrows point to the two sets of fly-away rail guides that were attached to the F-engine powered super-roc. The four cradles can be seen detacting from the rocket as soon as they exit out of the launch rail.

Fly-Away Guides For Egglofting Rockets

With this first test launch of the super-roc style rocket completed and deemed a success, I next turned my attention to a cradle for an egg-lofter design. The egg-lofting rocket that I used is a large transition section. This makes building the cradles more difficult because they also have to be a transition shape. I decided to build a transition like I would normally do for the rocket, but cover it with a layer of fiberglass to make sure it held its round shape after I cut it into two pieces.

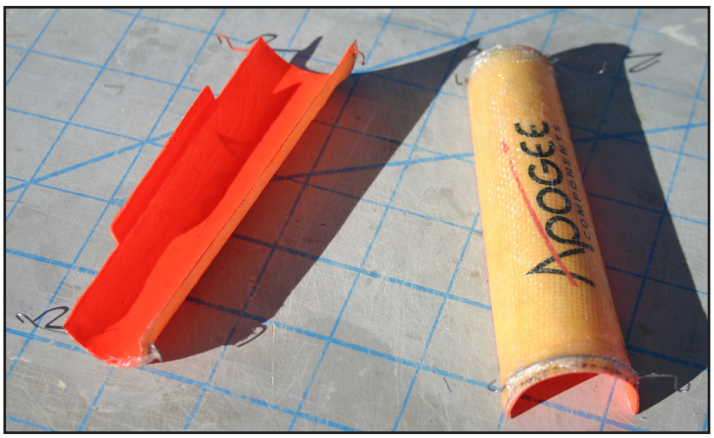


Photo 16: Fly-away rail guides for an egglofting rocket with a transition section for a body. Again, music wire was used to create the runners and the rubber band hooks.

I shaped the wire rail guides using the technique described previously; where I made a full-size drawing of the cross section of the rocket held snugly against the rail.

But because the egg-lofter rocket is so heavy, I needed one piece of music wire for each end to support the weight. Therefore, I had to make four sections of music wire as shown in Photo 16.

It was a little tricky gluing them to the fiberglassed sections. I had to make sure the ends where the wires engaged into the rail would be lined up pretty straight. Because I didn't want them to bind on the rail

Photo 17: Egglofting rocket supported on a launch rail using custom-made fly-away rail guides.

Photo 18: Close-up photo of egglofting rocket. Note the egg capsule does not touch the rail

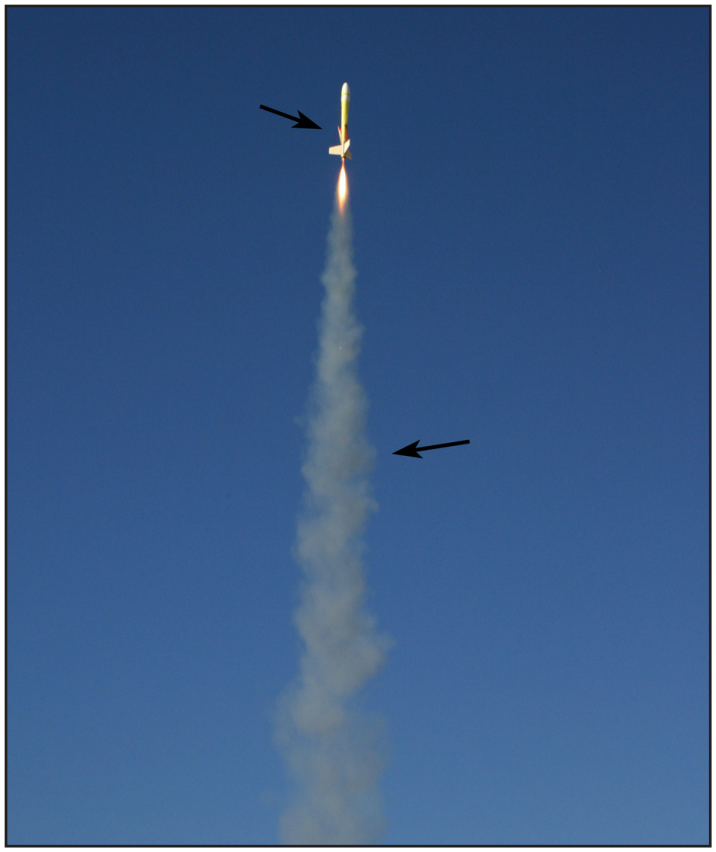


Photo 19: The egglofter initial ascent. The top arrow points to the cradle which was still in the process of falling off when the phto was taken. Note how straight the smoke trail is (lower arrow), indicating almost zero weathercocking.

Photo 20: A similar egglofter rocket launched a few minutes before my egglofter weathercocked sharply as it came out of a 3-foot long launch tower (inset shows the rocket in the tower).

as the rocket was taking off.

After gluing them to the sections, I put another layer of fiberglass cloth over the wires to make sure that they wouldn't pop off at launch. I'm glad I did that. Since they were so well affixed to pieces, I was able to slightly tweak their position and orientation so they wouldn't bind on the launch rail.

There was a bit of finagling to get this first egg-lofter cradle onto the launch rail correctly. I didn't like that aspect, especially since rocket and the fly-away rail guides were for a contest and time was in short supply. But the flights on the contest day in late October, 2009 were fantastic. The rocket came out of the rail perfectly straight (see photo 19) because it had a chance to build up a lot of speed.

As a comparison, all the other competitors flew from 3-foot long launch towers. These other rockets were weathercocking, because the wind really affected them at the low speed right when they exited the launch tower.

Again, the cradles separated properly, and were recovered near the launch pad, so they could be reused during the contest.

First Revisions

The next revision I made to these egglofting cradles was to swap out the music wire standoffs for ones made out of balsa wood. Originally, I thought the music wire was a simple and elegant solution. But the finagle-factor of getting them to line up correctly on a rail was a problem that I wanted to solve. Part of the problem was a result of the rocket being a lot heavier than a normal model rocket. The music wire tended to bend at the stand-off location causing it to bind on the rail. The wire, while stiff, was still somewhat bendable. I didn't like it that I had to readjust the fit every time I took a set of cradles out of the range-box. As mentioned, the cradles for the egg-lofting rocket were giving me fits during the contest.

So my quick-and-dirty solution was to use two planks of balsa glued on edge to create the standoffs. To make them engage the rail (to create the "runners"), I glued small pieces at a right angle to the stand-offs. This worked very well. Basically, I created elongated rail buttons.

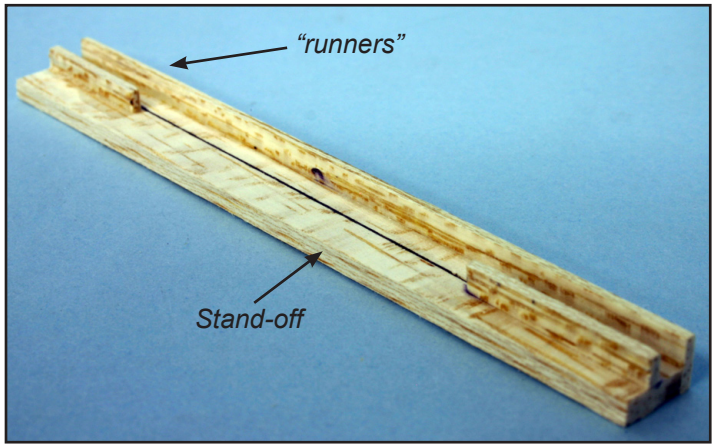


Photo 21: The revised balsa wood stand off (the part laying horizontal), and the rail runners (the parts standing vertically on edge).

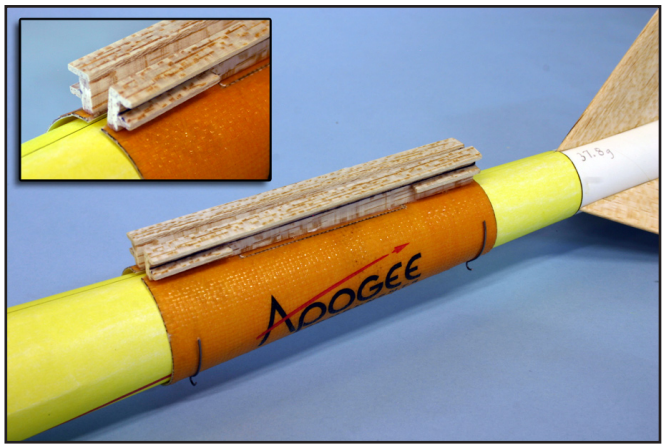


Photo 22: The new stand-offs glued to the cradles. Inset shows a close-up of the runners that engage the launch rail.

The other side of the cradle was also giving me problems, particularly on the transition section cradles. The edges of the cradle wanted to slide under/over each other and pull the cradle apart prematurely. This would cause the rail-runners to bind as it slid along the aluminum extrusion.

This was pretty easy to solve. I just glued a couple of strips of balsa wood along the edges of the cradles so that they wouldn't slide under each other (See Photos 23 through 25).

Photo 23: Back-side of the egglofting cradle. Wood strips were added to prevent the cradles from sliding over each other because of the rubber band tension.

Photo 24: The completed egglofting cradles. Because of their long length, a second rubber band was added to help pry it away from the rocket.

The other advantage of the strips is that they close the gap between the two cradles to that the rail guides form a complete circle around the rocket's tube. This is important, because a gap will allow the rubber bands to pull the edges together and thereby tighten the fit on the runners in the launch rail. The strips of wood prevent that from happening which means less tweaking and adjusting when loading the rocket onto the launch rail.

I have since added these balsa strips to all the fly-away rail guides that I have made. They seem to work well at minimizing the amount of adjustments that one has to make when loading the rocket onto the pad. For instance, if a cradle edge slides under the other cradle, that means one rail guide is binding tight up against the launch rail. So it has to be fixed by readjusting the cradles.

Another revision that I made was to cut some matching indexing notches into the cradle tubes. This makes the edges of the cradle (under the rail guides runners) like a puzzle piece; where the edges line up in an interlocking fashion. The purpose of this is to keep the cradles from sliding fore/aft with respect to each other. They must move as a unit. This is particularly helpful when the location of the cradles when applied to the rocket has to be repositioned with respect to the rocket's center of gravity.

I've tried several configurations for interlocking-indexing to see how easy they are to cut into the cradle halves and how well they popped open (see Photos 26 through 30).

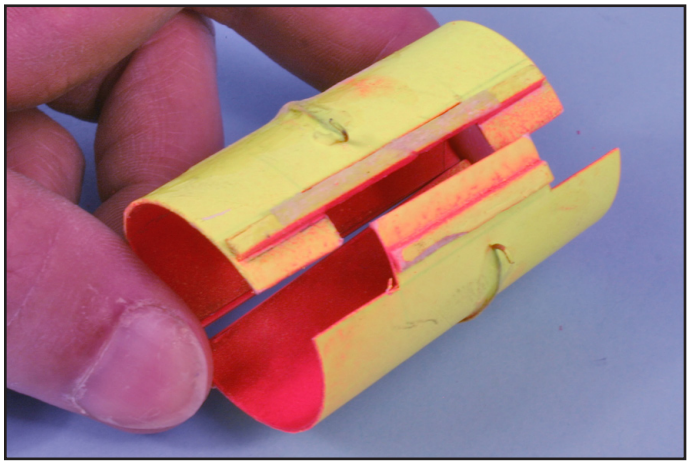


Photo 27: Here was an attempt to put the interlocking indexing tab on the rubber band hook side of the cradle. Note that the tab has to slide under the balsa wood strip. This slowed down the opening of the cradels when it exited the rail.

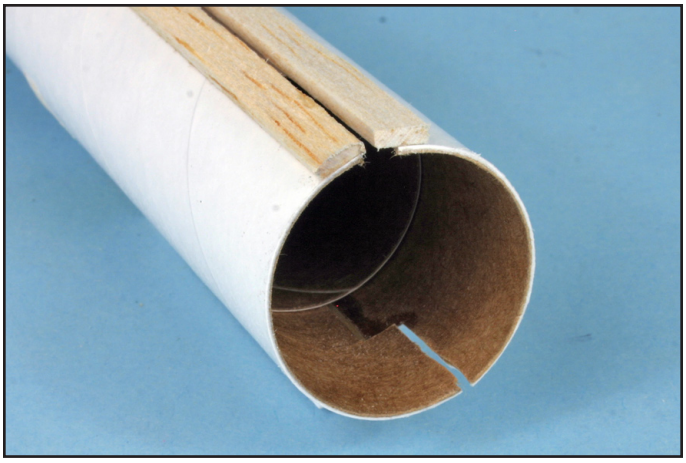


Photo 25: The strips of wood on the back side prevent the edges from sliding over one another, and they close the gap in the tube so the cradle forms a complete circle around the rocket's tube.

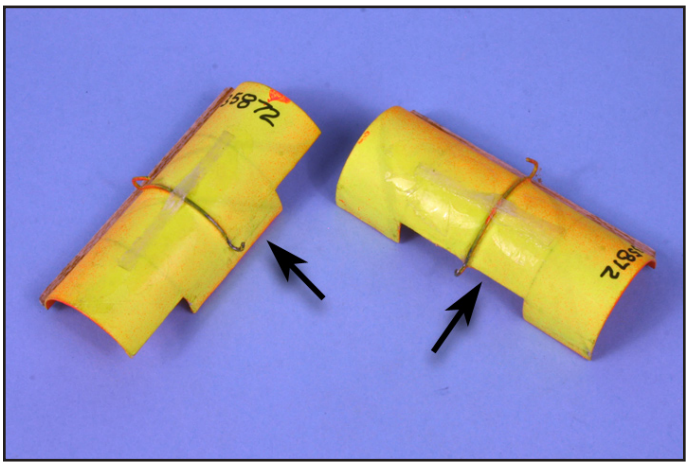


Photo 26: The first interlocking indexing tab was cut into the cradle on the runner side of the tube. This worked fine when I was using music wire for the rail runners.

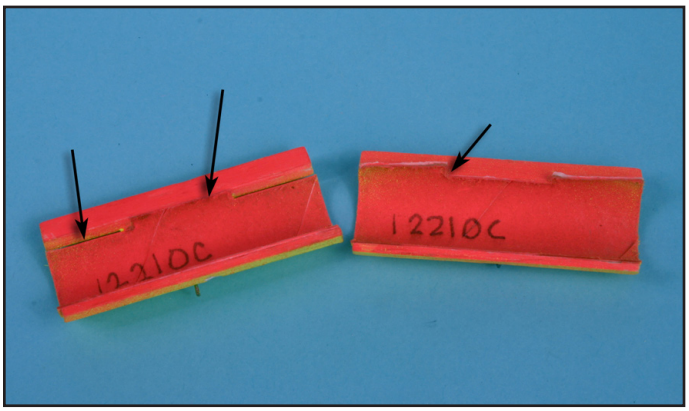


Photo 28: The interlocking-index tab has to be put on the runner side of the cradles. Here, the tabs interlock under the runners. This still causes slow opening of the cradles.

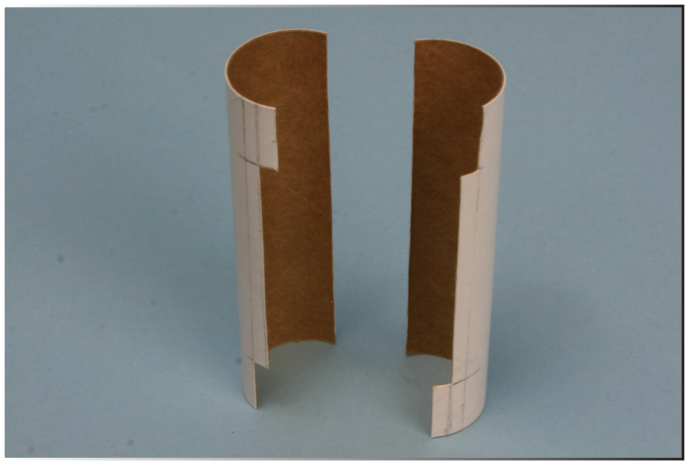


Photo 29: Putting the interlocking-indexing tabs on toward the end of the cradles is the final configuration that I settled on for my production pieces.

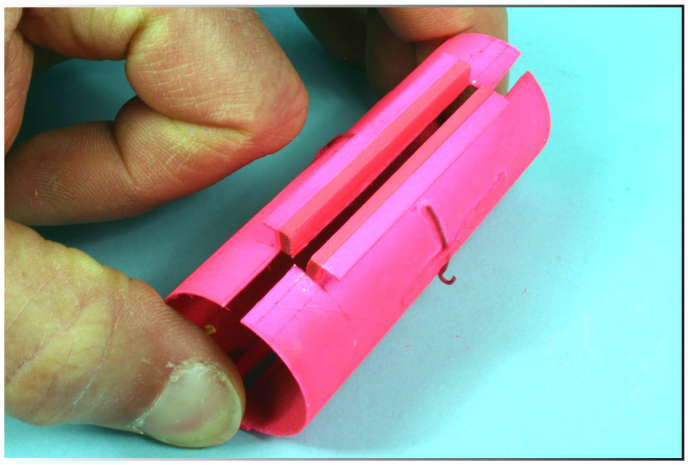


Photo 30: Here the runners have been added. The runners go between the interlocking-indexing tabs. This eliminates any hang-ups that prevent quick openings as the rocket exits the launch rail.

I didn't need to perform any flight tests to see how well the interlocking-indexing tabs worked. My tests were simple. I just positioned the cradles onto a rocket and put it on the rail that was laying on a bench in my workshop. I then just slid the rocket off the rail and watched what happened. What I was looking for was to see how fast the cradles separated from the rocket as the rocket slid off the rail. If it stayed attached, even after it exited the rail, then I knew that it wasn't a good configuration and I would try something a little different in the next set of cradles that I made.

Even though the "poorly" function cradles didn't work quite like I wanted, I didn't discard them completely. I still used them in competition. The reason is that all of them would come off in flight if they were subject to a good stiff jolt. I knew from the first tests that coming out of a launch rail during an actual launch is extremely jolting. That, plus all the air flowing past the cradles and getting under them would be enough to lift them off the rocket eventually.

Ideally, you want the cradles to separate as fast as possible after exiting the launch rail. This minimizes the drag on the rocket, and a little extra weight of the cradles themselves. Also, the longer it takes for the cradles to separate, the higher up the rocket will be when they do eventually fall off. That means that the cradles are going to drift downrange further and are going to be harder to retrieve after the flight. Getting them to detach quickly (hence at a lower altitude) means they are going to stay closer to the launch pad, and then they are easier to find laying on the ground.

After a trying a number of configurations, I've come to the conclusion that the reason the interlocking edge has to be near the rail guide runners is because the other edge (under the rubber band) has to remain straight so that it can pivot properly as the rubber band pulls them apart (see Photos 29 and 30).

I found that the best location for the cradles on the rocket was right up against the leading edge of the fins. The fins end up pushing the cradles upward when the rocket lifts off, instead of the rocket sliding up through the cradle and eventually having the fin smash into them anyway. Might as well start in that position to begin with to lessen the chances of the cradles cutting into the leading edge of the fin root.

Another modification that I'm making is to use an extruded plastic angle from Evergreen Plastics to make the rail runners. The balsa wood runners were better than the music wire. But balsawood has a grain, and the wood is not as dimensionally stable as I want. It is also rough and not slick enough in the launch rail. I've had several balsa tabs snap off during launches. They are repairable, but I'm always looking for something better.

Additional Runner Modifications

The progression of the runners that ran through the launch rail started out as music wire (see Photo 5). Then I switched to long runners made from strips of balsa wood (Photo 21). These long runners worked really well, because they required very little adjustment. The only drawback is their strength. I had one of the runner strips snap in half on one launch.

Because it was weak, I looked around for a substitute material that was stronger than balsa wood. I found it at the hobby store in the form of long plastic extrusions from Evergreen Plastics.

My first attempt was to use an "L" shaped extrusion. The only slight hitch was the legs on the part was too long to fit inside the launch rail. But that was easily solved by cutting off a strip from one of the legs as shown in Photo 31.

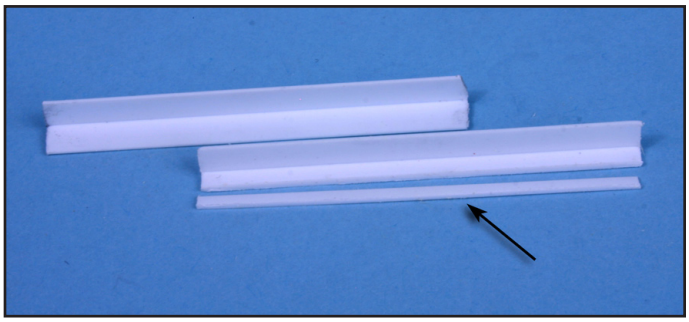


Photo 31: The plastic "L" extrusion is a bit wide to fit into fit into the slot on the launch rail, so it has to be trimmed to fit.

After it is trimmed, it is glued to a balsa or spruce strip (see Photo 32). The reason is that the wood strip helps to give the proper separation for the runners to engage the launch rail.

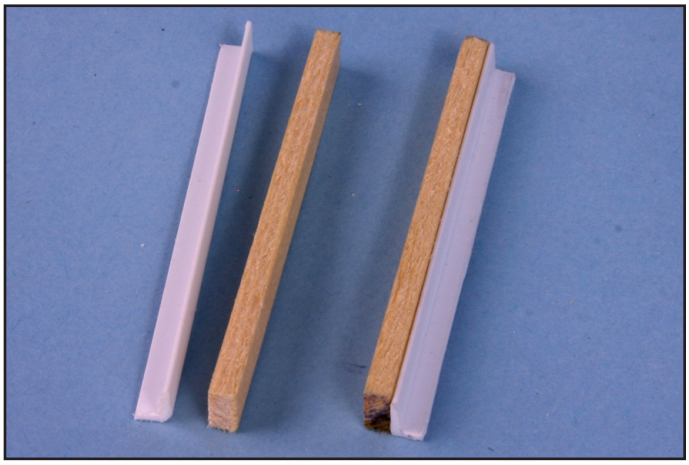


Photo 32: The plastic "L" extrusion is glued to a strip of wood.

Once two runners are made, you do need to check the fit if you have a launch rail handy (see Photo 33). You want the fit of the runners in the rail to slide effortlessly without any binding in the slot of the rail. If it is tight, now is the time to sand them down so that it does fit.

If you don't have a rail available during the time of construction, it is possible to sand the edge later when you do get out to the range. For reference, I use a strip of wood that is 3/32-inch thick that is glued to the extrusion. This only takes a minimal amount of sanding to give the right amount of fit in the rail.

When using the "L" extrusion, the strip of wood and the extrusion can be glued right to the cradle at this point. The cradle itself will act as the part of the runner to hold the rocket to the rail (See Photo 30). That is really cool, as it saves a lot of time when constructing the device.

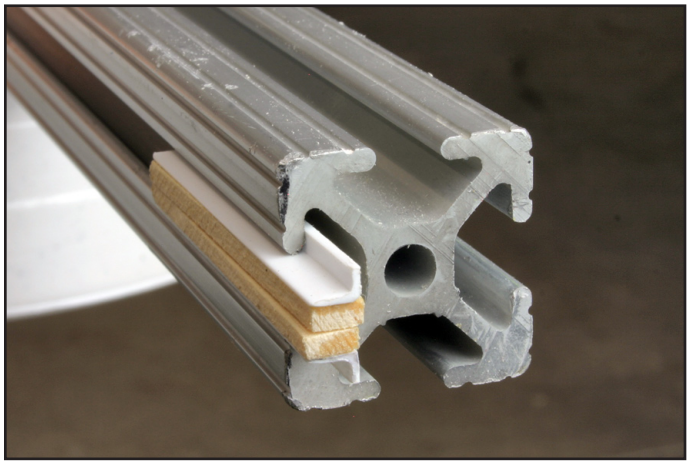


Photo 33: Test fit the runners in the rail, and sand the wood as necessary to adjust the fit so the runners slide easily.

If you are using a design that requires a stand off, then you will need a second piece of "L" extrusion that is glued to the stand-off wood. I typically use two short pieces to cut down on the friction when the runners are sliding along the rail (See Photo 34). But you can always use a long piece like you used for the top runner. The choice is yours.

To finish out the cradles, the next step is to add the music wire hooks. I used a pliers-like tool with rounded jaws to bend the wire (Photo 35). These can also be bent with regular pliers, but you have to use the very tip to help make a smooth curve.

I would check the curvature of the long leg that wraps around the tube often as you're bending it. The cross-section drawing (like the one shown in Photo 4) will work just fine for this task.

To attach it, I recommend using thick gap-filling CyA glue to glue the hook to the cradle. Then secure it permanently by adding a strip of fiberglass tow (strands of glass fibers) or fiberglass cloth over the top of the part attached to the tube section as shown in Photo 36.

Making the tabs on the rail runners from plastic "L" extrusion was a huge improvement over the original balsa wood runners. I was instantly impressed at how easily it slid up and down the aluminum launch rail.

The final modification that I made to the fly-away rail guides was to try another extrusion shape besides the "L". I found a square-corner "U" shape extrusion at the same local hobby store. At first I didn't think it would work because it was very sloppy when inserted into the launch rail. But after making up a complete set of cradles (see Photo 37), I've decided that the sloppiness isn't all that bad. And since it is a "U" shape, it really cuts down on the assembly time to make a complete assembly. You only have to attach it to backer wood strip, and then glue that to the tube.

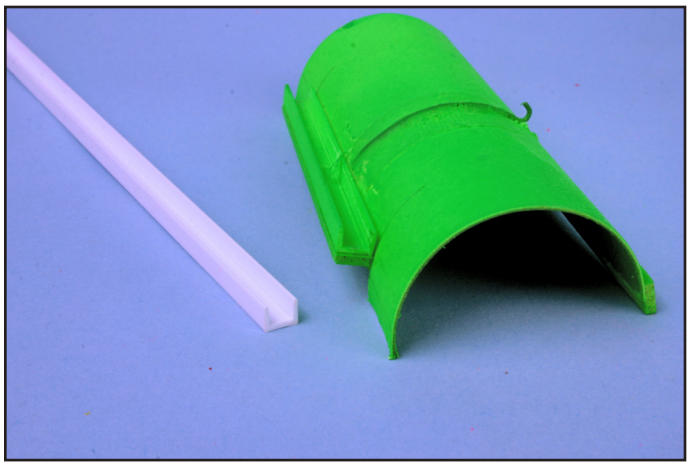


Photo 37: A "U" shaped extrusion was the final modifcation to the cradles. This really cut down on the assemy time to make a set for a rocket.

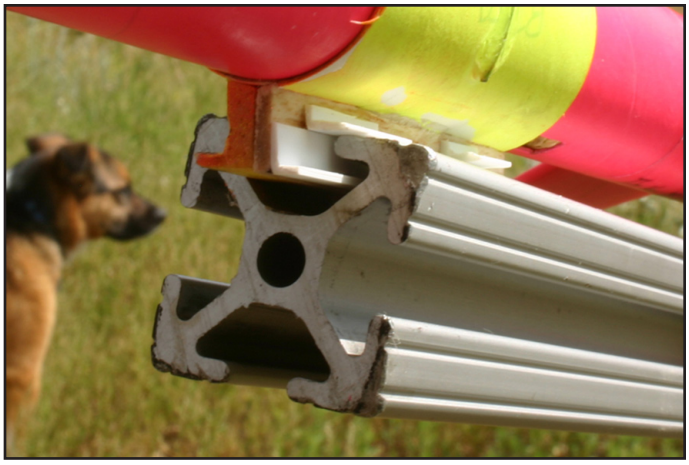


Photo 34: When a stand-off is used, you'll need to add extra pices of "L" extrusion to help guide the runners along the rail.

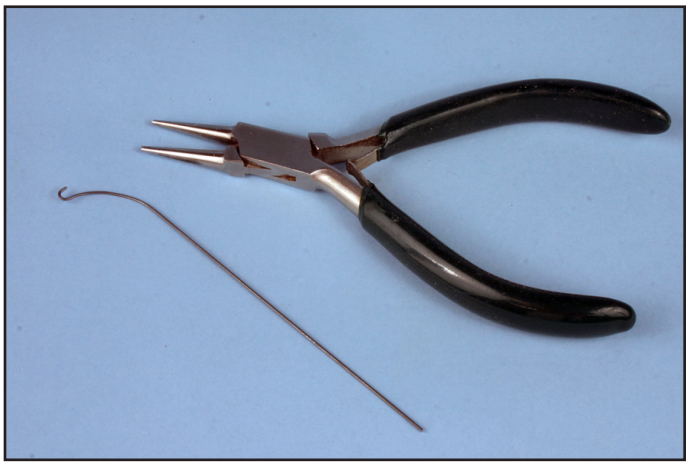


Photo 35: Bend the music wire to form a hook. This hook is then glued to the cradle.

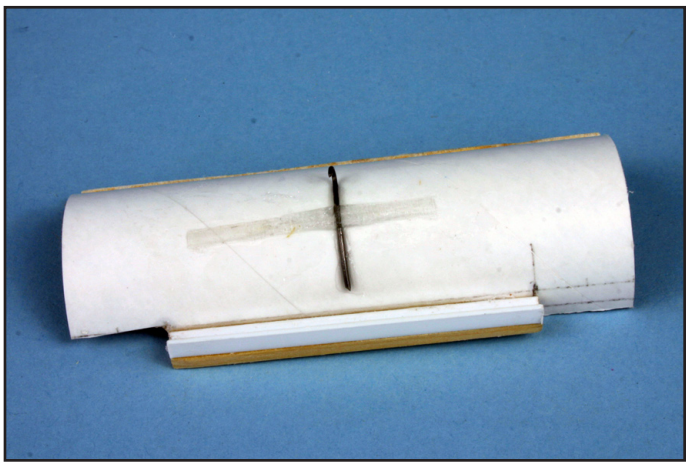


Photo 36: The music wire hook is held in place with a small piece of fiberglass that is CyA in place.

I don't seem to mind the slop myself, but if it is a concern that the rocket will leave the launch rail at some small angle-of-attack, this can be reduced by making the whole cradle assembly a lot longer. My cradles for the BT-50 size (24mm diameter) rockets is 3.0 inches long. Other than adding a little bit of extra weight at lift-off, the extra length would greatly reduce the potential of the rocket leaving the rod at an angle-of-attack.

Conclusions Drawn

The fly-away rail guide is an excellent tool that can be used to launch a rocket from a standard high-power launch rail without the use of traditional rail-buttons. By eliminating the button or the launch lugs, the rocket will have lower drag and should therefore fly higher. At the same time, it leaves the ground with higher velocity, which moves the center-of-pressure rearward on the rocket. This has the effect of making the model more stable at lift-off.

In the next two sections, called "Disadvantages of Fly-Away Rail Guides" and "Advantages of Fly-Away Rail Guides" I'll list the other conclusions I've come to as a result of this project. In this way, I hope to give both arguments as to the merits and drawbacks of users making and using this new device.

Disadvantages of Fly-Away Rail Guides

Here are some of the negative aspects that I have encountered when using the Fly-Away Rail Guides.

First, to the RSO of the contest, the violent falling away of the cradles as the rocket leaves the rail is not expected. It almost looks like the fins are shredding from the rocket. I had one early contest where the RSO was about to DQ the flight because of shred. I had to explain to the person that the rail guide cradles were expected and planned to come off that way.

Now, when at a launch, I inform the RSO that the rail guides will come off when the rocket takes off, and tell them not to be alarmed (unless of course, the rocket itself veers from vertical).

Second, any external shock cords, such as on small competition models that are designed to suspend the body tube sideways on descent, have to be under the cradle at launch. The reason is that a shock cord positioned on the outside of the cradle can prevent the cradle from detaching from the rocket when it exits the launch rail. The one failure I had where the fly-away rail guides didn't fall away was when I forgot to put the external shock cord underneath the cradle. The flight was still fine, but it just didn't go as high as I projected it would because of the extra drag of the cradles still attached.

Photo 38: An image of all the cradles that I made for this project. Each cradle fits a specific size rocket body tube. Some are also mounted on stand-offs to accomodate unique configuration rockets.

Third, the fly-away rail guides have to be constructed for a specific tube size. That means a BT-50 size (24mm) won't work on rockets that are made from a BT-20 (18mm) size tube. What this means is that a rocketeer will need a collection of different size fly-away rail guides in his range box. In my collection (see Photo 38), I made two of each size for the common body tube sizes: 13mm,

18mm, 24mm, and 29mm. I have two of each in case one or both cradles is lost on the first flight.

The reason I mention this is that each fly-away rail guide (set of two cradles with their runners and rubber band hooks), takes a bit of time to construct due to the precision craftsmanship necessary to get them to hold the rocket and to slide effortlessly along the rail.

The good news is that if you build a stand-off into a 24mm cradle, it will still work on 24mm diameter rockets that don't need a stand-off. That could save a little time in assembling a collection for competition rockets.

With many different sizes and configurations, another chore becomes organizing them in some container. Otherwise, finding two matching cradles might be a major hassle. And when you're in competition flights, you don't have time to waste looking for things.

Because of the potential that cradles can be missing, or lost after a flight, I've decided to make two identical sets for every size rocket I may need for a competition. Hopefully, this will minimize the chances of not finding at least one matching set.

The forth disadvantage that I found is that if you don't paint the cradles a bright color, such as florescent red or orange, they can get easily lost in the grass. The inside color of a body tube (kraft-paper brown), is nearly the same color as dry grass. It gets camouflaged really well.

Fifth, there is some additional prep time getting the rocket ready to launch compared to just sliding it down a launch rod. I would equate it more to prepping a rocket that is being piston launched.

First of all, you have to inspect the launch rail and make sure it is clean. The rail runners are squared off, and not round like a rail button, so they can push any grime and residue along the rail like a snow plow. This could impede the progress of the rocket ascending up the rail. I usually take baby wipes with me to the rail to clean them off. The other rocketeers really appreciate me doing this, because they like clean rails too.

As a side note, the smoky motors that produces dense black smoke, are really gunky. It is almost like a tar residue on the rail, and it is a lot harder to clean than the soot from a black powder motor.

Next, you have to position the cradles around the rocket and install the rubber band. You can't let go of the cradle until you slide its runner's into the launch rail otherwise, it will pop open on you and fall off. So it does take two hands to put the rocket on the rail. Longer super-roc style rockets usually require a second person to help load it on the rail too. Of course, they probably need two people to prep those long rocket no matter what way you intend to launch them.

Then you have to slide the cradles into position on the rocket. I prefer that they be slid down the body until the cradles just touch the leading edge of the fins at the fin root. You have to then make sure that the runners slide easily inside the launch rail. Actually, the fit and how easily the runners of the guides slide is fairly critical. Usually, I have to pinch the cradles together at the runner side (because the rubber bands are trying to pull them open – which increases the friction of the runners in the rail).

If you just grab the rocket by the cradles and try to slide it along the rail, it will often seem tight, even after you've adjusted it previously. The reason is that you are actually giving the cradles, and therefore the runners that are attached to them, a twist sideways. This sideways twisting action causes them to bind on the rail.

So instead of repositioning them by grabbing and holding the cradles, I found that it is best to just put your finger on one end of the runner (between the body tube and the launch rail), and slide it along the rail. When you move it this way, it will slide much easier and if you've built the cradles and the runners correctly, it will almost be effortless. This is the optimum condition that I try to achieve before launching the rocket.

The majority of my time in this project was spent trying to minimizing the prep and loading time associated with using the fly-away rail guides. In many respects, I believe that I succeeded, because the cradles that have the extruded runners take a lot less time to adjust than the original cradles that used music wire for the runners.

Advantages of the Fly-Away Rail Guides.

First advantage: Total support on long rockets.

Using a long launch rail to support a tall rocket like a super-roc is nearly ideal. The long rail supports the rocket so it doesn't sway in the wind like putting the super-roc into a competition launch tower.

As an experiment, the Richard Fonzi, a member of the COSROCS club, spliced together two launch rails (a 8-foot length, and a 6-foot length) using a couple of support plates on the sides of the rail. With a full 13 foot rail, the 4-meter tall F-engine super-roc was completely supported. A launch in high winds was accomplished successfully in January 2010 at the Winter Fest regional competition. I wouldn't have attempted a launch in high winds like that using a traditional launch rod or even a tower. Too much length of the rocket would have been unsupported, and the rocket would have crashed.

Photo 39: This 13-foot tall launch rail was made by the Richard Fonzi of the COSROCS club at my recommendation (based on the original "Peak-of-Flight Newsletter" article that I wrote).

Photo 40: This full 4-meter tall super roc model is held steady on the 13-foot tall launch rail by three fly-away rail guides (indicated by the arrows). You can't tell it but this was a very windy day, with sustained winds of 10 mph.

Second advantage: "drag reduction."

Since the fly-away rail guides are designed to separate from the rocket as it slides off the launch rail, there is no parasite drag on the side of the rocket such as would be caused by traditional launch lugs or rail buttons. Therefore, it has the advantage of a tower launcher, which would be of

great benefit to competition modelers.

Third advantage: "Low cost."

They fly-away rail guides were made from odd lengths of surplus tubes that I already owned. I believe that most modelers that have been in the hobby for more than a few years would have something similar.

The launch rail may be expensive if the local club doesn't already have one (such as a newly formed club), but I think this is a rare situation these days, and is likely to be even rarer in the future when thick rods (for high power rockets) are completely phased out. I can only think of one high-power kit manufacturer at the current time, LOC Precision, that still includes 1/2 inch diameter launch lugs with their rocket kits. Having a launch rail available at a club launch is not going to be something that modelers are going to have to worry about too much in the future.

Once the modeler knows that a launch rail is available at a launch, it really cuts down on the support equipment that they personally have to carry with them. For example, in the competition rocketry, a modeler won't have to invest in a launch tower. Currently, there is no manufacturer for launch towers, so the modeler has no choice, and will have to have one custom made. That means it is expensive and time consuming for the modeler.

Fourth advantage: "Increased launch velocity."

The rocket is actually constrained on the rail launcher a longer time and for a much longer distance than if it was launched from a 36 inch launch rod. While it is constrained, it is building up a lot of speed as the motor is producing thrust. So when it leaves the rail, its speed is much higher than it would be if it were launched from a shorter rod.

Now on the surface, some people would say, "Who cares… After all, the same rocket with the same motor will probably fly just as fine and high anyway. And besides, the longer distance it is on the rail, the more surface friction there is on the runners as they move along the rail. This means the rocket coming off the rod will probably go higher anyway." But this is wrong.

This is speed advantage coming off the rail is HUGE, even though most modelers may only give it just a small amount of attention. What this means is that there are three advantages to higher speed.

To begin with, the rocket is going to be more stable when it leaves the pad. Why is this? Because the faster speed allows the fins to be more affective because they have more air flowing over them. This actually moves the CP rearward on the rocket, which increases the distance from the CG and hence the rocket is more stable. So a rocket that might be "marginally stable" normally could become nice-and-stable.

The extra speed leaving the launch pad also means that the rocket will weathercock less in breezy conditions. That translates to a rocket that will fly

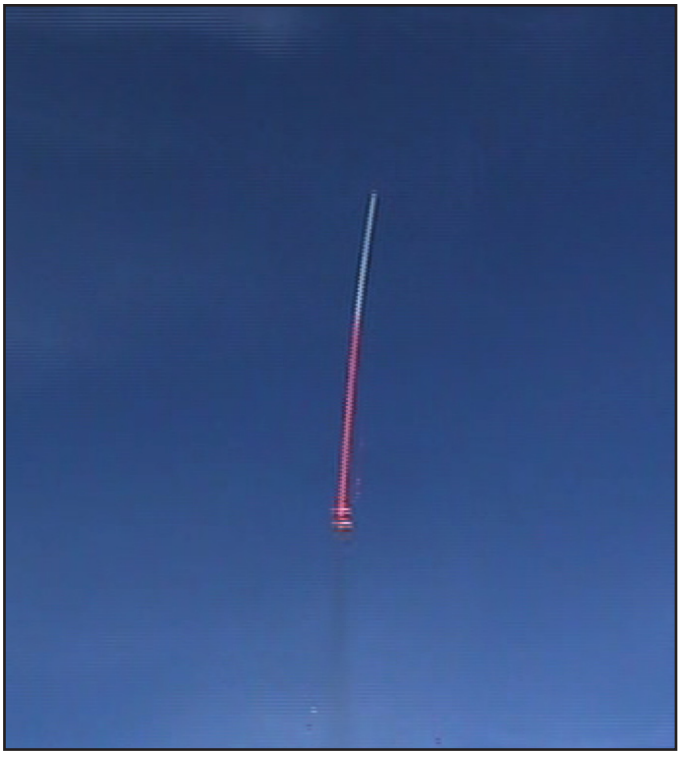


Photo 41: This super-roc is on the hairy edge of instability. Since it is flexible, the front of the rocket is flying at an angle of attack that is different from the fins. A longer launch guide gives extra speed which helped it fly relatively straight.

straighter and probably higher than a rocket that does weathercock (even slightly).

Weathercocking, which is the turning of the rocket into the wind is more pronounced at slow speeds. In other words, when the rocket is flying slow, the horizontal wind component has a larger influence on the rocket. It is simple vector addition. When the speed of the rocket is faster, the horizontal component is lessened and therefore the rocket will travel straighter.

In Figure 6 we see a plot that was generated from two RockSim simulations of the same rocket. The only difference was the launcher length was changed from 36 inches to 96 inches. (rocket used: Apogee Aspire, flown on a E6-8 motor in a 12 mph wind. 60 grams nose weight added as a mass object).

The actual RockSim data shows that the velocity at launch-guide-departure went from 31.25 mph on the 36 inch rod, to 48.99 mph on the 96-inch long rail. This translates to a straighter flight.

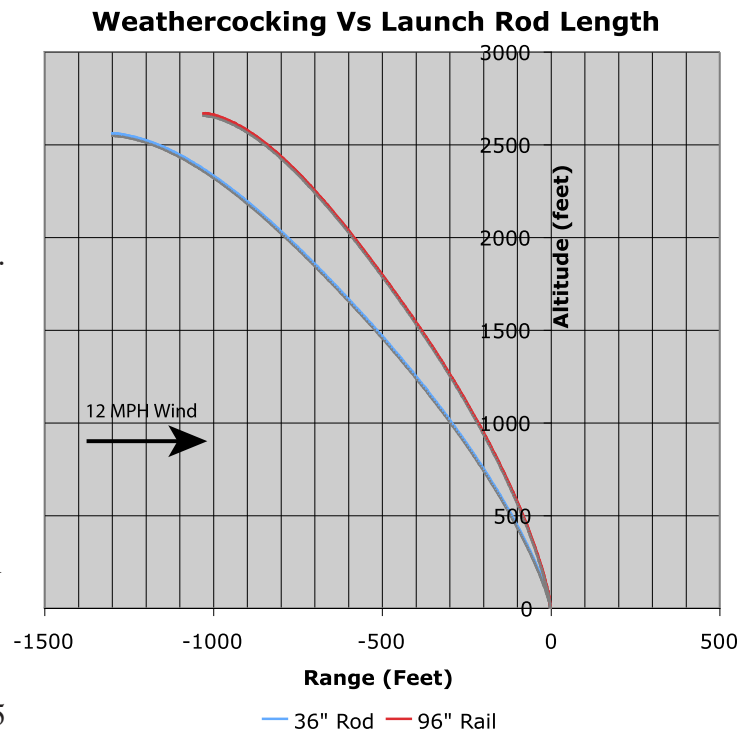


Figure 6: Trajectory plot from RockSim data showing how weathercocking is decreased when the launcher length is increased.

Actual launches as shown in the images of the egg-lofter rockets (Photos 19 and 20) show just how pronounced weathercocking can be. Two rockets, each pretty similar is shape and using the same motor are launched in breezy conditions. The rocket coming out of the short tower immediately weathercocks and travels at an angle away from vertical. Once it starts its turn, the rocket is now using a portion of its thrust to gain some horizontal velocity as well as vertical velocity. The horizontal component is wasting the energy of the rocket, and therefore the rocket is not going to fly as high.

By contrast, the rocket that leaves the long rail is traveling nearly perfectly vertical, as evidenced by the straight column of smoke. So even if there is a bit more friction of the runners on the rail, the fact that it is going vertical and straight is more than going to make up for the extra friction of the runners on the rail. You'll get a higher flight if your rocket leaves the rail at a higher speed compared to leaving a shorter launch rod (all other things being equal).

The only time that a rod might have an advantage over the rail is when the air is dead calm. But that is so very rare, that I believe it is worth the extra hassle to use the fly-away rail guides.

And besides, the advantage of the rail is that it is stiffer and doesn't whip around as the rocket transverses up its length.

Because the rocket is more stable, and flying straighter, modelers are then more confident that it will travel along the trajectory path that we anticipated prior to launch. If they are more confident, that in practical terms means that the rocket flight is "safer." For this reason alone, using a launch rail should be the preferred method of launch. That is why most clubs around the country have already phased out large diameter launch rods for high power rockets, and have switched to launch rails. It is just plain "safer" to launch off a rail because of the advantages of the higher lift-off speeds.

Fifth advantage: "Adaptability to Odd Configuration Rockets"

The fly-away launch rails can be used on models that traditionally wouldn't lend themselves to being launched out of a launch tower. For example, gliders can't be launched out of a tower launcher, but it is an

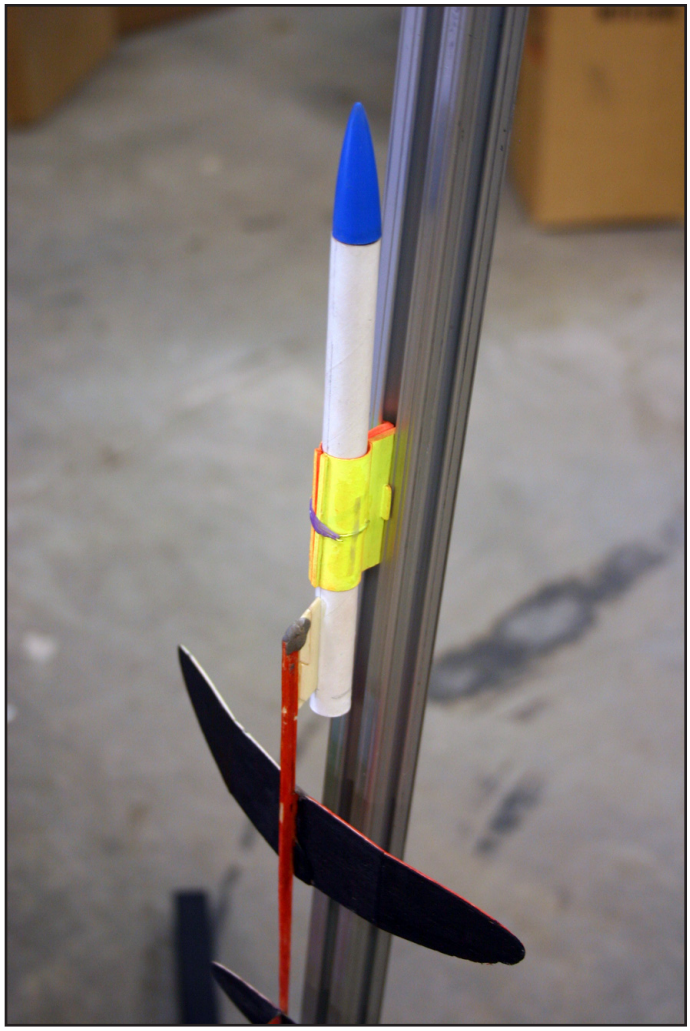
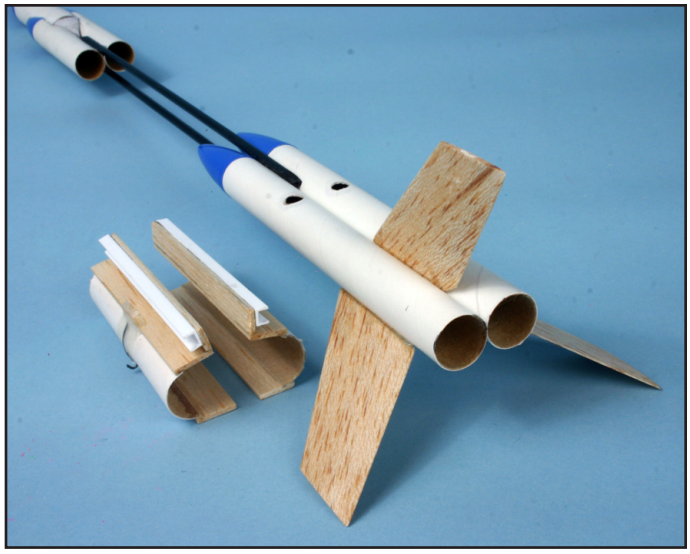


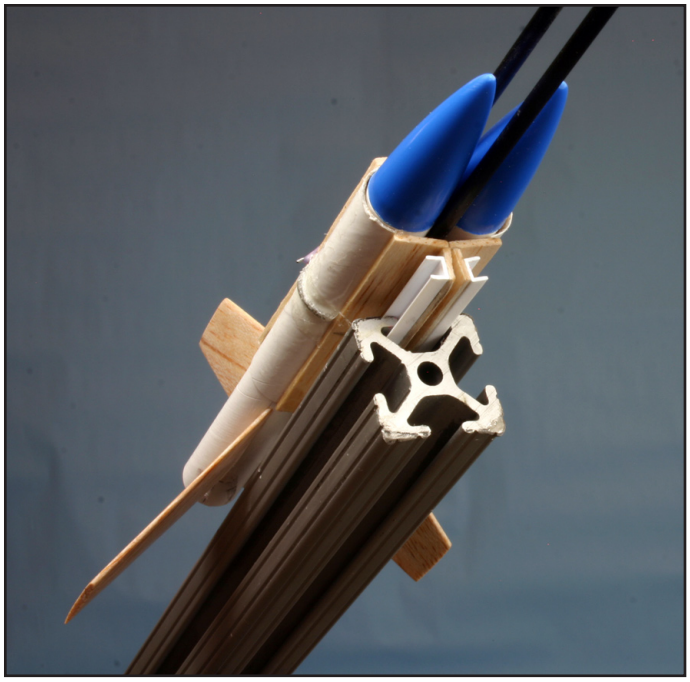
Photo 42: Fly-Away Rail Guide attached to the power-pod of a front-engine boost glider. The longer length can help keep the glider going straight up on launch. Plus it is more stable in the wind.

Photo 43: A piston launcher can be supported on the launch rail too using the Fly-Away Rail Guides. This allows the piston to move with the rocket and keep both the rocket and the piston tube going in a straight line.

easy adaptation to launch them off a launch rail using the fly-away rail guides as shown in Photo 42. The extra length of the rail will really help keep the rocket going straight as it just comes off the rail. It also is more sturdy in windy conditions when typically it is hard to keep the glider attached to the power pod (prior to launch).

Attaching a fly-away rail guide to a piston launcher is probably the easiest way I have yet found to hold a piston launcher beneath a rocket (see Photo 43). The same size fly-away rail guide you'd use on the rocket can be used on the piston launcher too. The advantage is that the piston tube moves in a straight line with the rocket as it travels up the rail. And should it detach too early, the Fly-Away Rail Guide on the rocket will prevent tip-off of the rocket, assuring a straighter flight. This arrangement would allow piston launchers to be used on heavier rockets (like egg-lofter) that don't typically use piston launchers because the weight of the rocket is hard to support on the piston tube.





Photos 44 (Top) and 45 (Right): The concept of fly-away rail guides can be adapted to other rocket shapes too. This is a two-tube cluster that was made in the same way as all the others in this report.

Another configuration that can be created with a little ingenuity is cluster arrangements, such as 2-motors side-by-side (like a double-barrel shot-gun) as shown in Photos 44 and 45.

About the only types of rockets that don't lend themselves to adaptation of flying off the launch rail are rockets UFO shaped rockets and monocopters that need to rotate as they ascend.

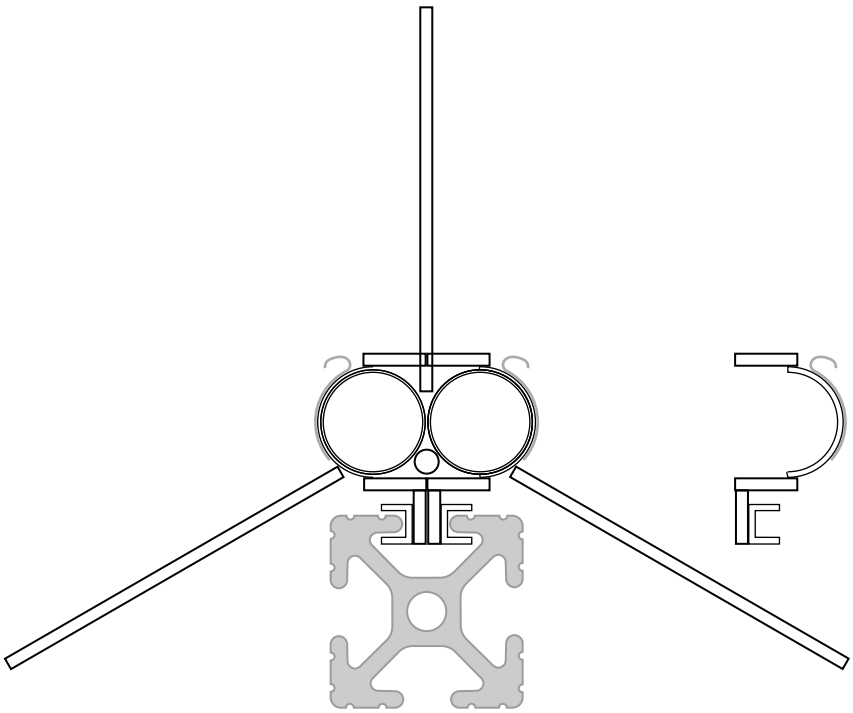


Figure 7: Cross-section drawing showing a two-motor cluster rocket (shown in Photo 24) engaged on the launch rail. On the right is a isolated view of the cradel and the runners.

References

"Development of the Fly-Apart Rail Guides" by Tim Van Milligan. *Peak-of-Flight Newsletter #243,* September 8, 2009. www.ApogeeRockets.com/education/downloads/Newsletter243.pdf. This article is the original impetus for this project.

"Fly-Away Launch Lug" - Product from Flis Kits. I've never actually seen one of these devices. I've only heard a vague description of it, and from that drew the illustration shown in Figure 2.

Astrobee D - NASA sounding rocket that uses a spring-steel band that springs open when the rocket leaves the rail. Shown at: http://www.rocketryonline.com/how-to/astrobee/ad_forward-lug.html (Images below borrowed from that web site).

Photo 46: Spring-steel bands from the Astrobee sounding rocket did fall away like the fly-away rail guides in this report.

Photo 47: Edge view of the spring-steel bands off the Astrobee sounding rocket.

"Basics of Flight Analysis" by Tim Van Milligan. This 6-part series of articles describes the theory behind getting rockets to fly higher. It describes in detail the reasons why rockets coming off a longer launch rod go straighter. Printed in *Peak-Of-Flight Newsletter* #192, #193, #195, #196, #197, and #198 (Dated between September 11, 2007 to December 4, 2007). Downloadable at: http://www.apogeerockets.com/Peak-of-Flight_index.asp#stability

"Why do tall and skinny rockets go unstable?" by Tim Van Milligan. *Peak-of-Flight Newsletter #239*, July 14, 2009. www.ApogeeRockets.com/education/downloads/Newsletter239.pdf

"Rocket Plan: the "Kink" Supper-roc Rocket" by Tim Van Milligan. *Peak-of-Flight Newsletter #245*, October 5, 2009. www.ApogeeRockets.com/education/downloads/Newsletter245.pdf

"Contest Plan: Build the Eggs-Terminator Rocket" by Tim Van Milligan. *Peak-of-Flight Newsletter #247* November 3, 2009. www.ApogeeRockets.com/education/downloads/Newsletter247.pdf. This article not only describes how to make an egg-lofter rocket, but also shows the method of making the cradles that are part of the fly-away rail guides.

"Build Your Own High Power Rail Launch Pad" by Tim Van Milligan. *Peak-of-Flight Newslet-*

ter #235, June 15, 2009. www.ApogeeRockets.com/education/downloads/Newsletter235.pdf

"Rocket Plan: Tim's Push-Me Pull-You Rocket" by Tim Van Milligan. *Peak-of-Flight Newsletter #235*, June 15, 2009. www.ApogeeRockets.com/education/downloads/Newsletter235.pdf

RockSim software - Used to run simulations and make transition patterns. http://www.apogeerockets.com/rocksim.asp

Equipment Used

The majority of the equipment used was standard modeling supplies, like hobby knives, sand paper, super glue, ruler, cutting mat, and spray paint.

During the design phase, I used my computer, and a laser-printer to make templates. The software I used was Adobe Illustrator. But it is possible to use other drawing or drafting software if it is available.

For the flight tests off a launch rail, I initially used the club equipment from COSROCS, CRASH, and SCORE. These clubs all had standard 8-foot long launch rails.

Based on the article in *Peak-of-Flight Newsletter #243*, Richard Fonzi, a member of COSROCS spliced together a 6-foot rail and 8-foot rail to make a 13-foot long rail for the COSROCS club. This rail was flown from in January, 2010 at the Winterfest regional launch hosted by the COSROCS club of Colorado Springs (NAR section #515).

In the spring of 2010, my company, Apogee Components, started selling a heavy duty launch pad developed by Norman Pfund. I borrowed one of these pads and its rail from inventory to make the final adjustments in the fly-away rail guide design. The "Gun-Turret" launch pad has a retail price of $427 (http://www.apogeerockets.com/Gun-Turret_Pad.asp).

Photographic equipment: Still images were taken by my 6-mega-pixel Canon Rebel digital camera. Video images were taken using my Aiptek 720P HD digital video camera set to 60 frames-per-second.

Facilities Used

No special facilities were required for this project of the development of the fly-away rail guides. I did the work out of my house and workshop.

Launches, where test and competition flights using the fly-away rail guides were the club launch facilities of COSROCS (NAR section #515), CRASH (NAR Section #482), and SCORE (NAR section #632). My thanks goes to those clubs for having the proper equipment in their club inventory and for allowing me to use it for the contests and for test launches.

Money Spent on the project (Budget)

This was a fairly low budget project because all the parts to create the fly-away rail guides were already in my workshop of odd-parts. The biggest item in the rail guides was the body tubes that were used to create the cradles. The longest of these is three-inches long, and I had plenty of those in my scrap rocketry parts bins. I also used odd bits of balsa wood, from 1/16th inch, 1/32nd inch, and 1/8th inch thick.

I did buy some plastic extrusions from the local hobby store toward the end of this project as I was making the final revisions to the design. These were only 80¢ each, for a total of $2.40.

Music wire was also in my spare-parts bins. But if I were to have purchased it new, I would have only needed two 36-inch long pieces (at 40¢ each) for a total of $0.80.

With the exception of the very first test launch, all the motors used were purchased for the competition events that I competed in, so I do not include them in the budget of this project. The first motor was the exception, and that was a F10-6 motor from Apogee Components (retail cost: $24.96)

Consumable supplies, like super glue, paint, hobby knives, paper, toner cartridges, fiberglass cloth, and epoxy were also already in my workshop and did not have to be purchased to complete this project. But if I were to guess how much was consumed, I'd hazard to guess it was approximately $50 worth of materials.

Costs (as described above):

Plastic Extrusions	$2.40
Orthodontic Rubber Bands	$1.21
Music Wire	$0.80
F10-6 rocket motor	$24.96
Consumable shop supplies (estimate)	$50.00
Total Budget	**$79.37**

Data Collected

The data collected was photographic or video footage of actual launches in which the fly-away rail guides were used, such as shown in Figures 7, 10 through 15, 19, and 20. This was a project that not so much relied on measurements of things, but that answered a simple question: "Did it work? Yes or No." For this I relied on the photographic or video evidence.

When I made modifications to the design, it was based on reducing the complexity of the design configuration and to make it easier to install on the rocket. Again, this is hard to measure and document, because it was based on my engineering intuition of whether or not I thought the refinements were an improvement over the initial design. Again, the "initial design" configuration worked the very first time that I used it. After that, all the refinements were implemented to suit my own preferences and were not necessary to say that the project was successful or not. They were just tweaks to the initial design to improve usability.

There was one data set from the regional competition in hosted by the CRASH club in Denver, Colorado (BMMRC, Oct 2009) that I did find for this report. The altitude of the straight flight rocket (shown in Photo 19) was 551m (1,807 feet). The flight of the rocket shown coming out of the tower that then weathercocked (Photo 20) reached an altitude of 490 m (1,608 feet). This shows strong evidence as RockSim predicts (See Figure 6) that a straighter flight as a result of a longer launcher will yield higher

altitudes.

Results Obtained

The final result from this project was the creation and refinement of four different fly-away rail guides that are configured for distinct types of rockets.

The first is for the constant diameter body tube. It would be used most often, as this is the most common type of rocket configuration, particularly in competition.

The second is for a rocket that needs a stand-off because the rocket is made up of multiple tubes of different diameters. The super-roc style rocket was one such model that required at least two of the fly-away rail guides, where one of them needed a stand-off. Another rocket that required a stand-off was a 4XA-motor cluster altitude design. This rocket was able to use a fly-away rail guide that was also used on the F-engine super-roc.

The third configuration was a fly-away rail guide for a rocket with a transition for a body, instead of a straight tube. The example of this was the competition style egg-lofting type rocket that used the ice cream cone configuration.

The fourth configuration was a special-shape rocket, where a cluster of two tubes were glued side-by-side. A special side-by-side cradle had to be constructed for this configuration, and it worked quite well. I tested this configuration to see what the limitations of the shape of the fly-away rail guides might be, and it appears that with a little ingenuity and imagination, almost any configuration can be used. Even gliders could be launched using the fly-away rail guide device.

Finally, I found that a piston launcher can also be supported beneath a rocket with a Fly-Away Rail Guide. This is probably the easiest way I've ever seen to support both the rocket and the piston launcher at the same time. The advantage is that adding the long rail to the rocket assures that the rocket will leave the ground going straight up.

Further Work

No formal experimentation is planned to continue the development of the fly-away rail guides. The reason is that I am satisfied with how they work, the level effort that it takes to make a set.

List of any related R & D Reports previously entered by the author:

There were no previous R&D reports on this topic entered by this author.

Appendix A - Creating Custom Shape Cradles

Making a custom shape cradle isn't all that hard to do, and typically is similar to making a custom-made part for any model rocket (like a transition). We think of cradles as typically being straight tubes that are sliced in half. If the rocket is not straight, like a transition, then the cradle has to conform to it so it is snug around the rocket.

Other than being conforming to the shape of the rocket, the only other criteria that I can foresee is that it be semi-rigid (so that it holds its shape). A typical body tube is thick enough to hold the circular shape when it is cut in half. But transitions, since they are make from thinner paper do not hold the circular shape well, and therefore have to be stiffened. I chose to use 2-oz fiberglass cloth, since that is what I had laying around in my parts bins.

I created a small transition from heavy paper as a starting point. Normally when making a transition, you can get away with regular white or wood glue for assembly. But this leaves a bump on one side when the glue hardens. This bump prevents the transition from being snug on the real rocket.

I did assemble it using rubber cement, since I needed it as round as possible. Rubber cement stays pliable, so you can reform it to a round shape after the edges are tacked together. To keep it round while I was working on it, I placed a cardboard disk inside

Photo 48: The cardstock transition (background) is kept round by temporarily placing two cardboard disks inside. Use the pattern sheet as a guide for cutting out the right size/shape piece of fiberglass cloth.

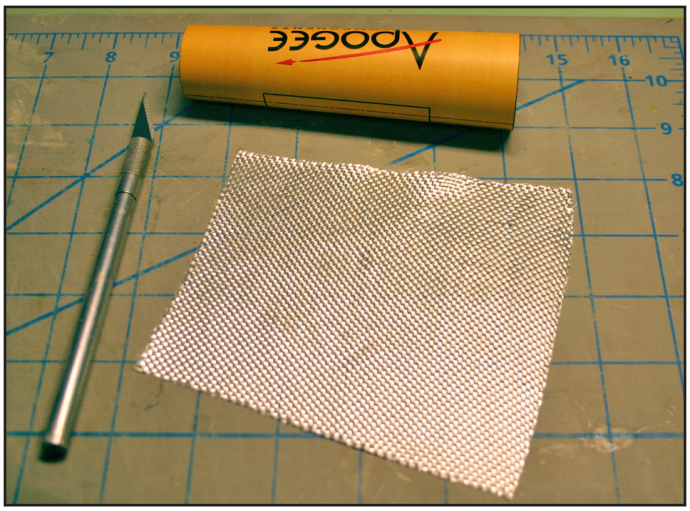


Photo 49: The fiberglass cloth has been cut out and is ready to be applied to the transition.

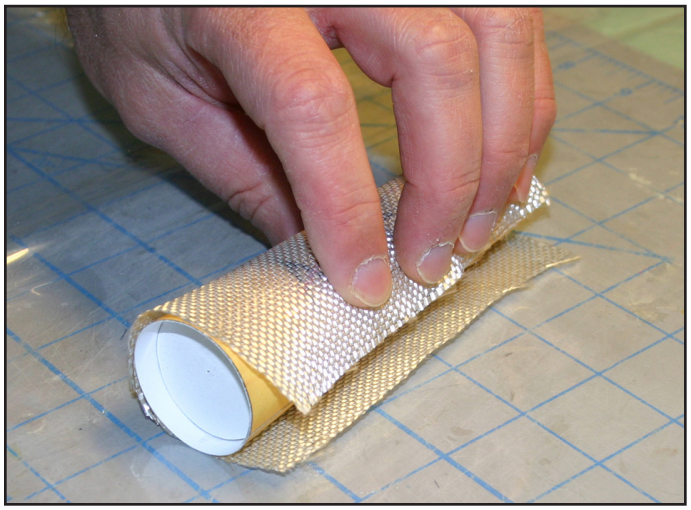


Photo 50: The fiberglass cloth is wrapped over the transition. One layer of cloth is sufficient to hold the shape.

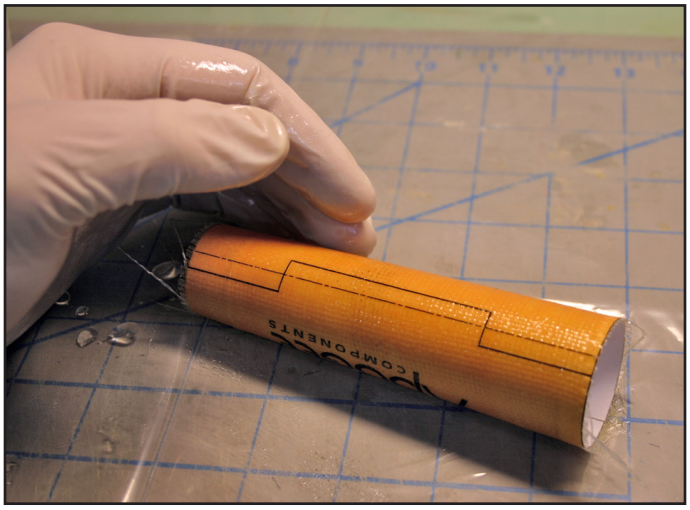


Photo 51: The cloth is wetted with liquid epoxy. Squeegie off any excess resin with paper towels.

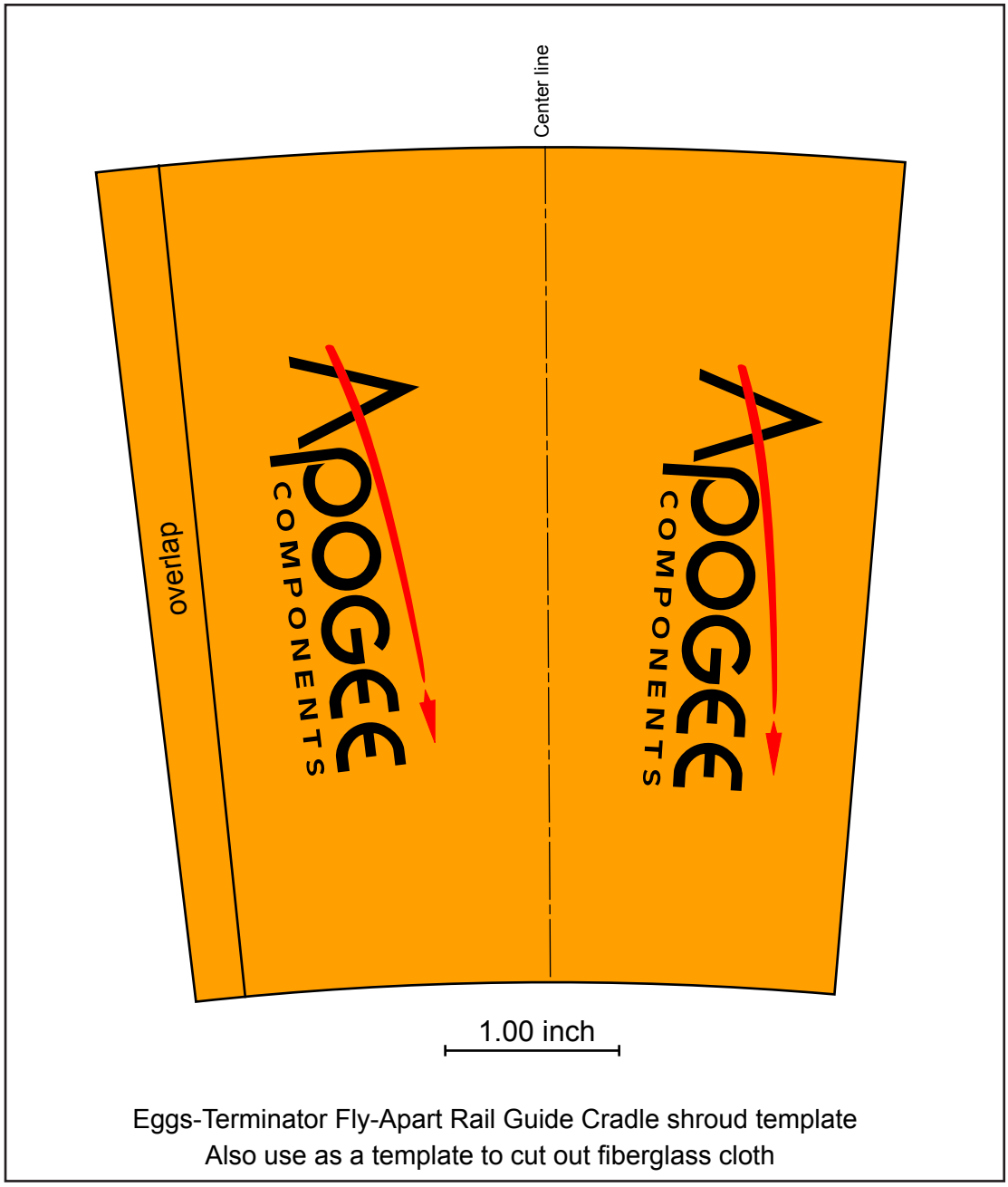


Figure 7: Template to make the cradle in the shape of a transition for the Egg-Terminator contest rocket.

each end (see Photo 48). The disks were just tacked in with a little glue, and were removed when the assembly was complete and the resin had hardened.

Then I cut out a piece of heavy fiberglass cloth, using another printout of the shroud template (see Figure 7 on the next page) as a pattern (Photo 49). I wrapped that cloth over the paper shroud (see Photo 50) and wetted it out with 5-minute epoxy (see Photo 51). You have to work fast, as epoxy will harden fairly quickly. Fiberglass is tricky to work with, because it wants to slide around on you. The epoxy resin is no picnic either, as it seems to get on everything. There are a lot of safety precautions when using fiberglass and epoxy, like always wearing disposable gloves, so just be advised.

In place of epoxy resin, you can use thin CyA glue. But it kicks off so fast (almost instantly) when it hits the fiberglass, that you have to work very quickly. The epoxy will make a better looking part, but the

CyA is quicker if you are in a time crunch.

Once the epoxy has cured and is hard, you can then trim off the ends to remove the whiskers, and then sand it down smooth. At that point, you can cut it in half like you would making any normal cradles.